

**Board Staff Interrogatory #44**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh A1-3-3. Page 11

In the above reference, OPG has stated that “changes to public policy, especially the Government of Ontario’s Long Term Energy Plan (“LTEP”) could impact OPG’s nuclear production. In particular, a change to the refurbishment schedule for future units at the Darlington generating station...”

- a) What is OPG’s understanding of when the Government of Ontario would make a decision about whether or not there could be a change to the refurbishment schedule and possibly the cancellation of the refurbishment of units subsequent to Unit 2?
- b) What is OPG’s understanding of what factors the Government would consider in making such a decision?
- c) If the Government of Ontario were to cancel the DRP after Unit 2 is complete, what Facilities and Infrastructure assets would no longer be required?

**Response**

- a) At this time, OPG has no expectation that the Government of Ontario would change the refurbishment schedule for the Darlington units or cancel the refurbishment of units subsequent to Unit 2.
- b) The Government has not specified what factors it would consider in assessing the on-going feasibility of the current refurbishment schedule or the planned refurbishment of units subsequent to Unit 2. OPG would expect that any decisions regarding the on-going feasibility of the schedule or the plan would only be made after a rigorous process of evaluation similar to the one which was undertaken on the decision to proceed with the refurbishment of the Darlington (and the Bruce) units. OPG expects the evaluations and decision-making would involve OPG, the Independent Electricity System Operator, the Ministry of Energy, the Ministry of Finance, other relevant Ministries, and the Cabinet.
- c) If the Government of Ontario were to cancel the Darlington Refurbishment Program after Unit 2 is completed, all of the Facility and Infrastructure Project assets are expected to remain useful for the operation of the Darlington Nuclear Station.

**Board Staff Interrogatory #45**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-1 Chart 1

In 2016, OPG began the execution phase of the \$12.8B refurbishment of the Darlington Nuclear Generating Station. OPG has selected a “multi-prime contractor” model for DRP. OPG is the integrator among the prime contractors and is responsible for the entire DRP. OPG Functional Support refers to work including oversight, coordination and integration among the various contractors and ongoing station operations.

- a) Is OPG asking for \$12.8B to be approved by the OEB in this proceeding?
- b) In Chart 1 of Ex. D2-2-1, the functional support cost is presented with respect to the total DRP forecast cost of \$12.8B. The functional support cost is forecast to be 17% of the total. In Figure 1 of the same exhibit, there is a breakdown of the forecast Unit 2 in-service amounts. The functional support cost is forecast to be 25% of the total. Why is the functional support cost as a percentage of total higher for Unit 2?
- c) How do the forecast functional support costs compare with other mega-projects that have employed a multi-prime contractor model? If there is a significant difference, please explain why.

**Response**

- a) No. The specific approvals OPG is requesting with respect to the DRP are set out in Ex. A1-2-2, pp. 4-5 and Ex. D2-2-1, p. 6.
- b) The reasons why the percentage of functional support costs as a percentage of the Unit 2 in-service amount is higher than the average functional support cost percentage for the RQE 4-unit estimate are as follows:
  - Unit 2 is the first unit to be refurbished and returned to service, and the in-service amount for Unit 2 shown in Figure 1 of Ex. D2-2-1 includes the Definition Phase planning costs. As shown in Figure 1 of Ex. D2-2-4, the Definition Phase costs include \$0.4B of OPG Planning and Support Services costs. These costs were incurred for work such as completion of detailed design engineering, developing and executing the contracting strategy, the on-boarding of OPG’s contract



1 partners, and the establishment of the required reporting and controls  
2 infrastructure for implementing the proper project controls (including databases).  
3

- 4 • Unit 2 is the only unit of the four Darlington units which is planned to be executed  
5 without an overlapping unit being refurbished for at least a part of its refurbishment  
6 duration. Based on the current plan, the subsequent units will benefit from  
7 economies of scale by having certain OPG functional support costs shared  
8 amongst two units as they are being executed with an overlap for all or a part of  
9 the duration of the refurbishment outage.

10  
11 c) OPG cannot provide a comparison of functional support costs in the DRP to that of  
12 other megaprojects for the following reasons:  
13

- 14 • OPG is not privy to a sufficiently detailed cost breakdown for other megaprojects.  
15  
16 • OPG employed a multi-prime contractor model from the outset based on lessons  
17 learned from other projects which did not employ this model initially (i.e., projects  
18 that used a general contractor to assume the Owner's role). OPG is not aware of a  
19 comparable megaproject or megaprogram that was structured as a multi-prime  
20 contractor model from the outset.  
21  
22 • DRP is unique in that each unit will be refurbished within an operating station with  
23 two or three other units operating. As a result of this, OPG functional support costs  
24 include certain operations costs, such as work control authorization and radiation  
25 protection services, which would not be relevant in most other megaprojects. A  
26 description of the Operations and Maintenance Function's accountabilities can be  
27 found in Ex. D2-2-9, p. 5.

**Board Staff Interrogatory #46**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-2, Figure 1

Ref: Exh D2-2-2, Attachment 2, Appendix B

The above references provide organizational charts for the Nuclear Refurbishment Organization Structure and DRP

For the key positions, please provide copies of the resumes for the individuals filling these positions, and summarize the individuals' experience with the multi-prime contractor model, nuclear refurbishments and managing outages of units.

**Response**

The following is a list of the key executives in the Nuclear Refurbishment Organizational Structure together with their years of experience:

- Gary Rose, Vice President, Planning and Project Controls, 28 years
- Dietmar Reiner, Senior Vice President, Nuclear Projects, 37 years
- Michael H. Allen, Senior Vice President, Nuclear Refurbishment, 32 years
- Neil A. Mitchell, Vice President, Refurbishment Engineering, 35 years
- Art Rob, Vice President, Nuclear Projects and Modifications, 34 years
- Meg C. Timberg, Vice President, Project Assurance and Contract Management, 32 years

The Curriculum Vitae of the above individuals are attached as Attachment 1.

OPG used the multi-prime contractor model for Pickering Unit 1 Restart and for Pickering Units 2 and 3 Safe Storage projects. Although these projects were not of the same magnitude as the Darlington Refurbishment Program (DRP), OPG staff who were involved in these projects gained valuable experience with the multi-prime contractor model. Neil Mitchell, Michael Allen, and Gary Rose were involved in these projects.

Dietmar Reiner has been involved with the DRP since 2010 as the Senior Vice President, Nuclear Refurbishment, and has been accountable for the DRP and OPG's Nuclear Projects and Modification group since 2014. As SVP, Nuclear Refurbishment, Mr. Reiner has been

1 intimately involved in all of the key strategic decisions made during the Definition Phase and  
2 has been a key driver behind ensuring that lessons learned on other projects were  
3 incorporated into the Planning phase of the DRP. In prior positions, e.g., as Vice President of  
4 OPG's Inspection and Maintenance organization from 2008 to 2010 and Vice President of  
5 Commercial Systems from 1999 to 2008, Mr. Reiner has been accountable for the  
6 implementation of high value projects for OPG.  
7

8 Michael Allen has been directly involved in refurbishment projects since 2010 when he was  
9 seconded to the Pt. Lepreau nuclear station first as Restart Director, then as Project Director.  
10 Mr. Allen gained valuable refurbishment experience during those secondments. In addition,  
11 Mr. Allen has held positions as Deputy Site Vice President at the Darlington Nuclear station  
12 and has held senior position in Work Management, Operations Management, Outage  
13 Management, and Maintenance Management at OPG's Nuclear stations and nuclear stations  
14 in the United States.  
15

16 Meg Timberg is a highly experienced lawyer who has had extensive experience in  
17 developing contracting strategies and negotiating contracts for major projects while with  
18 OPG. Her experience with major projects is summarized below:

- 19 • **Nuclear New Build at Darlington:** Lead OPG lawyer in a team including Ministry of  
20 Energy, Ministry of Finance and Infrastructure Ontario that was exploring the possibility of  
21 building two new nuclear units at Darlington. Participated in developing innovative and  
22 effective strategies for creating competitive tension and obtaining value for money for  
23 OPG.
- 24 • **Darlington Refurbishment Program:** Lead OPG lawyer responsible for co-ordination of  
25 timely and business minded legal input into development of contracting and procurement  
26 strategies for this complex project. Participated in dual track negotiations of a complex  
27 contract with two different joint ventures using a target cost model for the critical path  
28 retube and feeder replacement project. Co-ordinating and managing legal input into all  
29 other significant contracts associated with the DRP.
- 30 • **Joint Ventures at Brighton Beach and Portlands:** Oversight of legal issues and Board  
31 governance, including supervising the resolution of all significant claims.
- 32 • **Resolution of Significant Intellectual Property Issues:** Lead lawyer in negotiations  
33 that resolved outstanding intellectual property issues with AECL in contemplation of sale  
34 of AECL by the Federal Government.
- 35 • **Beck Tunnel and Lower Mattagami Projects:** Responsible for oversight of all legal  
36 issues and commercial negotiations related to these significant projects.
- 37 • **Aecon Projects:** Exposed to all major projects executed by Aecon, with a focus on  
38 projects in Western Canada, while on secondment with Aecon from January 2013 to  
39 November 2014.  
40

41 Neil Mitchell has been with Ontario Hydro and OPG for 35 years and the Director of Restart  
42 Engineering at the Pickering A Restart Project, Senior Manager, Plant Design at the  
43 Pickering B Station and has also been responsible for the Environmental Qualification project  
44 at the Darlington Station, a key initiative in order to satisfy a license condition. For the past 6  
45 years, Mr. Mitchell has been the Vice President of Engineering at the DRP. Mr. Mitchell has

1 been behind many initiatives at the DRP to improve front-end planning, including the  
2 Collaborative Front End Engineering process with OPG's contact partners.  
3

4 Art Rob has 36 years industry experience including many senior positions in OPG's  
5 Hydroelectric plants. Prior to his current position in OPG's Nuclear Projects organization, Mr.  
6 Rob was the Plant Group Manager for OPG's Northwest Hydroelectric Plant Group, where  
7 he was responsible for 11 hydroelectric generating stations with 39 generating units and  
8 associated control dam structures, 4 work centres, an operations centre and 140 staff in NW  
9 Ontario. Mr. Rob also was the Partnership leader for the legal partnership with Lac Seul First  
10 Nation on the first commercial partnership for a joint venture between OPG and Lac Seul  
11 First Nation.  
12

13 Gary Rose has been with the Nuclear Refurbishment group at OPG since 2008, first as  
14 Director of Planning and Controls and then as Vice President of Planning and Projects  
15 Controls for both the DRP and the Nuclear Projects and Modifications organizations. Mr.  
16 Rose has been responsible for putting in place project controls and reporting infrastructure  
17 for the DRP and has led many initiatives to improve the quality of planning during the  
18 Definition Phase. Mr. Rose has also previously held Managerial positions in Corporate  
19 Finance at the Pickering Restart project and in Project Controls with the Projects and  
20 Modification organization and the New Nuclear Build project. Mr. Rose holds memberships in  
21 the Association for the Advancement of Cost Engineering (AACE), the Project Management  
22 Institute (PMI), Construction Industry Institute (CII) – Member of Product Review Board  
23 (PRB), and is a Chartered Professional Accountant.

## **CURRICULUM VITAE OF DIETMAR REINER**

### **SENIOR VICE PRESIDENT, NUCLEAR PROJECTS**

#### RESPONSIBILITIES:

As Senior Vice President, Nuclear Projects, Mr. Reiner's responsibilities include:

- contributing to and supporting the development of Ontario Power Generation's long-term business strategies and objectives
- providing vision and leadership for OPG's nuclear projects portfolio, including the successful implementation of the mid-life refurbishment of the Darlington Nuclear Station
- jointly developing a long-term vision and strategy for the Darlington Nuclear Station post-refurbishment

#### EDUCATION:

University of Waterloo, Bachelor of Applied Science, Honours Electrical Engineering

#### EXPERIENCE:

1999 to Present	Ontario Power Generation
2014 to Present	Senior Vice President, Nuclear Projects
2010 to 2014	Senior Vice President, Nuclear Refurbishment
2008 to 2010	Senior Vice President, Inspection, Maintenance & Commercial Services
2000 to 2008	Chief Information Officer
1999 to 2000	Vice President, Commercial Systems
1998 to 1999	Director, Generation Resource Management
1985 to 1998	Ontario Hydro
1997 to 1998	Manager, Production Planning
1995 to 1997	Section Head, Hydroelectric Business Unit
1985 to 1995	Engineer, Power Systems Operations and Nuclear Operations
1986 to 1986	Elder Engineering Inc. Consulting Engineer
1979 to 1980	Ontario Hydro Nuclear Operator Training Program

#### MEMBERSHIPS:

Professional Engineers Ontario

## **CURRICULUM VITAE OF MICHAEL H. ALLEN**

### **SENIOR VICE PRESIDENT, NUCLEAR REFURBISHMENT**

#### RESPONSIBILITIES:

As Senior Vice President, Nuclear Refurbishment, Mr. Allen is responsible for all aspects of the successful preparation and execution of the Darlington Nuclear Station refurbishment project.

#### EDUCATION:

Northwestern University, Illinois, USA - Bachelor of Physics  
US Navy - Nuclear Engineer Officer  
US Nuclear Regulatory Commission – Senior Reactor Operator License  
Project Management Institute - Project Management Professional Designation  
York University, Master's Certificate in Project Management  
Institute of Nuclear Power Operations, Georgia, USA – Senior Nuclear Plant Management Course  
Ontario Power Generation – CANDU Advanced Operations Course

#### EXPERIENCE:

2003 to Present	Ontario Power Generation Inc.
2014 to Present	Senior Vice President, Nuclear Refurbishment
2012 to 2014	Deputy Site Vice President, Darlington Nuclear Station
2012	Restart Director, Point Lepreau Nuclear Station, OPG secondment to NB Nuclear
2010 to 2012	Project Director, Point Lepreau Nuclear Refurbishment, OPG secondment to AECL
2010	Director, Nuclear Programs
2006-2010	Director, Work Management
2003-2006	Maintenance Manager, Pickering A Nuclear Station
1999 to 2003	American Electric Power Company Inc.
2002 to 2003	Maintenance Manager, D.C. Cook Nuclear Plant
2000 to 2002	Outage Manager, D.C. Cook Nuclear Plant
1999 to 2000	Production Manager, Steam Generator Replacement Project, D.C. Cook Nuclear Plant
1996 to 1999	Florida Power & Light Company
1998 to 1999	Operations Manager, St. Lucie Nuclear Plant
1996 to 1998	Training Manager, St. Lucie Nuclear Plant
1985 to 1996	Dominion - Virginia Power Company
1989 to 1996	Supervisor Operations Training, North Anna Power Station

1985 to 1989	Lead Instructor, North Anna Power Station
1984 to 1985	Jersey Central Power & Light
1984 to 1989	Operations Engineer, Oyster Creek Nuclear Generating Station
1979 to 1984	US Navy
1979 to 1984	Qualified Submarine Officer and Nuclear Engineer Officer



## **CURRICULUM VITAE OF MEG C. TIMBERG**

### **VICE PRESIDENT, PROJECT ASSURANCE AND CONTRACT MANAGEMENT, NUCLEAR PROJECTS**

#### RESPONSIBILITIES:

As Vice President, Project Assurance and Contract Management, Nuclear Projects, Ms. Timberg's responsibilities include:

- commercial management of all major nuclear projects at OPG, including the Darlington Refurbishment Project
- oversight of all nuclear projects including consolidating and co-ordinating the responses to all independent oversight provided by the Province, OPG's Board, OPG's President and all external oversight entities (WANO, INPO, etc.)
- ensuring effective and efficient management of all major contracts, setting commercial strategy, co-ordinating all major negotiations and managing any significant claims.

#### EDUCATION:

Queen's University, Bachelor of Commerce (Honours), 1984  
Osgoode Hall Law School, York University, LLB 1988  
Law Society of Upper Canada, Called to the Bar, 1990

#### EXPERIENCE:

2014 to Present	Ontario Power Generation Inc.
2014 to Present	Vice President Project Assurance and Contract Management, Nuclear Projects
2013 to 2014	AECON Group Inc.
2013 to 2014	Vice President, Contract Integration & Interface Management
2000 to 2012	Ontario Power Generation Inc.
2012	Acting Senior Vice President, Law and General Counsel, Law Division
2006 to 2012	Assistant General Counsel, Law Division
2003 to 2006	Senior Counsel, Law Division
2000 to 2003	Counsel, Law Division
1988 to 2000	Gowling, Strathy & Henderson LLP
1996 to 2000	Partner
1990 to 1996	Associate
1988 to 1989	Articling Student

MEMBERSHIPS:

Law Society of Upper Canada

## **CURRICULUM VITAE OF NEIL A. MITCHELL**

### **VICE PRESIDENT, REFURBISHMENT ENGINEERING**

#### **RESPONSIBILITIES:**

As Vice President, Refurbishment Engineering, Mr. Mitchell is responsible for all aspects of Engineering for the Darlington Refurbishment Project.

#### **EDUCATION:**

University of Toronto, Bachelor of Applied Science in Mechanical Engineering, 1981  
University of Toronto, Master of Engineering, Mechanical, Nuclear Operations, 1988

#### **EXPERIENCE:**

<b><u>1998 to Present</u></b>	Ontario Power Generation
2010 to Present	Vice President Refurbishment Engineering
2008 to 2010	Senior Manager, Darlington NGS-A Environmental Qualification Project
2007 to 2008	Senior Manager, Plant Design, Darlington NGS-A Design Authority
2006 to 2007	Senior Manager, Plant Design, Pickering NGS-B Design Authority
2005 to 2006	Director, Restart Engineering, Pickering NGS-A Return to Service
2004 to 2005	Senior Manager, Plant Design, Pickering NGS-A Design Authority
2002 to 2004	Manager, Design, Pickering NGS-A Return to Service
2001 to 2002	Manager Environmental Qualification Project, Pickering NGS-A Return to Service
1998 to 2001	Manager, Environmental Qualification Program, Nuclear Operations Support Services
<b><u>1981 to 1998</u></b>	Ontario Hydro
1996 to 1998	Project Manager (Acting), Environmental Qualification Project of Pickering Nuclear Division
1990 to 1996	Technical Supervisor, Pickering Nuclear Generating Station, Equipment & Documentation Unit
1989 to 1990	Technical Supervisor, Pickering Nuclear Generating Station, Reactor Safety Unit
1989	Technical Supervisor, Nuclear Studies and Safety Department, Reactor Safety Operation Analysis Support
1988 to 1989	Assistant Technical Supervisor / Technical Supervisor attached to the Pickering Nuclear Generating Station Technical Unit, Conventional Controls
1987 to 1988	Acting Technical Supervisor, Radioactivity Management and Environmental Protection Department

1983 to 1987	Assistant Technical Supervisor, Radioactivity Management and Environmental Protection Department
1981 to 1983	Junior-Engineer-In-Training, Nuclear Generation Division.

MEMBERSHIPS:

Professional Engineers Ontario  
Canadian Nuclear Society  
Society of Automotive Engineers

## **CURRICULUM VITAE OF ART ROB**

### **VICE PRESIDENT, NUCLEAR PROJECTS AND MODIFICATIONS**

#### RESPONSIBILITIES:

As Vice President, Nuclear Projects and Modifications, Mr. Rob's responsibilities include:

- development and execution for all sustaining and improvement projects in the nuclear business for the Darlington, Pickering and Nuclear Waste Management Organization, and
- Safety and Improvement Opportunity and Facility and Improvement Program projects that are pre-requisites for Darlington Refurbishment

#### EDUCATION:

Confederation College, Diploma in Mechanical Engineering Technology (First Class Honours), 1982

Lakehead University, Bachelor of Mechanical Engineering (First Class Honours), 1989

Project Management Institute, Comprehensive Project Management Course, 2001

Lakehead University, Business Leadership Development Diploma, 2004

#### EXPERIENCE:

1989 to Present	Ontario Power Generation Inc., Ontario Hydro
2013 to Present	Vice President, Nuclear Projects and Modifications
2010 to 2013	Plant Group Manager, Northwest Plant Group
2006 to 2010	Project Manager, Lac Seul Generating Station
2000 to 2006	Project Manager, Northwest Plant Group
1998 to 2000	Front Line Manager, Technical & Programming Support
1994 to 1998	Technical Supervisor, Northwestern Ontario
1993 to 1994	Front Line Manager, Thunder Bay Production Centre
1991 to 1993	Maintenance Supervisor, Mechanical and Civil
1985 to 1991	Thermal Station Engineer, Thunder Bay
1982 to 1985	Montreal Engineering Company
1982 to 1985 commissioning	Mechanical Technologist, Thunder Bay and Atikokan Generating Stations

#### MEMBERSHIPS:

Professional Engineers Ontario  
Canadian Dam Safety Association

## **CURRICULUM VITAE OF GARY ROSE**

### **VICE PRESIDENT, PLANNING AND PROJECT CONTROLS, NUCLEAR PROJECTS**

#### **RESPONSIBILITIES:**

As Vice President, Planning and Project Controls, Nuclear Projects, Mr. Rose's responsibilities include:

- Accountability for project controls functions including maintenance of project infrastructure, systems, and methods.
- Leads strategic planning efforts including project planning, business planning, funding and release strategies including RQE, and OPG wide project improvement strategies.
- Responsible for the processes for estimating, scheduling, cost management, forecasting, change control, project and performance reporting.
- Responsible for the preparation of all Executive, Board, Stakeholder, and external reporting.

#### **EDUCATION:**

Ryerson Polytechnic University - Bachelor of Commerce (Accounting)

Chartered Professional Accountants of Canada –Chartered Professional Accountant (CPA/CGA)

McLaughlin Masters Certificate in Project Management at Durham College Atocrates Centre for Project Management

Project Management Institution - Project Management Professional (PMP) Designation

#### **EXPERIENCE:**

1999 to Present	Ontario Power Generation
2008 to Present	Director, Planning and Control – Nuclear Refurbishment
2005 to 2007	Manager, Finance Process and Support – Nuclear Finance and Projects
2004 to 2005	Manager, Finance Process and Support – Pickering A Return to Service
2002 to 2004	Manager, Corporate Accounts Payable – Controllership
1999 to 2002	Manager, Special Projects – Controllership
1988 to 1999	Ontario Hydro
1997 to 1999	Manager, Fixed Assets & Accounts Receivable – Corporate Accounting
1988 to 1997	Various progressive roles – Financial Analyst, Senior Financial Analyst

#### **MEMBERSHIPS:**

Association for the Advancement of Cost Engineering

Project Management Institute

Construction Industry Institute – Member of Product Review Board and Board of Advisors

Chartered Professional Accountant

**Board Staff Interrogatory #47**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-2, page 7

The above reference explains that the Planning and Controls Function supports the DRP through the establishment and application of project controls, including cost management, reporting, and risk management at both the Program and project levels.

- a) Describe how and when OPG will continue to assess risks of the DRP during the execution phase and provide a copy of all written processes and procedures.
- b) What reporting system is set up for this? E.g. what data will be provided to management? What is the frequency of risk updates to management?
- c) What efforts are being made to ensure that all of the materials/equipment/tools are procured, staged, and ready to be released to the project?

**Response**

- a) Risk identification, assessment, mitigation, monitoring and reporting is an on-going process and will continue during the execution phase. OPG uses a database tool in which risks are continually updated by the project managers and their project control leads. For copies of procedures and processes please see Ex. L-4.3-1 Staff-48, Attachments 1, 8, 15, 24, 34, 40, 41, 42, and 43.
- b) There is an on-line web-based reporting system which is used by project staff. User reports can be generated by anyone on the project at any time. Project and functional managers receive risk reports by project bundle or function on a monthly basis (or more frequently if requested). Senior project and functional managers receive a Key Risk Area report on a bi-monthly basis and the Key Risk Dashboard on a monthly basis. There is a bi-monthly Risk Oversight Committee meeting at which key risks and mitigating actions are reviewed and updated.
- c) Equipment, materials and tools are defined, ordered, delivered and staged in accordance with the field execution needs. Based on lessons learned from previous nuclear projects, a dedicated procurement and materials tracking oversight model, under the accountability of an experienced project director, has been put in place. This model determines, based



1 on the execution schedule, when specific purchase orders need to be placed to allow for  
2 timely receipt of project material.

3  
4 The status of material deliveries is monitored, with a specific focus on long-lead items.  
5 Materials are tracked at the work package level. Senior project and functional managers  
6 regularly review reports and intervene as required. Metrics are based on the execution  
7 schedule and corresponding procurement schedules. Material status is one of the  
8 project's Key Indicators and has significant visibility with senior project executives.

**Board Staff Interrogatory #48**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-2

- a) Provide a copy of all processes and procedures (which have not been provided elsewhere in the evidence) that OPG has put in place to manage the DRP. Include the date of adoption and revision(s). Provide all policies and procedures for the DRP including, but not limited to, OPG Governance, OPG's Project Management Standards, Project Oversight Standards.
- b) Provide the written processes and procedures that govern how OPG will evaluate and report on the project schedule.
- c) Provide the written processes and procedures that explain how OPG will integrate contractor schedule updates throughout the execution phase of the DRP.
- d) Describe OPG's Change Management procedure and systems for tracking performance and monitoring contractor change orders including a copy of all applicable written processes and procedures. Identify the OPG Staff with responsibility for administering the change management procedure and explain decision making authority of the OPG project management team members involved in change management.
- e) Describe OPG's plan to coordinate engineering changes during the execution of Unit 2 and through future units. Provide all applicable written processes and procedures.
- f) What systems, processes, and procedures will OPG use to track each contractor's field performance and monitor contractor change orders? Provide a copy of all written processes and procedures.
- g) Provide any written procedure regarding commercial correspondence and contractual notices that OPG will use for the DRP.
- h) Provide the written cost control process, if any, for the DRP.
- i) Who on the OPG project team is responsible for reviewing and vetting claims received from the Project's contractors?

**Response**

- a) Copies of the Darlington Refurbishment Program (DRP) processes and procedures are attached as listed in the chart below:

**Chart 1 - List of Attachments**

Att.	Document
1	Balance of Plant Project Management Plan NK38-PLAN-09701-10166
2	Conduct of Engineering N-PROG-MP-0007
3	Contract Administration in Oncore N-INS-00150-10001
4	Contract Management Standard N-STD-AS-0029
5	Contractor Management Process N-GUID-00120-10008
6	Contractor Owner Interface Requirements for Nuclear N-COI-00120-00001
7	Darlington Refurbishment Contract Management Plan NK-38-NR-PLAN-09701-10001 Sheet 13
8	Defueling Project Management Plan NK38-PLAN-09701-10134
9	Engineering Change Control N-PROG-MP-0001
10	Field Engineering Standard N-STD-AS-0031
11	Guide for Contractor Owner Interface Requirements Document (COIR) N-GUID-00120-10009
12	Guideline for Construction Oversight N-GUID-09701-10120
13	Guideline for Engineering Oversight N-GUID-01920-10000
14	Integrated On-line Work Schedule N-PROC-MA-0022
15	Islanding Project Management Plan NK38-PLAN-09701-10159
16	Nuclear Refurbishment – Milestone Definition Framework N-MAN-00120-10001-SCH-06-R004
17	Nuclear Contract Management Manual N-MAN-09701-10003
18	Nuclear Management System N-CHAR-AS-0002
19	Nuclear Refurbishment Gate Review Board –Terms of Reference NK38-PLAN-09701-10006
20	Nuclear Projects - Gated Process N-MAN-00120-10001-GRB
21	Nuclear Projects - Records and Document Management N-MAN-00120-10001-RDM
22	Nuclear Refurbishment Data Management Plan N-MAN-00120-10001-RDM-20
23	Nuclear Projects Cost Estimating N-MAN-00120-10001-EST
24	Nuclear Projects Risk Management N-MAN-00120-10001-RISK
25	Nuclear Projects Schedule Management N-MAN-00120-10001-SCH
26	Nuclear Refurbishment - Cost Management and Reporting N-MAN-00120-10001-PC-13
27	Nuclear Refurbishment - Program Change Management N-MAN-00120-10001-PC-12
28	Darlington Refurbishment Schedule Management Plan for Integrated Level 3 Execution N-Man-00120-10001-SCH-11
29	OPG Business Model OPG-POL-033
30	Oversight of Supplemental Personnel N-STD-AS-0032
31	Processing Administrative Governance Documents OPG-PROC-0001
32	Project Communications N-MAN-00120-10001-COM
33	Project Controls N-MAN-00120-10001-PC
34	Project Execution Plan - DNGS Integrated Implementation Plan NK38-PEP-01060-10016
35	Project Management N-PROG-AS-0007
36	Project Management Standard N-STD-AS-0028
37	Project Oversight Standard N-STD-AS-0030 Note: The mark-up seen in this Standard is an OPG approved format for issuing urgent changes.
38	Purchased Services Agreement Operating Instruction N-INS-08400-10027

39	Requirements for Administrative Governance Documents OPG-STD-0001
40	Retube and Feeder Replacement (RFR) Project Management Plan NK38-PLAN-09701-10074
41	Shutdown & Layup Services Refurbishment Support Facilities Project Management Plan NK38-PLAN-09701-10238
42	Steam Generator Project Management Plan NK38-PLAN-09701-10164-0001
43	Turbine Generator Project Management Plan NK38-PLAN-41000-10001-0001
44	Darlington Nuclear Refurbishment Program – Scope Control NK38-INS-09701-10001-R006
45	Nuclear Refurbishment Earned Value Management N-MAN-00120-10001-SCH-007
46	Intentionally Omitted.
47	Intentionally Omitted.
48	Intentionally Omitted.
49	Intentionally Omitted.
50	Intentionally Omitted.
51	Intentionally Omitted.
52	Intentionally Omitted
53	Nuclear Refurbishment Change Control Form N-FORM-11252-R004
54	Darlington Refurbishment Program Milestone & Integrated Master Schedule NK38-PLAN-00300-10000-R003
55	Darlington Refurbishment Program Management Plan Structure NK38-NR-PLAN-09701-10001 Sheet 1
56	Darlington Refurbishment Planning and Controls Program Management Plan NK38-NR-PLAN-09701-10001 Sheet 2
57	Darlington Refurbishment Return to Service Program Management Plan NK38-NR-PLAN-09701-10001 Sheet 3
58	Darlington Refurbishment – Environmental Program Management Plan NK38-NR-PLAN-09701-10001 Sheet 4
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64	Darlington Refurbishment Management Systems and Performance Improvement Management Plan NK38-NR-PLAN-09701-10001 Sheet 10
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66	Darlington Refurbishment Construction Program Management Plan NK38-NR-PLAN-09701-10001-0012 Sheet 12
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72	Darlington Refurbishment – Training Program Management Plan NK38-NR-PLAN-09701-10001 Sheet 19
73	Nuclear Refurbishment Human Performance Management Plan NK38-NR-PLAN-09701-10001 Sheet 20
74	Darlington Refurbishment Program Quality Plan NK38-NR-PLAN-09701-10001 Sheet 23

b) Please see Attachments 14 and 25.

c) Please see Attachments 14 and 25.

d) Please see L-4.3-1 Staff-058 part b, and Attachments 9 and 27.

e) Engineering change control is described in section 1.6.7 of the Conduct of Engineering document (Attachment 2, p. 16), Engineering Change Control document (Attachment 9), and the Guideline For Engineering Oversight (Attachment 13). OPG would follow these requirements in coordinating engineering changes during the execution of Unit 2 refurbishment and through future units. The Engineering Change Control Program ensures all modifications to OPG nuclear plant systems, structures, and components, including software and engineered tooling, are planned, designed, installed, commissioned, placed into service, or removed from service within the Safe Operating Envelope and comply with the regulator's operating licensing conditions. In addition, this program ensures all problems or improvement ideas requiring modifications are reviewed prior to approval. OPG engineering staff identifies and specifies adequate engineering oversight activities using a graded approach based on the engineering risks and utilizing best practices and lessons learned from both internal and external nuclear projects. Please see Attachments 2, 9 and 13 for more information.

f) Please see L-4.3-1 Staff-069 parts a to c, and Attachments 3, 4, 5, 6, and 11.

g) Please see Attachments 5 and 33.

h) Please see Attachments 14 and 25.

i) Please see L-4.3-1 Staff-058 part c, sections 1.2.5 and 2 of the Contract Management Standard (Attachment 4), section 2.2.5 of the Darlington Refurbishment Contract Management Plan (Attachment 7), and section 4.5 of the Nuclear Contract Management Manual (Attachment 17).

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## Balance of Plant Project Management Plan

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2015-10-07

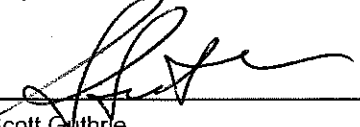
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### Revision Summary

Revision Number	Date	Comments
00	2013-05-23	Initial Issue – Gate 1
01	2014-02-10	Revision 1 – Gate 2
02	2015-01-16	Revision 2 – Updated to include the following changes: <ul style="list-style-type: none"> <li>Align with NK38-NR-PLAN-09701-10001 R000 and associated suite of Sheets (supersedes NK38-PLAN-09701-10067).</li> <li>Status of Gate 2 Sub-Gate progression.</li> <li>Administrative and organizational changes.</li> </ul>
03	2015-12-07	Revision 3 – updated to include the following changes: <ul style="list-style-type: none"> <li>Section 1.0 added LPSW temporary mod to scope</li> <li>Section 2.2 removed Black &amp; McDonald vendor reference</li> <li>Section 3.2 updated to reflect Construction Management oversight strategy</li> <li>Section 4.3 updated to reflect that BoP no longer acts as sponsor for P&amp;M Refurb projects</li> <li>Section 4.4 updated engineering deliverables for installation planning and subsequent work phases</li> <li>Section 4.6 updated to reflect Gate 3 planning</li> <li>Section 5.0 updated current BoP DSR total &amp; fire protection emergent scope risks, added IIP scope and Appendix C reference, added schedule management governance</li> <li>Section 5.1.1 Table 2A updated to reflect new cyclic/corrective maintenance scope</li> <li>Section 10.1.2 Tables 4a/b/c contact info updated</li> <li>Section 10.1.4 BoP quad performance and Nuclear Refurbishment metrics website added</li> <li>Section 11.3 updated to refer to RMO tool</li> <li>Section 12 updated to reference the Procurement Tracking Tool process, ER3-1 corrective actions and East Warehouse strategy</li> <li>Section 13 acronyms updated</li> <li>Appendix A approved DSR list updated to reflect current DSR database</li> <li>Appendix C added IIP items and DSR relationship table</li> </ul>



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## 1.0 INTRODUCTION

Darlington Nuclear Generating Station (DNGS) requires a major refurbishment in order to extend the service life of all four production units. The refurbishment is currently planned to begin in 2016. The four units will be shut down in a partially overlapping sequence with the second unit shutdown commencing after removal of all reactor components in the first shutdown unit (i.e. the end of the removal phase of the first unit).

The Balance of Plant (BoP) portfolio consists of 3 (three) sub-bundles that span the full scope of the project as noted below.

- OPG Common – This sub-bundle covers areas such as OPG staffing, scope defining inspections, contract administration/overheads and materials. In addition, any modification work that is required to be completed under OPG QA will be completed in this sub-bundle.
- Conventional – Primary scope in the conventional sub-bundle includes Electrical Systems, Service Water Systems (stopple plug modification and temporary modifications), Fire Protection Systems, Feed Water Systems, and Valve Rehabilitation work. In addition, cyclic and corrective maintenance scope has been added into three areas: Electrical, Valves and Other (Miscellaneous).
- Nuclear – Primary scope in the nuclear sub-bundle includes Alternate SDC Heat Sink and Emergency Heat Sink modifications, Primary Heat Transport work, Reactor Regulating Systems and the Vault Vapour Recovery System work. Adjuster rods replacement in the Regulating scope of work will be a first time evolution for DNGS.

The BoP project has progressed from the definition phase to Gate 2X (approved July 2015). Gate 3 is planned in November 2015 and January 2016 with the key deliverable to achieve this milestone being the approval of Level 3 schedules and revised cost estimates.

DCAVR/Design complete was achieved by August 15/15 for all projects with two exceptions: Alternate Shutdown Cooling multi-lin relay (on track for Sept 30) and software ECs (EHS, NPC, ASDCH) that require DCAVR approval to proceed. Both exceptions received exemption approval to the Aug 15 milestone.

The project is now transitioning to a Procure/Construct and Readiness to Execute (RTE) focus. Implementation of the Material Tracking File (MTF) and resolution of construction interfaces are two critical areas required to progress the test RTE project: Containment ScopeID 7012 Button-up Modification scheduled to start in the field Feb 1/16. Release quality estimate (RQE) base and contingency funding amounts are now confirmed and will be used as the baseline for cost going forward.

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## 2.0 GOVERNANCE STRUCTURE AND INTERFACES

### 2.1 BoP Management Plans

The Balance of Plant Project Management Plan has followed the guidance set within the OPG Governance per Figure 1. The content of this PMP is divided into nine knowledge areas as shown below:

- Section 4.0: Project Integration Management,
- Section 5.0: Project Scope Management,
- Section 6.0: Project Schedule Management,
- Section 7.0: Project Cost Management,
- Section 8.0: Project Quality Management,
- Section 9.0: Project Human Resource Management,
- Section 10.0: Project Communications Management,
- Section 11.0: Project Risk Management, and
- Section 12.0: Project Procurement Management.

Supporting ESMSA Documents for the BoP PMP:

- Extended Services Master Services Agreement
- ESMSA Request for Work, N-INS-00120-10025
- ESMSA COIR, N-COI-00120-10000 Rev 000

Supporting OPG Management Plans for the BoP PMP:

- Nuclear Refurbishment Project Oversight, N-MAN-00120-10001 R003

### 2.2 EPC Management Plans

A crucial input to the management and execution of the BoP Project will be the schedule, scope, cost, risk and planning integration with the ES MSA Contractors. Each EPC contractor will follow their respective process for management including the preparation and issue of management plans as specified in the Contract Terms and Conditions.

The EPC management plans follow the layout documented in the ES Fox Program Management Plan ESFL-PMP-00 and Babcock Wilcox Project Management Plan BW-DVR-V001.

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### 3.0 SAFETY

#### 3.1 Safety Management

Safety is a core value at OPG for Nuclear Refurbishment and is reflected in all safety management plans produced by OPG and contractors. The BoP Project will adhere to all applicable obligations as defined in the Occupational Health and Safety Act (OHSA), the OPG expectations (N-POL-0001, OPG-POL-0001, and N-GUID-09701-10011), as well as the requirements set out in the EPC contracts terms and conditions.

ES Fox has issued a Site Specific Safety Plan (SSSP) that has been accepted by OPG. The project will ensure that SSSPs are issued for other BoP vendors prior to commencement of any field work. Compliance to the SSSP will be monitored as part of the BoP Project Oversight Plan (POP).

#### 3.2 Construction Management

The Balance of Plant Project will adhere to all applicable obligations as defined in the Occupational Health and Safety Act (OHSA), the OPG expectations, and the terms and conditions for each EPC Contract under which BoP work will be executed.

Construction oversight will be achieved by the use of matrixed construction staff that will be the primary overseers of trades work in the field. The matrixed construction staff will have extensive field/trades experience and knowledge of OHSA/OPG safety requirements. A dedicated BoP Contract Administration (CA) position has also been approved and interviews will commence late 2015. The dedicated CA, in addition to Project Engineer (PE) staff will support the matrixed construction staff to ensure that all contractual and administrative duties are covered by CA and PE staff thereby ensuring the matrixed construction staff maximize their time in the field. It is also expected that CA and PE staff are in the field verifying progress/quality.

The first matrixed construction resource is expected to commence mid October 2015 and will be a key participant in the RTE project Construction Completion Declaration table top scheduled for late October.

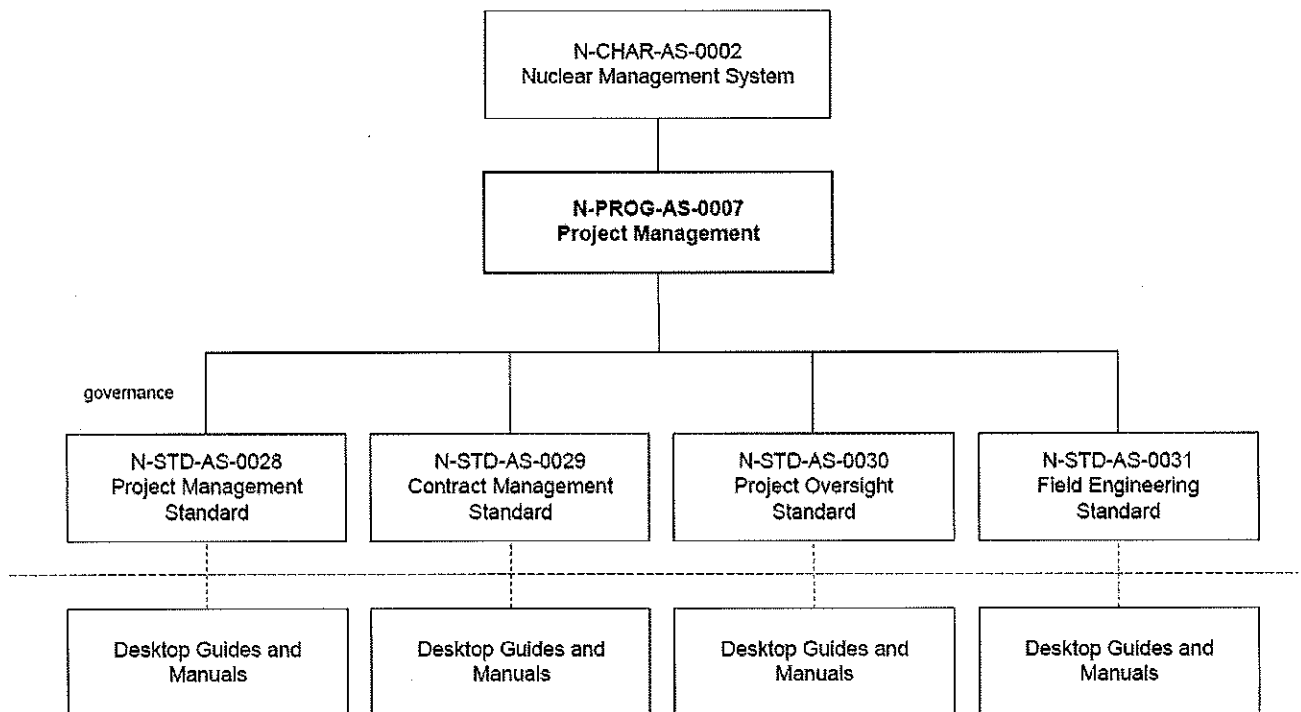
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## 4.0 PROJECT INTEGRATION MANAGEMENT

### 4.1 Integrated Governance

The integration of OPG and EPC vendor processes will enable coordination of activities between OPG and EPC organizations. The BoP Project will be managed in accordance with the governance illustrated in Figure 1. Each of the standards referenced in Figure 1 will be applied in providing contractor oversight to ensure contractors are working within OPG governance, within the requirements set out in the contract as well as within their Quality Assurance (QA) program. Specific oversight activities will be documented in the BoP POP (NK38-PLAN-09071-10200) and activities/findings will be maintained in the Oversight Log.

The ES MSA Contract Owner Interface Requirement (COIR) N-COI-00120-10000 documents how the integration is achieved at the working level. OPG will also review the EPC management plans (reference Section 2.2) to ensure they integrate with OPG governance and expectations.



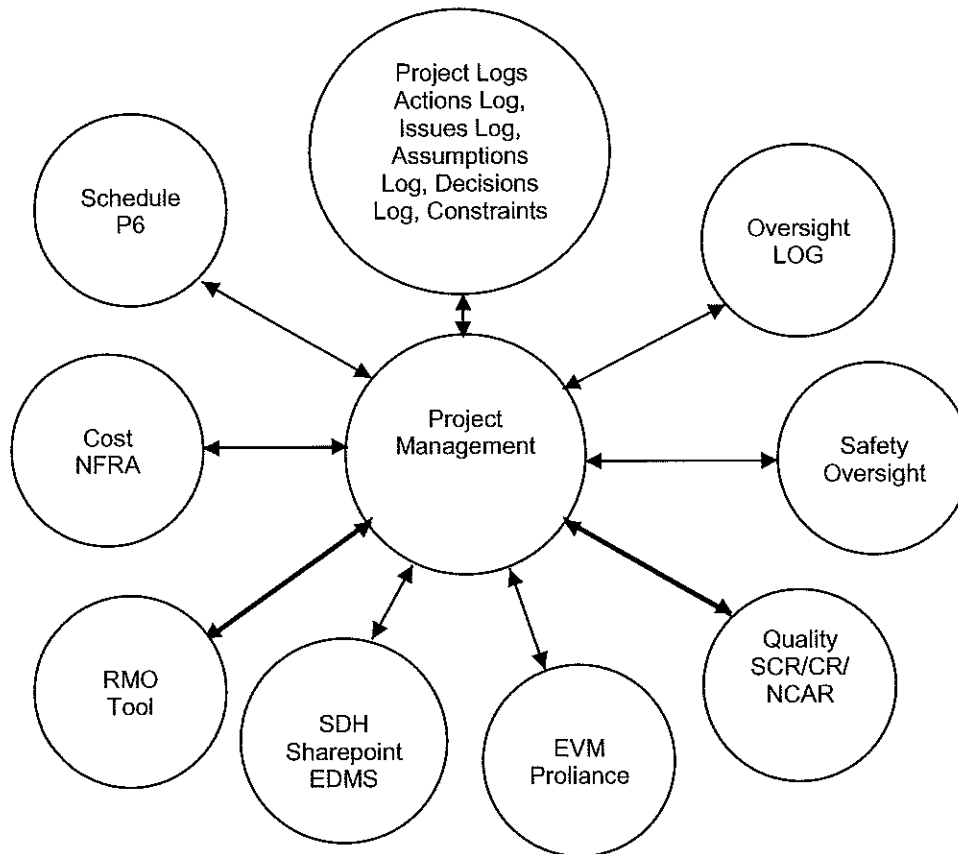
**Figure 1: OPG Management System**

### 4.2 Project Management Toolset

The OPG project management toolset is illustrated below. The toolset will be used to manage OPG internal project activities, facilitate coordination with the EPC vendor activities and document and manage findings resulting from vendor oversight.

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**Figure 2: Project Management Toolset**

### 4.3 Project Oversight

The BoP Project vendor oversight will be completed in accordance with NK38-PLAN-09071-10200 and a log of activities will be maintained to document findings and trends in SharePoint. For Pre-Req modifications being managed by Projects and Modifications Organization (P&M) all oversight of the EPC vendors will be done by P&M staff in accordance with their approved POPs. Transition of the applicable refurbishment projects is now complete therefore BoP staff will no longer act as project sponsors for P&M staff.

Refer to POP NK38-PLAN-09071-10200 for further details in this area.

### 4.4 Contract Management

Contract Management of the ES MSA vendors will be in accordance with the Extended Services Master Services Agreement Contract Management Plan N-PLAN-00150-10001. Work will be contracted out in accordance with the Balance of Plant Contract Strategy NK38-REP-09701-10102. The project has received funds in late 2014 to allow the hiring of a full time Contract Management resource for both BoP and Shutdown Layup. This individual was



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expected to commence work in Q1 2015 and has been delayed until Q4 2015. The importance of this resource to assist in managing emergent ES MSA contracting issues/strategies has been escalated to Sr Management.

ES MSA core team and overhead resource funding for other BoP vendors has been approved in the RQE. It is expected that a significant portion of the resource funds will be allocated to temporary vendor staff to resolve cross cutting issues as the various Refurb project phases evolve. A typical example would be the assignment of a temporary vendor RTE project management position to expedite resolution of cross cutting construction/materials issues that emerge as part of the test project implementation. Funding will also be required to support Refurb functional initiatives such as East Complex warehouse assessment and subsequent bar coding.

Release of ES MSA contracts will be in accordance with the phases identified below. Release will be via PCA approved by the BoP Project Director. Each release will have agreed cost and schedule criteria of which a subset will be utilized as part of the Vendor scorecard.

Contract Phase	Key Deliverables	Status/Timeline
2A	Level 3 Schedule, Class 3 estimate, RTE pre-req MA22 milestones	Complete
2B	Milestone types documented in Appendix D	Nearing Completion Post gate 3A/B/C to Breaker open
13A	Segment 1 PIMS Milestones Segment 1 CCDs (as applicable) IPG Milestones Segment 2 pre-req PIM Milestones IIP Milestones (as applicable)	Breaker open to end of Segment 1
23B	Segment 2 PIMS Milestones Segment 2 CCDs (as applicable) Mod AFS (as applicable) IPG Milestones Segment 3 pre-req PIM Milestones IIP Milestones (as applicable)	End of Segment 1 to end of Segment 2
33C	Segment 3 PIMS Milestones Segment 3 CCDs (as applicable) Mod AFS (as applicable) System AFS IPG Milestones Segment 4 pre-req PIM Milestones IIP Milestones (as applicable)	End of Segment 2 to end of Segment 3
44D	Segment 4 PIMS Milestones Segment 4 CCDs (as applicable) Mod AFS (as applicable) System AFS IIP Milestones (as applicable) Project Closeout	End of Segment 2 to end of Segment 3

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#### 4.5 Engineering Design Management

The OPG Refurbishment project's governance structure for executing Engineering work is described in the Darlington Refurbishment Engineering Program Management Plan NK38-NR-PLAN-09701-10001-0008.

Engineering Design Management in Darlington Refurbishment follows the modification process outlined in N-PROC-MP-0090. All modifications will have Modification Design Requirements (MDR) document issued under OPG Quality Assurance prior to the movement of this work scope into an EPC contract where the design will be completed under the Contractors QA program. In addition, the project will ensure that all staff is familiar with each engineering subcontractor's COIR deviations that have been approved by the Refurb Design Authority.

Each EPC contractor working with the BoP Project will issue design plans for each modification in compliance with the ES MSA COIR. Engineering Earned Value has been implemented in accordance with Refurb procedure N-MAN-00120-10001-SCH-07 and documented/tracked in each vendors P6 schedule.

With DCAVR complete, a review of all the Issues Tracking File (ITF) areas has been completed. Significant issues for any mods will be documented in the Vendor quad charts and applicable RMO actions will be entered into the RMO tool to track to completion.

During the installation planning phase, the vendors engineering group will be focusing on the areas identified below:

- Resolution of any DBOM procurement issues
- Intent/non-intent field initiated changes (FIC)
- Manufacturer non-conformance/technical specification resolution as a result of vendor issued purchase orders to subcontractors
- EC revision as a result of emergent issues (to be minimized and challenged rigorously)
- CWP/ITP review
- Workplan and TPAR submittals

OPG will continue to implement a collaborative approach to ensure engineering issues are effectively resolved with quality and value for money.

#### 4.6 Project Gate Progression Plan

The OPG gated process, described in N-MAN-00120-10001-GRB, is a critical project process and requires integration with the EPC contractor's processes as various contractor inputs will be required for each gate.

Gate 2X was approved July 2016 approving funds to finalize Level 3 schedules, update estimates and progress assessing in order to complete deliverables required for Gate 3. Two projects were granted funding beyond the Gate 3 TCDs below based on the higher level of schedule and cost details namely: ESW L15 (ES Fox ) and SHIM (OPG in-house).

Gate 3 has been broken into three sub-Gates (Gates 3A/B/C) as identified on the following page.

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Gate	Project	Milestone	Comment
3A	Containment Adjusters Flux Detectors PHT + Aux Components Fire Protection	Dec 10/17	Contingency funding will also be requested for any subsequent gate projects to ensure PIMS milestone compliance as applicable.
3B	Alt SDC Heat Sink Emerg Heat Sink LPSW TMODs ESW L15 Fission Chambers	Jan 29/16	Same as above
3C	Other (cyclic scope) SW Stopple Electrical Valves	Feb 28/16	Same as above.
3Execution	Full release of Unit 2	Nov 30/16	Full execution release of unit 2 funding

The next Gate for all Gate 3 A projects is Nov 30/16. The next Gate for Gate 3B & 3C projects will be sequenced at the same time frame subject to RPET availability. At the next Gates, full release funding to execute Unit 2 to closeout will be requested.

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## 5.0 PROJECT SCOPE MANAGEMENT

The OPG Refurbishment project's governance structure for scope management is described in the Refurbishment Program Planning and Controls Program Management Plan NK38-NR-PLAN-09701-10001-0002.

BoP was assigned Execution Owner duties for a number of DSRs being project managed by the Projects and Modifications (P&M) organization. Execution VP approval was obtained to move the ownership duties to P&M. That action, including ownership changes in the DSR database, is now complete and P&M report status of those projects as part of the Campus Plan and Facilities projects. DRAS challenges, the Blue Ribbon scope review, and transfer of BoP SIO related DSRs to Projects and Modifications (P&M) has resulted in over 100 BoP DSRs being removed from the project since January 2013. Currently there are 87 DSRs at Approved status in BoP scope per Appendix A

At this time, the only areas where scope may be subject to change are:

- Inspection findings from DNRU2 inspections (Calandria duct for example) and D1641/D1831 planned outage inspections (NIR cable inspections for example). Major areas include components, structures and reactor components.
- Fire Protection emergent repair scope as a result of scheduled inspections & testing. Scope includes:
  - Inspection of selected fire stops to confirm Sikaflex has not been installed
  - Equipment fuel & lube oil tanks including selected berm and penetrations
  - Selected fire system isolating valve testing (4)
- DSR TS0360-7 DCC Consequential changes. DRAS then PSRB approval is required to transfer this scope to AISC. Note - this work does not commence until ~ 50% through Unit 3 Refurb.

Contingency funds have been allocated for all of the above areas

Regulatory (IIP) scope will be managed to ensure float is maintained and the regulatory commitment risk remains low. Appendix C identifies all BoP IIP scope. Reference NK38-REP-03680-10185 Rev 2 for specific actions and completion dates. ARs have been assigned for each BoP IIP item. Note - a breakdown of all IIPs due by the end of 2019 is documented in the Gate 3A package under Appendix D.

## 5.1 OPG Scope Management

### 5.1.1 Scope Definition

This PMP revision covers the work to be performed from Gate 2X to Gate 3. For past work programs refer to the previous rev of the PMP. The next expected update will occur immediately prior or after Gate 3 pending subject to the extent of revisions required due to changing data from Level 3 schedules, estimates or risks.

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Table 2a below lists the applicable EPC Contract scopes of work for each BoP project excluding modifications that will be completed in-house (Adjuster Shim Operation, SCID 7026).  
Note – some of the projects have been broken into E, PC contracts as noted.

Table 2a: Project and Scope ID Breakdown			
Project (Vendor)	Scope Document and Detail	Scope ID	Status
PHT and Auxiliaries – Rehabilitation (ES Fox)	Refurb PHT Pump Motors – field work scope	7001	PHT motor scope transferred to P&M Assessing complete
	Inspect and overhaul PHT Pumps	7002	
	Contingency – PHT Pump Refurb	7003	
	Replace PHT switches and cabling	7005	
Emergency Heat Sink Mod (ES Fox)	EHS – ESW to PHT tie (Mod)	7004	Design complete, detailed assessing I/P
Flux Detector Replacement (ES Fox)	Replace RRS Vertical In-Core Flux Detectors	7020	Assessing late - recovery plan I/P
	Replace SDS 1 Vertical In-core Flux Detectors	7021	
	Replace SDS 2 Horizontal In-Core Flux Detectors	7022	
Adjusters (ES Fox)	Replace Adjusters (Mod)	7023	Design complete, rehab assessing late, modification assessing I/P
Fission Chambers (ES Fox)	Fission Chambers Modification (Mod)	7027	Design complete, detailed assessing I/P
Electrical Systems (E Unit 2 – Areva (nearing completion)) (EPC – TBD)	MCC Maintenance	7040	Front end planning PO issued to AREVA, detailed assessing & Level 3 schedule I/P
	BU 1-8 Maintenance		
	Replace various components	7041	
	Replace 500kV Bushings		
	Replace Motor Starters feeding the vault coolers (U2 only)	7042	
	Contingency – Refurb MOT transformer	7043	

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Table 2a: Project and Scope ID Breakdown			
Project (Vendor)	Scope Document and Detail	Scope ID	Status
	Contingency – Refurb UST transformer		
	Cyclic Preventative Maintenance	7174	
Service Water (E Unit 2 – B&Mc (nearing completion) (EPC – TBD)	Stopple Plug (Mod)	7050	Design complete. Front end planning activities underway with new Vendor (ES Fox) for Unit 2 Execution
Containment (ES Fox)	Replace 3 way AOVs & key components	7010	Rev 1 of design complete, modification detailed assessing I/P, rehab assessing late – recovery plan I/P
	Install VVRS bypass and airlock/transfer chamber doors (Mod)	7011	
	Install new Containment button-up valves (Mod)	7012	
Fire Protection (ES Fox)	Fire Protection (Major Mod) - Shafts, dampers & Fire Separations	7081	Unit 2 Design complete, Unit 1/3/4 designs I/P, detailed assessing I/P
	Fire Protection (Major Mod) - Fire Alarms	7083	
	Fire Protection (Minor Mod) - Emergency Lighting	7082	
	Fire Protection (Minor Mod) - Fire Separation & Penetration Seals	7081	
	Fire Protection (Minor Mod) – Lightning Protection	7085	
	Fire Protection (Minor Mod) – Endurance of Fire Alarm Cables	7086	
	Fire Protection (Minor Mod) - Transformer Dikes	7084	
	Fire Protection (Minor Mod) – Fault Isolation Modules	7085	

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Table 2a: Project and Scope ID Breakdown			
Project (Vendor)	Scope Document and Detail	Scope ID	Status
Valves (B&W)	PHT & Aux. - Inspect Two Representative PHT Loop Isolation/Interconnect MOVs	7121	NICRs and assessing I/P, long lead material POs issued
	PHT & Aux. - Repack all PHT Loop Isolation/Interconnect MOVs		
	PHT & Aux. - Contingency - Overhaul / replace PHT loop/interconnect MOVs		
	PHT & Aux. - DNGS Primary Heat Transport Pressure and Inventory Control: Replace Non-Return Valve 33840-NV21 in All Units		
	SDC - Repack Manual Valves (x32)	7122	
	SDC - Repack All MOVs (x52)		
	SDC - Contingency for Manual Valves		
	SDC - Contingency for MOVs		
	SDC - Inspect Representative SDC MOVs		
	MOD & AUX. - Overhaul Seat Ring and Disk for Moderator Check Valves	7123	
	MOD & AUX. - Replace X-32210-NV112 in all units		
	MOD & AUX. System - Part 2: Replacement of Valves (Contingency)		
	MOD & AUX. - Replace DELORO Disc Hard Facing w/STELLITE 6 for MV20, 27 & 29 in All Units		
	MOD & AUX. - 32110-NV37 / 32510-NV11 INSPECTION		

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Table 2a: Project and Scope ID Breakdown			
Project (Vendor)	Scope Document and Detail	Scope ID	Status
	MOD & AUX. - 32110-NV37 / 32510-NV11 INSPECTION (contingency repair or replace)		
	Vault Vapour recovery valves	7125	
	Compressed Air System: Manual Diaphragm Valves	7127	
	LPSW Critical Valve replacement during refurbishment	7128	
	Valve cyclic/corrective maintenance scope	7166 7167 7168	
Specialized - PHT Motor Overhaul	Refurb PHT Pump Motors – off site re-build of motors by SME vendor.	7101	Removed from scope – transferred to P&M
Alternate Shutdown Cooling Heat Sink (E – AMEC) (ePC – ES Fox)	Alternate SDC Heat Sink (Mod)	7100	Design complete, detailed assessing I/P
ESW Line 15 (ES Fox)	Replacement of ESW pipework	7092	Assessing complete
Components (ES Fox)	Replacement of EQ cables and penetration modules	7110 7111	Assessing complete
SHIM (OPG in-house)	Restoration of SHIM operation	7913	TPAR submission complete, procedure updates I/P
Other (TBD)	Miscellaneous cyclic and corrective maintenance	7160 7161 7162 7163 7164 7165	PO issued to commence front end planning work



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### 5.1.2 Work Breakdown Structure

The BoP Project Work Breakdown Structure has been prepared in accordance with N-MAN-00120-10001-SCH-05 and can be found in the P6 schedule.

### 5.1.3 Scope Control

DSR based scope changes require prior PSRB approval prior to implementation.

Scope clarifications within DSR scope will be processed via Project Change Authorization (PCA) forms for ES MSA contracts and contracts amendments/notification to proceed (NTP) or Project Change Directive (PCD) for the B&W contract. Prior DRAS approval will be obtained as applicable.

Options Review Board (ORB) approval will be requested for significant scope changes such as EHS leak detection. All ORB decisions will also be documented via DRAS and submitted to the CCB for either approval or information.

A Change Control Form (CCF) in accordance with N-MAN-00120-10001-PC will also be processed with scope changes to ensure planned value and P6 schedules are updated. The CCF may request release of bundle contingency or program contingency.

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## 6.0 PROJECT SCHEDULE MANAGEMENT

Project schedule management is concerned with defining, sequencing, and estimating resources and durations of the project activities which are integrated in the project schedule. It will require schedule development and monitoring to be integrated with OPG project and functional groups, EPC contractors and other contractors [i.e. Owner Support Service (OSS)] schedules.

Each EPC contract will require that the Contractor provide a detailed Level 3 P6 schedule that integrates with the overall OPG P6 schedule.

Vendor Level 3 schedules will be resource loaded for OPG resources in accordance with Resource Loading of Functional Engineering Resources Within Level 3 Project Schedules NK38-CORR-09701-0489190.

OPG and Vendor schedules will be managed within milestones documented in the following governance:

- N-PROC-MA0022 – all work that will be completed via IPG
- NK38-MAN-09701-10005 – all work completed during the Refurbishment outage on the Refurbishment unit
- N-PROC-MA0013 – all work completed during planned outages

In addition, Refurb scheduling expectations (Expectation #2) templates have been forwarded to Vendors for their implementation.

### 6.1 OPG Schedule Management

Balance of Plant project schedule management will be performed in accordance with the Refurbishment Program Planning and Controls Program Management Plan NK38-NR-PLAN-09701-10001-0002. Refurb Expectation #2 also documents scheduling templates that are to be utilized for Refurb.

### 6.2 EPC Contractor Schedule Management

Each EPC contractor will have a process to address project schedule management. The EPC portion of the BoP project Level 2 schedule will directly reflect the vendor Level 2 schedule (i.e. all activities with current status). In addition, all 2016 pre-req tasks have work orders assigned to a specific work week and status will be reviewed against the applicable MA22 milestones.

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## 7.0 PROJECT COST MANAGEMENT

Project cost management is concerned with budgeting and controlling overall project costs. The RQE project estimate is 651.3M and is broken down per below:

- Base EPC 336.1M
- OPG Oversight 110.1M
- EPSCA/Training 5M
- Cyclic OM&A 61M
- Contingency 138.9M

All costs will be baselined against RQE values and CCFs will be issued to document any change to the project estimate.

### 7.1 OPG Cost Management

The BoP Project cost management and integration is governed by the following documents:

1. Darlington Refurbishment program document N-MAN-00120-10001-PC, Project Controls
2. Nuclear Refurbishment Cost Management and Project Reporting, N-MAN-00120-10001-CST
3. Refurbishment Planning and Controls Management Plan NK38-NR-PLAN-09701-10067-0002

EPC contractor costs are integrated with internal OPG BoP Project costs/contingency to provide a total estimated cost for the project. Costs associated with efforts of the OPG functional groups are not included at the project level and are managed by the respective functional groups except where dedicated matrix staff have been identified. Note - costs for external contracts to prepare modification design requirements and conceptual design reports are included in the project cost estimates under the OPG Common sub-bundle.

EPC contractor costs are incorporated in the project cost management worksheet and updated monthly based on the OPG Nuclear Financial Reporting and Analytics (NFRA) Cost Reports. Costs are managed for work packages in the Work Breakdown Structure (WBS) which are aligned to the Oncore load sheet provided to each EPC contractor and further align with Proliance. This allows the EPC contractor costs to be captured at the work package level as determined by the project and tracked against the original cost estimate via Proliance PV targets.

Any changes to contract cost will be approved via CCF (if required) followed by PCA or PCD. . In all cases, PV will be updated to reflect the cost changes to ensure EV is accurately tracked.

### 7.2 EPC Contractor Cost Management

BoP baselines and cash flows reflect the EPC Contract values. Estimates requested at the Gates will be updated (if required) via Change Control Forms once the purchase order is issued and the actual values are known.

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ES Fox issues weekly cost summaries to track accruals and estimate to complete costs. The project is currently working to delineate contract phase costs and is expected to be completed by Dec 2015. Valve predefine and corrective scope cost is currently being analyzed with BWXT to confirm the Level 3 cost estimate and P6 schedule. AREVA is completing the same analysis for the Electrical program work under a time and material contract with BWXT phases based on poor subcontractor cost tracking performance. Dedicated staff are now in place and this initiative has been extended indefinitely.

### 7.3 OPG Change Management

The Change Management is a process to manage changes within projects. It extends from identification to inclusion or cancellation of changes to costs (including budgets, planned values, funding, and forecasts), schedule, and scope.

This Change Management process applies to all Nuclear Refurbishment (NR) funded projects. This process applies to work programs, including contingency, approved by the Gating process, and functional work programs approved by the Program Release.

If a change is needed, a Change Control Form (CCF), N-FORM-11252 shall be initiated. Subsequently will follow reviews and sign off's in accordance with the Refurbishment document identified below

Balance of Plant Change management will be performed in accordance with the Refurbishment Change Management Plan N-MAN-00120-10001.

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## 8.0 PROJECT QUALITY MANAGEMENT

The overall quality management process will apply to all work in the BoP project; however, the particular QA requirements will be specified in each EPC Contract according to the nature of the work.

Each ES MSA vendor will have a Quality Assurance Manager assigned to support BoP work as required. As part of Construction oversight, OPG hold points will be inserted in Vendors ITPs as applicable to monitor Vendor quality. In addition, it is expected that observation and coaching reviews will take place as field work progresses to ensure that OPG maintains its due diligence with respect to Vendor quality.

### 8.1 OPG Quality Management

The Quality Management of the BoP Project will be in compliance to:

- N-CHAR-AS-0002 - Nuclear Management System,
- N-PROG-AS-0001 - Managed Systems,
- N-PROG-AS-0007 - Project Management,
- N-STD-AS-0028 - Project Management Standard,
- N-STD-AS-0029 – Contract Management Standard,
- N-STD-AS-0030 – Project Oversight Standard,
- N-STD-AS-0031 – Field Engineering Standard
- N-MAN-09701-10002 – Nuclear Project Oversight Guide,
- N-PROC-MM-0010 – Establishing and Maintaining Ontario Power Generation Nuclear Approved Supplier list.

#### 8.1.1 Quality Assurance

For EPC work, each contractor has Quality Assurance Plans that addresses the interface responsibilities with external organizations. For all EPC quality assurance plans, each will address all applicable codes and standards including CSA Z299, CSA N286-05 and CSA N286.7 standards, as required, identifying what quality programs and procedures will be followed, including the contractor's and their sub-contractor's personnel responsibilities under the various quality programs. OPG will review and accept the contractor's project quality assurance plans.

During the different phases of project work, the project team, jointly with the functional groups will work to ensure that the quality of design, materials, and services provided and the quality of installation and commissioning work performed meet OPG standards, purchase order requirements, and are in compliance to applicable codes and standards.

In the instance of a quality system failure or a breakthrough event occurring for which the contractor is accountable; such adverse conditions will be documented per the contractor's QA Program and per N-PROC-RA-0022. The contractor will be asked to initiate a Corrective Action as per their program for any identified quality issues. When there is a systemic failure of

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their implemented Quality System, a formal Non Conformance and Corrective Action Request process will be initiated by OPG Supply Chain Quality Services as per N-PROC-MM-0010 and N-GUID-01935-10004.

To ensure compliance to OPG requirements, the contractor interface will be controlled by the Contractor Owner Interface Requirement (COIR) document forming part of each agreement.

For internal quality issues the OPG Station Condition Record (SCR) and corrective action process will be followed. Vendors will utilize their own corrective action programs to address their issues however the OPG SCR system will be utilized as documented in NK38-GUID-09701-10022 (draft).

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## 9.0 PROJECT HUMAN RESOURCES MANAGEMENT

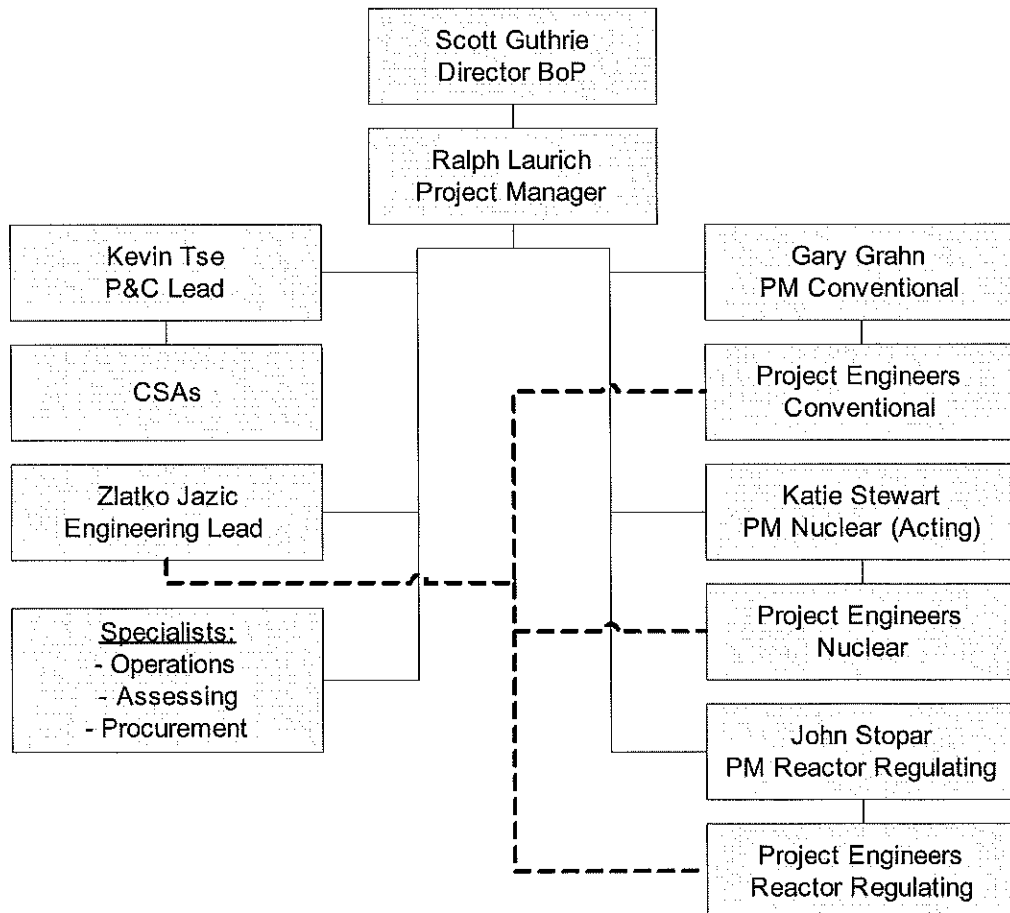
The BoP Project human resources management will be in accordance with Darlington Refurbishment Program Staffing Management Plan NK38-NR-PLAN-09701-10001-0016.

### 9.1 OPG Human Resources Management

#### 9.1.1 Team Resourcing

The BoP Project Organization is shown below. The key roles and their respective accountabilities are described in Appendix B: Project Organization.

Nuclear Refurbishment has elected to employ a Matrix organizational model to execute the Refurbishment Program. It is the BoP Project's plan to staff the project team with OPG and Augmented staff. Managed task resources will be used at a minimum to supplement to ensure cost, schedule, safety and quality issues remain on track. OPG staff will either be embedded in the team or will be matrixed from the NR functional support organizations.



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**Figure 3: Balance of Plant Project Organization**

## **9.1.2 Team Development**

### **9.1.2.1 Training & Resource Development**

#### Qualifications

Each project member that is matrixed will be assigned the appropriate qualifications by their respective functional manager to ensure compliance with the applicable standards for that group. A review of the current qualification set that are available for project management, contract owner and similar functions is performed by the project.

In order to effectively provide oversight to the EPC contractors, one would ideally have like experience and training similar to that of the EPC contractor. The project will continue to explore internal and external opportunities to develop these skills.

### **9.1.2.2 Training & Resource Development**

The following assessments and methods will be employed and expectations communicated to all project team members:

- Annual Incentive Plan (AIP) Score Card – (Management team only)
- Project Performance Review (PPR),
- Monthly summary data sheets.
- Contract SOWs and Deliverables for contract staff

Vendors will be required to document which programs they train staff under OPG TIMS and their internal programs. A program based milestone will be established for ES Fox to document the applicable programs and ensure alignment with OPG training.

Given the recent challenges that occurred for the valve program during VBO, the Valve Vendor (BWXT) will be required to show how they are utilizing training mock-ups and ensuring sufficient trades skills as part of their valve preparation scope.

## **9.2 EPC Contractor Human Resources Management**

Each EPC contractor will be responsible for the management of their staff. The EPC contractor in the ESMSA for BoP projects will develop resource management plan for all staff and subcontractors in accordance with the ESMSA terms and conditions. A critical document associated with this work is the ES MSA Program Management Plan which will reference a mobilization plan based on allocated or secondary compete awarded work. As of September 2015 the ES Fox has submitted resource plans but they are unacceptable. As a result, a resource planning management representative will be hired into ES Fox on a temporary basis to complete a PMT and overall resource management plan. Deliverables/milestones are being confirmed at the time of this PMP update. In addition, ES Fox will be hiring a temporary RTE Project Manager to facilitate the transition to breaker open and implementing all Construction interfaces effectively from Feb 1/16 to Oct 15/16.



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## 10.0 PROJECT COMMUNICATIONS MANAGEMENT

Balance of Plant Project communication management will be consistent across each project except if there are differences stipulated in each EPC contract. If major differences exist they will be documented in this plan.

Each SoW issued to the Contractor will have a list of current OPG staff associated with the work. The Contractor will document the names/contact #'s of applicable OPG & Contractor staff in their communication plan and make any updates as required.

## 10.1 OPG Communications Management

### 10.1.1 Information Control

The main stakeholder communication methods are:

- Face to face
- Telephone and Email communications
- Submittals and Requests for Information (RFI)
- Weekly Meetings/Conference calls
- Publications and Reports

Emails: Regularly used to document interface with stakeholders, the project team and with contractors.

Meetings: Conducted face-to-face with available teleconference and videoconference as required. The stakeholder meetings involving the BoP project and its internal stakeholders are listed in Table 4a, and external stakeholders in Table 4b (Conventional Contracts), and Table 4c (Nuclear Contracts).

Records: The Communication Technology and Information distribution tools that will be used by the project include:

- VendM: External environment used for information exchange and management of contractor submittals.
- SharePoint 2007: Internal document storage, exchange environment used for storage of project documents, deliverables, schedules and cost information,
- Project Records will be maintained in SharePoint, Project Emails and VendM.
- Assett Suite 7

### 10.1.2 EPC Job Aid

The combination of a large number of contracting reference documents, contract deliverables, and contracts in BoP, will result in a significant volume of documents. To manage the documentation, BoP developed an electronic binder (E-Binder) system referred to as EPC Job Aids. EPC Job Aids were established for Vendor common documents, which contain on-

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boarding reference documents and Vendor Program Level Plans, and for each project/contract, which contain project specific contract deliverables. The EPC Job Aid E-Binder suite is maintained on the BoP SharePoint Team Site.

Table 4a: Stakeholder Meetings		
Meeting Title	Description	Frequency
BoP DR Meeting	Management review of issues	Weekly
BoP Project Team Meeting	Communication and review of cross functional project management and administrative information.	Bi-Weekly
ES Fox Status Meeting	Project Quad and programmatic issue review	Weekly
BWXT Weekly Status Review	Conference call to review tracking metrics/issues.	Weekly
OPG/Vendor Project Review Meetings	Working level - 4 week look ahead Level 3 schedule review and issues/risks. See Tables 4b & 4c below.	Weekly
Project/Engineering Schedule Review	Execution led Projects and Functions alignment meeting	Weekly
Options Review Board	Review recommended options to resolve issues to ensure management alignment	As required
Oversite Review Committee	Present and discuss oversight findings, common trend areas between projects and corrective/mitigating actions.	Monthly
Scope Review Board	This includes the related Technical Screening Committee and Funding Screening Committee meetings. Scope addition, removal, modification processing.	Quarterly (Or As Required)
Vendor Summit	Review OPG/Vendor cross-cutting issues and resolution. Provide updates on upcoming process changes or direction.	Monthly
Vendor Leadership Meeting	Working level review of OPG/Vendor cross cutting issues and resolution.	Monthly

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Table 4a: Stakeholder Meetings		
Meeting Title	Description	Frequency
MRM Meeting	Review and processing of station condition records associated with BoP.	Weekly
Project Status Review Meeting	Project Performance Updates via BoP Quad review, Issue resolution.	Monthly
DN Refurbishment/CNSC Meeting	Alignment meeting	As Requested
Nuclear Refurbishment All Staff Face-to-Face Meeting	Project update	As Required

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**Table 4b: External Stakeholder Meetings – Conventional Contracts**

No.	Project	Meeting: Location/Weekd ay/Time	Prime Attendees	Subcontractor Attendees	OPG Attendees
1.	SW Stopple Plug	Teleconference, bi-weekly Tuesdays, 3-4pm	ES Fox: Mina Khalil	Tetra Tech: Aaron Gabourie	Project: Jessica Perryman/Gary Grah  Design: Tyler Yada
2.	Electrical (DNRU2 and PM/CM scope)	AREVA office, Pickering Wednesdays 8:30 – 9:30	AREVA: Thomas MAeck	N/A	Project: Greg Mills/Gary Grah Engineering: Thomas Maeck (AREVA)  Supply Chain: Y. Nayak
3.	Components	ES Fox office, Whitby Tuesdays 8:00 – 9:00	ES Fox: Neeraj D'Mello John Puopolo	Tetra Tech: Aaron Gabourie	Project: Greg Mills/Gary Grah  Design: Geoffrey Toye
4.1	Fire Protection (A)	E.S. Fox Whitby Office / Tuesday / 9-10 AM	ES F ES Fox: John Puopolo, Saurabh Srivastava ox:	S&L: Sean Hagen Green, Joseph Aldieri (phone), Tom Martin (phone), Gary Jasutis (phone)	Project: Oweis Chohan/Gary Grah/Sai Saidefar Design: David Dias
4.2	Fire Protection (B)	Tetra Tech Pickering Office / Tuesday / 2-3 PM		Tetra Tech: Tetra Tech: Glenn Gilchrist, Thuriya Hasson Ali, Negar Mahmoudi, Jing Liu	
5.	Valves (DNRU2 & PM/CM scope)	Teleconference, bi-weekly Wednesdays, 11- 11:30am	B&W: Vic Jakubaitis, Deepak Dhar	N/A	Project: Jessica Perryman/Mike Hodges/Gary Grah  Design: Jake Kong (PE) Components: John Li  Supply Chain (PM/CM): Y. Nayak
6.	L15	DEC, bi-weekly Wednesdays, 2:30-3pm	ES Fox: John Puopolo	N/A	Project: Jessica Perryman/gary Grah  Construction: James Elliott

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7.	LPSW Temporary Mods	E.S. Fox Whitby Office / Tuesday / 9-10 AM	ES Fox: Mina Khalil	Tetra Tech: Aaron Gabourie	Project: Greg Mills/Gary Grahm  Design: Tyler Yada
8.	Other (cyclic & corrective)	E.S. Fox Whitby Office / Tuesday / 9-10 AM	ES Fox: Mina Khalil	N/A	Project: Mike Hodges/Gary Grahm  Supply Chain: Y. Nayak  Construction: James Elliott

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Table 4c: External Stakeholder Meetings – Nuclear Contracts					
No.	Project	Meeting: Location/Weekd ay/Time	Prime Attendees	Subcontractor Attendees	OPG Attendees
1.1	Alt SDC Heat Sink (Eng Contract)	Conference call Thursday 1:00 PM	AMEC: Hooman Shobhit ES Fox: Nancy Taleb, Abdullah Nijad	N/A	Project: Doina Idita/Katie Stewart Engineering: Cora Silveira, Alana Osmond
1.2	Alt SDC Heat Sink (ePC Contract)	Conference call Thursday 10:30 a.m.	ES Fox: Nancy Taleb, Abdullah Nijad	KSB: Markus Mark AMEC: H Shobhit	Project: Doina Idita/Katie Stewart Engineering: Cora Silveira, Alana Osmond
2.	Containment	Conference call Wednesday 11 am (1 hour))  CL2 24" Valve: Con call Wednesday 1:30 pm	ES Fox: John Puopolo Mahiyar Panthaky	S&L: Dave Olsen Ravi Aggarwal Sean Hagen (optional) Jeff Philips James Chavanic Klijeet Sapple	Project: Gee Sham/Katie Stewart  Design: Ali Azarbad
3.	EHS	Conference call Wednesday 10:30 am	ES Fox: John Puopolo Ghafoor Khodayari	AMEC: Asaad Mohammed Marijus Svirskas Kevin Tsai	Project: Nadeem Nathoo Katie Stewart  Design: Alana Osmond Dustin Ridge Paul Bekeris
4.	PHT + Aux.	Conference call Friday 11 am	ES Fox: Nancy Taleb, Mahdi Rezazazadeh	RCMT: Michael Buenonavista	Project: Nadeem Nathoo Katie Stewart  Design: David Dias (optional) Sheldon Doyle (optional)  System Eng: Renata Samaroo (Optional)
5.	Fission	Tuesdays 1:30-	ES Fox:	Tetra Tech: Danny	Project: George

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Table 4c: External Stakeholder Meetings – Nuclear Contracts					
No.	Project	Meeting: Location/Weekday/Time	Prime Attendees	Subcontractor Attendees	OPG Attendees
	Chambers	2pm Teleconference	John Puopolo (PM), Jana Ratnam (MTL)	Sundararajan  Rolls Royce: John Mann	Naguib/John Stopar  Design: Syed Abbas
6.	Adjusters	Tuesdays 2:00 – 3:00 pm	ES Fox: John Puopolo (PM), Jana Ratnam (MTL)	Tetra Tech: Danny Sundararajan  Rolls Royce: Kent Carlson	Project: George Naguib/John Stopar  Design: Michael Zhang
7.	Shim	Tuesdays 1:00 - 2:00	N/A (In-house)	N/A (in-house)	Project: Gee Sham/Katie Stewart  Design: Andy Zupan
8.	Flux Detectors	Tuesdays 11:30-12 Teleconference	ES Fox: John Puopolo (PM), Mahiyar Panthaky (MTL)	AMEC: Mayank Sood, Navindra Persaud	Project: George Naguib/John Stopar  Design: Syed Abbas



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### 10.1.3 Stakeholder Inputs

Stakeholder inputs are gathered through the various meetings conducted by and with the project team. Actions, issues and risks are then tracked in the appropriate system as described in the Risk Management Plan.

The major stakeholders for the BoP Project are listed in Table 5.

Table 5: Stakeholder Register			
Identification	Main Expectations	Potential Influence & Phase of Most Influence	Stakeholder Classification
Darlington Nuclear Generating Station (DNGS)	Return of units 1-4 as per Refurbishment Program Charter	Owners of Plant Systems; Execution Phase	Internal
ESMSA Contractors	Coordination with OPG and other EPC Vendors as per ESMSA Agreement	Throughout the entire project	External
Non-ES MSA Contractors	Coordination with OPG and other EPC Vendors as per ESMSA Agreement	Throughout the entire project	External
NR Function Groups: Engineering, Nuclear Safety, Ops, Maintenance, Rad Protection, Reg Affairs	Consultation, input required for review of deliverables	Required to perform oversight activities; Throughout the entire project	Internal
Darlington Engineering, Operations, Work Control and Maintenance Staff	Consultation when implementing modifications on the operating stations	Owners of the Plant Systems; Throughout the entire project	Internal
Darlington and Fuel Handling	Coordination required when executing pre-req outage work and NR work during no-fuel windows	Owners of the FH system, critical impact to installation schedule of the project	Internal

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Table 5: Stakeholder Register			
Identification	Main Expectations	Potential Influence & Phase of Most Influence	Stakeholder Classification
Darlington – Mechanical Design Group	Provide input on pressure testing requirements	Owners and operators of station pressure testing equipment. Key stakeholder in developing pressure test strategy	Internal
Government of Ontario	Performance of Program on Time, on Budget, within Scope, and without Safety Incidents	Major influence in making go, no-go decision for Execution Phase	External
Unions	Upholding of Collective Bargaining Agreements	Entire Project	External
Canadian Nuclear Safety Commission	Compliance with Regulations	Throughout the Project	External
Technical Standards and Safety Authority (TSSA)	Compliance with Regulations	Throughout the Project	External
Municipality of Clarington	Compliance with Codes and By-laws	Throughout the Project	External
Ministry of Environment	Compliance with Regulations	Throughout the Project	External
Ministry of Labour	Compliance with Regulations	Throughout the Project	External
Electrical Safety Authority	Compliance with Regulations	Throughout the Project	External

#### 10.1.4 Performance Reporting

Performance reporting will be executed in accordance with the Darlington Refurbishment Planning and Controls Program Management Plan NK38-NR-PLAN-09701-10001-0002. Project cost and schedule performance will be gauged and monitored using the Earned Value

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Management technique in accordance with N-MAN-00120-10001-SCH-07, Nuclear Refurbishment Earned Value Management.

A monthly BoP quad will be issued and reviewed at the monthly project status review meeting. The quad will include the following reporting categories:

- Executive summary
- Cost Performance/Variance Explanation
- Schedule Performance/variance Explanation
- Risk Performance/Additional Explanation
- Engineering Earned Value

The recently issued Nuclear Refurbishment Reporting Website will be used going forward to identify all program and project specific metrics.

A bundle specific Refurbishment specific Scorecard is planned to be issued in Q1 2016 documenting ES MSA performance..

## **10.2 EPC Contract Communication Management**

The EPC contractor will issue/maintain individual communication management plans as required by the Contract Terms and Conditions.

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## **11.0 PROJECT RISK MANAGEMENT**

Risk Management for the BoP Project will require the integration of the BoP Project Risk Management process and the EPC contractor risk management processes.

### **11.1 OPG Risk Management**

OPG Risk Management follows the procedures outlined in these documents:

- NK38-NR-PLAN-09701-10001-0011 Darlington Refurbishment Program Assurance Program Management Plan
- N-MAN-00120-10001-RISK OPG Risk Management Processes

Risks in BoP are managed per the governance of OPG Risk Management. RADAR is a program used to track risks during the entire life cycle of all projects. The BoP Risk Management Plan NK38-PLAN-09701-10196 is specific to the documentation and management of risks in Balance of Plant.

### **11.2 EPC Contractor Risk Management**

EPC contractors will provide risk management plans as required in the Contract Terms and Conditions. The vendor Risk Management Plans are to include requirements for risk identification, tracking and mitigation. Vendors will be required to incorporate risk reporting into the monthly quad charts.

### **11.3 Risk Management Integration**

EPC contractors will manage risks per their internal processes. Interfacing risks identified by EPC contractors will be documented in the RMO tool and mitigating actions assigned accordingly. In general risk communication can take place via the following methods:

- Part of project communication meetings
- Part of weekly quad review meetings
- Vendor Summit/leadership meetings
- BoP Quad risks presented at the Project Status Review Meeting
- Oversight Committee meeting review

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## 12.0 PROJECT PROCUREMENT MANAGEMENT

For all OPG procurement activities, the processes as defined in OPG-PROC-0058 Procurement Activities will be followed.

EPC contractor procurement will be in accordance with the applicable Contractor procurement process. Vendors will provide weekly input into the Procurement tracking Tool (PTT) via an excel file (Materials Tracking File) in accordance with N-GUID-09701-10124. EPC contractor procurement will be in accordance with the applicable Contractor procurement process and the OPG accepted Procurement Plan.

### 12.1 OPG Procurement Management

Material provided by OPG to fulfill BoP scope will be procured using existing OPG processes and procedures. The scope of these materials is currently:

- Electrical/Other/Valve – cyclic and preventative maintenance scope
- PHT + Aux - cables
- Containment – EQ cables
- OPG materials available as a result of emergent scope and schedule constraints
- Construction Interface supplied equipment/materials (pending confirmation)

### 12.2 EPC Contractor Procurement Management

Each vendor is required to issue a Procurement Management plan that is accepted by OPG. Project Specific Procurement plans will include the following as a minimum:

- Manufacturer schedule and/or hold points identifying which hold points will be witnessed by the EPC Vendor. These hold points will include selected materials as a result of PNGS ER3.1 findings. To date, 12 CATIDs have been identified for ES Fox that fall into this category. A review of BWXT and AREVA materials is on-going.
- The above hold points will be input in P6 under a standardized code in accordance with Expectation #2.
- Procurement plan checklist as documented in N-GUID-09701-10124

The East Complex warehouse will be used to stage EPC vendor materials prior to movement to approved SATM staging areas inside the protected area. A bar code system will be implemented to manage the movement of materials and a single vendor will be used to transport all materials from the East Complex warehouse to inside the protected area. Vendors are expected to staff the warehouse to care and control their material, including applying the bar code and preparing the materials for transportation into the protected area.

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### 13.0 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

AIP	Annual Incentive Plan
BoP	Balance of Plant
BCS	Business Case Summary
CAT	Cost Allocation Table
CBS	Cost Breakdown Structure
COIR	Contractor Owner Interface Requirements
CPI	Cost Performance Index
CTP	Consent to Proceed
D2O	Heavy Water (Deuterium Oxide)
DEC	Darlington Energy Complex
DSR	Darlington Scope Request
DRAS	Decision Record Analysis Summary
ECC	Engineering Change Control
EDMS	Electronic Document Management System
EPC	Engineering, Procurement and Construction
EPC Contracts	Any combination of E only, PC only or EPC contracts
EQ	Environmental Qualification
ESMSA	Extended Services Master Service Agreement
EV	Earned Value
GRB	Gate Review Board
IIP	Integrated Improvement Plan
ILW	Intermediate Level Waste
IPG	Integrated Planning Group
LLW	Low Level Waste
MTF	Material Tracking File
NFRA	Nuclear Financial Reporting and Analytics
NR	Nuclear Refurbishment
OAR	Organizational Authority Register
OHSA	Occupational Health and Safety Act

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ORB	Options review Board
OSS	Owner Support Service
PCA	Project Change Authorization
PCCS	Program Coordination and Control Schedule
PCD	Project Change Directives
PHTS	Primary Heat Transport System
PIMS	Program Integrated Master Schedule
P&M	Projects and Modifications Organization
PM	Project Manager
PMBOK	Project Management Body of Knowledge
PMP	Project Management Plan
PMSS	Program Milestone Schedule
PO	Purchase Order
POP	Project Oversight Plan
PS	Project Schedule
QA	Quality Assurance
RFI	Request for Information
RMP	Risk Management Plan
RQE	Release Quality Estimate
RTE	Readiness to Execute
SCR	Station Condition Record
SDH	Supplier Document Hub
SoW	Scope of Work
SPI	Schedule Performance Index
SSSP	Site Specific Safety Plan
T&C	Terms and Conditions
WBS	Work Breakdown Structure
ToR	Terms Of Reference

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## 14.0 REFERENCES

- Extended Services Master Service Agreement (available on P&M website)
- N-CHAR-AS-0002, Nuclear Management System
- N-COI-00120-10000, Contractor/Owner Interface Requirements For Nuclear
- N-GUID-01935-10004, Desktop Guide For Supplier Nonconformance Correction Requests (NCAR)
- N-GUID-09701-10011, Darlington Refurbishment - Safety Management Essentials
- N-INS-00120-10025, Extended Services Master Services Agreement Request For Work
- NK38-INS-09701-10001, Darlington Nuclear Refurbishment Program - Scope Control
- NK38-PLAN-01060-10003, Darlington NGS Refurbishment Project Reference Plan – Scope Definition
- NK38-NR-PLAN-09701-10001-0002, Darlington Refurbishment Planning and Controls Program Management Plan
- NK38-NR-PLAN-09701-10001-0016, Darlington Refurbishment Program Staffing Management Plan
- NK38-NR-PLAN-09701-10001-0013, Darlington Refurbishment Contract Management Plan
- NK38-PLAN-09701-10196, NR Balance of Plant Project - Risk Management Plan
- NK38-PLAN-09701-10200, Balance of Plant Project Oversight Plan
- NK38-PLAN-09701-10195 Balance of Plant For Utilizing The Extended Services Master Services Agreement
- N-MAN-00120-10001-CST, Nuclear Refurbishment Cost Management and Project Reporting
- N-MAN-00120-10001-GRB, Nuclear Projects Gated Process
- N-MAN-00120-10001-PC, Project Controls
- N-MAN-00120-10001-RISK, Nuclear Projects Risk Management Process
- N-MAN-00120-10001-RISK-04, Nuclear Refurbishment Risk Management
- N-MAN-00120-10001-RISK-06, Darlington Refurbishment Lessons Learned and OPEX Management
- N-MAN-00120-10001-RISK-07, Nuclear Refurbishment Assumptions and Decisions Management
- N-MAN-00120-10001-SCH-05, Nuclear Refurbishment Program/Project WBS Manual
- N-MAN-00120-10001-SCH-07, Nuclear Refurbishment Earned Value Management
- N-MAN-09701-10002, Nuclear Projects Oversight
- N-POL-0001, Nuclear Safety Policy
- N-PROC-MM-0010, Establishing And Maintaining Ontario Power Generation Approved Suppliers List



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- N-PROC-MP-0090, Modification Process
- N-PROC-RA-0022, Processing Station Condition Records
- N-PROG-AS-0001, Managed Systems
- N-PROG-AS-0007, Project Management
- N-STD-AS-0028, Project Management Standard
- N-STD-AS-0029, Contract Management Standard
- N-STD-AS-0030, Project Oversight Standard
- N-STD-AS-0031, Field Engineering Standard
- N-STD-MP-0009, Contractor\owner Deliverables And Activities Interface Control
- OPG-POL-0001, Employee Health and Safety Policy
- OPG-PROC-0058, Procurement Activities

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**Appendix A:**

**DSR List**

#	DSR#	Title	IIP
1	IP1220-1	Fire Protection Gaps – Fire Water	Yes
2	IP1220-2	Fire Protection Gaps – Shafts, Dampers, and Dikes	Yes
3	IP1220-3	Fire Protection Gaps – Fire Separations & Penetration Seals	Yes
4	IP1220-4	Fire Protection Gaps – Emergency Lighting	Yes
5	IP1220-5	Fire Protection Gaps – Fire Alarms	Yes
6	IP1220-6	FIRE PROTECTION GAPS	Yes
7	IP1220-14	FIRE PROTECTION GAPS	Yes
8	IP1220-18	FIRE PROTECTION GAPS	Yes
9	IP1270-1	ISR FIRE PROTECTION ISSUE D044 - FIRE ALARM SYSTEMS	Yes
10	IP1300-1	ISR FIRE PROTECTION ISSUE D225 - FIRE PROTECTION WATER SUPPLY	
11	SI0050-1	Emergency Heat Sink for Accidents – Make up to HTS	Yes
12	SI0310-2	Fission Chambers for start-up following refurbishment	No
13	SI0410-1	Modification - Adjuster Rod Shim Operation	No
14	TS0080-4	Replace DELORO Disc Hard Facing w/STELLITE 6 for MV20, 27 & 29 in All Units	No
15	TS0090-1	Overhaul and Inspect Select Main HT Pumps	Yes
16	TS0090-2	Inspect Two Representative PHT Loop Isolation/Interconnect MOVs	Yes
17	TS0090-4	Inspect Collection Tank, Vent Condenser Tank, and Collection Tank Coolers on U2	No
18	TS0090-7	Replace Cable Associated w/PHT Trip Pressure Switches	Yes
19	TS0090-9	Repack all PHT Loop Isolation/Interconnect MOVs	NO

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20	TS0090-12	Contingency - Refurbish All PHT pumps	YES
21	TS0090-13	Contingency - Overhaul / replace PHT loop/interconnect MOVs	NO
22	TS0090-14	Contingency - Extend Collection Tank Inspection to the Rest of the Units	No
23	TS0100-5	DNGS Primary Heat Transport Pressure and Inventory Control: Replace Non-Return Valve 33840-NV21 in All Units	No
24	TS0110-2	Inspect Representative SDC MOVs	Yes
25	TS0110-7	Repack All MOVs (x52)	No
26	TS0110-8	Repack Manual Valves (x32)	YES
27	TS0110-13	Contingency for MOVs	YES
28	TS0110-15	Contingency for Manual Valves	No
29	TS0220-3	Darlington Reactor Regulating: Replace Adjuster Absorbers (AA's)	No
30	TS0220-5	Darlington Reactor Regulating: Replace All RRS Flux Detectors	No
31	TS0240-10	Shutdown System 1 Process: Replace All 228 Vertical Flux Detectors	No
32	TS0260-8	Shutdown System 2 Process: Replace all SDS2 In-Core Flux Detectors	NO
33	TS0290-5	Vapour Recovery Valves	No
34	TS0320-1	Refurbish All PHT Pump Motors	YES
35	TS0360-7	DC&M Computer Software Shipment Incorporating Refurbishment Modifications	No
36	TS0360-8	Replace WIBA terminal connectors (Contingency)	Yes
37	TS0500-1	SIO: Alternate Shutdown Heat Sink	Yes
38	TS0510-1	DNGS Structures: Perform Inspections for Reactor Building Structure	Yes
39	TS0510-2	DNGS Structures: Perform Inspections for the Reactor Building Internal Structures	Yes
40	TS0510-4	DNGS Structures: Perform Inspections for Civil Structures Located in Central Control Area	Yes

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41	TS0510-6	DNGS Structures: Perform Inspections on Pumphouse Structures	Yes
42	TS0510-7	DNGS Structures: Perform Inspections on Pipes, Ducts Encasements Structures	Yes
43	TS0510-8	DNGS Structures: Inspections on EPS Buildings	Yes
44	TS0510-9	DNGS Structures: Perform Inspections For Turbine Hall and Turbine Auxiliary Bay	Yes
45	TS0510-11	DNGS Structures: Perform Inspections for the Civil Structures in the Reactor Auxiliary Bay (RAB)	Yes
46	TS0510-14	DNGS Structures: Perform Inspections for Irradiated Fuel Area	Yes
47	TS0510-16	DNGS Structures: Repair/Replacement of Reactor Building Structures (Contingency)	Yes
48	TS0510-17	DNGS Structures: Repair/Replacement of Reactor Building Internal Structures (Contingency)	Yes
49	TS0510-18	DNGS Structures: Repair/Replacement of Civil Structures Located in Reactor Auxiliary Bay (RAB) (Contingency)	Yes
50	TS0510-22	DNGS Structures: Repair/Replacement of Damaged Items in Pump-House for all Four Units (Contingency)	Yes
51	TS0510-23	DNGS Structures: Repair/Replacement of Pipes, Ducts, and Encasements (Contingency)	NO
52	TS0510-24	DNGS Structures: Repair or Replacement of the Items Found to be Unacceptable in EPS Building	Yes
53	TS0510-28	DNGS Structures: Repair/Replacement of Civil Structures Located in Irradiated Fuel Area (Contingency)	Yes
54	TS0510-29	DNGS Structures: Repair/Replacement of Civil Structures Located in Fuel Handling and Service Area (Contingency)	Yes

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55	TS0570-7	Main Power Output System: Replace multiple components for the MOT, UST and SST at the transformer terminal & switchyard (Unit 2 only - see the component list below)	No
56	TS0570-20	Main Power Output System: For the MOT Transformers - Overhaul/Replacement of the MOT 500kV Bushings (Unit 2 only)	No
57	TS0570-21	Main Power Output System: MOT Transformers - Possibility of Additional Work Required in the Transformer	No
58	TS0570-22	Main Power Output System: UST Transformers - Complete Inspection at Beginning of Refurb Outage	No
59	TS0570-23	Main Power Output System: MOT Transformers - Actions to remanufactre the Transformers (Contingency)	No
60	TS0570-24	Main Power Output System: UST Transformers - Actions to remanufactre the Transformers (Contingency)	No
61	TS0630-6	LPSW Critical Valve replacement during Refurbishment	No
62	TS0650-3	Compressed Air System: Manual Disphragm Valves	No
63	TS0780-7	Unit Islanding Modifications for Nuclear Systems: Reactor Vault HVAC	No
64	TS0840-4	Layup Modification for LPSW System Outage	No
65	TS0900-2	EQ Cable Replacement (Potential) In The Vault: Identification of Cable Material	No
66	TS0900-3	EQ Cable Replacement (Potential) in the Vault	No

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67	TS0980-2	Low and Medium Voltage Cables Replacement: Perform Aging Assessment for Selected Low Voltage Cables	No
68	TS0980-3	Low and Medium Voltage Cables Replacement: Perform Aging Assessment for Selected Medium Voltage Cables	No
69	TS0980-4	Low and Medium Voltage Cables Replacement: Field Replacement of Cable	No
70	TS0990-1	Electrical Penetration (Signal and Power) Modules Replacement: Critical Containment Penetrations Locations	No
71	TS0990-4	Electrical Penetration (Signal and Power) Modules Replacement: Field Replacement of Penetration Modules	No
72	TS1070-3	Moderator & Auxiliaries System-Part 2: Replacement of Isolating Valves	Yes
73	TS1370-2	Vapour Recovery - Part 3: Replacement of VVRS 3-Way AOV's	No
74	TS1450-1	OVERHAUL SEAT RING AND DISK FOR MODERATOR CHECK VALVES	Yes
75	TS1450-2	REPLACE SEAT RING AND DISK FOR MODERATOR CHECK VALVES	YES
76	TS1590-1	INSPECTION OF STANDBY GENERATOR BUILDINGS	Yes
77	TS2180-1	CALANDRIA RELIEF DUCT INSPECTION	No
78	TS2180-2	CALANDRIA RELIEF DUCT INSPECTION	No
79	TS2250-1	32110-NV37 / 32510-NV11 INSPECTION	NO
80	TS2250-2	32110-NV37 / 32510-NV11 Contingency Repair/Replace	No
81	TS2300-1	Replacement of VBO ECI NV's	No
82	TS2440-1	Reaplacement of VVRS Primary Containment Boundary Valves and Relocation of the VVRS Secondary Containment Boundary	No

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83	TS2550-1	Replacement of Degraded Carbon Steel Piping L15 in ESW System Due to MIC Corrosion During Refurbishment Outage	No
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Note – DSR TS0840-4 (LPSW emporary mod) transfered over to BoP I/P in the DSR database

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## Appendix B: Project Organization

Project Sponsor: Vice President, Nuclear Refurbishment Execution

### Accountabilities:

- Ensure the program is fully staffed
- Ensure adherence to Nuclear Refurbishment Program
- Administer quarterly Executive Oversight Meetings. Address any concerns escalated in a timely fashion

### Project Director,

The BoP Project Director has the accountability for all aspects of the Project including:

- Environment, Health & Safety
- Scope
- Schedule
- Cost
- Risk
- Quality
- Staffing & Resources
- NR Program Governance adherence
- Reporting & Communications
- Oversight
- Contract Adherence

### Project Manager

Each BoP Project Manager has the overall accountability for the successful delivery of their sub-bundle projects which includes:

- Environment, Health & Safety
- Scope
- Schedule
- Cost
- Risk
- Quality
- Stakeholder Management
- Communications & Reporting



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- Vendor oversight

#### Project Controls Lead

The Project Controls Lead is accountable to:

- Ensure project conforms to NR Program Governance, supported by routine quality checks and self assessments
- Liaising between functions and project including centers of excellence
- Cost Management
- Schedule Management
- Risk Management
- Change Management
- Gated Process including budget loads and baselines
- Reporting including Earned Value
- Analysis and Forecasting
- Business Planning
- Project Tools including IT tools, processes and instructions
- EPC contractor integration within OPG system

#### Procurement Lead

The Procurement Lead will be accountable to:

- Be the single point of contact with the EPC contractor for all procurement related matters
- Hold the Contractor accountable to complete procurement activities in accordance with the correct QA requirements, procedures and programs
- Coordinate OPG conducted audits and attend as required
- Arrange for OPG participation in and oversee contractor audits of sub-contractors as required
- Ensure oversight of EPC contractors sub-contractors procurement process
- Ensure materials and services are procured per schedule
- Ensure and coordinate resolution of any Non-Conformances

#### Engineering Lead

The Engineering Lead will be responsible for:

- Ensuring that the ECC process required is defined, understood, reflected in the schedule and implemented per process
- Provide resources and context to perform adequate document reviews within the contractual time frame allotted

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- Ensuring resources and context to perform adequate oversight of EPC contractors to ensure project objectives for cost, scope, schedule, and quality are met
- Attend COMS reviews and ensure OPEX is embedded in the Engineering deliverables
  - Ensure scope is defined, understood and managed per the applicable scope management governance
  - Ensure all risks associated with Modifications are identified in RADAR per appropriate governance; mitigating actions are prepared tracked monthly and updated as required
  - Identify, coordinate and solicit all stakeholder inputs to engineering deliverables reviews

#### Project Submittals

Accountabilities regarding project submissions for OPG staff are outlined below. The main responsible groups are Nuclear Refurbishment Records and Document Management group (NR RDM), Document SPOC and document reviewers.

#### NR RDM

- Accountability for support on project submissions to the project team resides with the NR Records & Document Management (RDM) group

#### RDM

- Handles day-to-day transactional responsibilities, including being the medium between the project team and EPC contractors for transaction of submissions related to SDH. RDM also support the initiation, tracking and closure of SharePoint workflows related to document reviews.

#### Document SPOC

- The document SPOC can be the Project Leads or other person delegated responsibility for coordinating documents reviews. The Project Lead is accountable to ensure the document is reviewed by the appropriate stakeholders and for ensuring the review is completed within the specified time.

#### Reviewers

- Reviewers of project submissions, as designated by the Project Lead via review workflows, are responsible for their review of a project submission per the indicated timeline on the workflow.

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**Appendix C:**

**IIP Scope/DSR List**

<b>IIP Item #</b>	<b>IIP Activity Description</b>	<b>DSR</b>
IIP-CC 028	Overhaul X-32110-NV3/4/9/10/23/24/28 with new seat and disk material. Replace X-32210-NV112 in all units.	TS1450-1
IIP-CC 029	Replace the following isolating valves 1/2/3/4-63253-V52/53 and 1/2/3/4-32110-V5, V6, V21, V22, V25, V26 and 1/2/3/4-32110-MV1, MV7, MV8, MV11, MV12, MV31, MV32	TS1070-3
IIP-CC 050	Inspect 5 representative MOVs on Unit 2	TS0110-2
IIP-CC 050	Disassemble and inspect removed valves to determine path forward for remaining units Provide an inspection and rehab strategy prior to and after inspections are complete in Unit 2	TS0110-2
IIP-CC 050	Inspect 4 representative valves in U1, U3 & U4	TS0110-2
IIP-CC 050	Inspect MOV intergate drain lines	TS0110-2
IIP-CC 050	Replace bellows sealed valves 33410-MV28 MV97 in Unit 2	TS0110-2
IIP-CC 051	Complete an engineering assessment of manual valves to determine if repacking is required. Repack the SDC manual valves as required.	TS0110-8
IIP-CC 037	Replace the cables associated with PHT trip pressure switches and perform any corrective maintenance for switch modules and pressure switches in all units.	TS0090-7
IIP-CC 039	Inspect 2-32110-P3 and fix gasket leaks. Repair gasket leaks on 1-32110-P2. Inspect one Unit 3 pump and repair/replace if required.	TS0090-12
IIP-OI 001	Upgrade the station fire alarm system to allow transfer of the fire alarm to the secondary control areas where applicable alarms will be displayed.	IP1270-1
IIP-OI 001	Add fault isolation modules where missing from stairwells.	IP1270-1
IIP-OI 002	Complete an analysis to determine where modifications to the Fire suppression system are required and make any required modifications.	IP1220-2
IIP-OI 003	Complete an additional analysis to determine if seismic restraints are required for fire extinguishers located in the areas specified by the clause. Install any required seismic restraints for fire extinguishers.	IP1220-6

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IIP-OI 004	Complete an evaluation of the existing SG combustible fuel oil tanks secondary containment dykes to confirm that the dyke's permeability is not deteriorating. Correct any deficiencies.	IP1220-14
	Additionally, inspect the Standby Generator and Emergency Power Generator combustible fuel oil tanks secondary containment penetration locations to confirm their integrity is not deteriorating. Correct any deficiencies.	IP1220-14
IIP-OI 019	Replace door S-213A to the laundry room shaft in room S-213 with a listed and labelled fire door having a rating of not less than 45 minutes.	IP1220-2
IIP-OI 022	Provide emergency lighting in the Fuel handling Transfer Chamber S120	IP1220-4
IIP-OI 023	Protect the Fire and Smoke Detection system cabling located above the instrument air compressors in R-108.	IP1220-18
IIP-OI 024	Perform a review of penetration seals larger than a single cable, a single tube, or 13mm mm wide construction joint seal, in required fire separations to confirm that listed fire stopping materials are used. Replace unlisted materials if they have been used.	IP1220-3
IIP-OI 025	Install fire dampers in ducts penetrating Service Shafts S-289 and S-290 on the 107.5m and 110.9m elevations in the CSA, in the normally occupied areas.	IP1220-2
IIP-OI 027	Install fire dampers at the duct penetrations of vertical service shafts S-289 and S-290 between the Central Services Area 107.5m and 110.9m elevations in normally occupied areas and seal any penetrations	IP1220-2
	Enclose the top of the two laundry shafts in rooms SM-215 and SM-208 by construction that would provide a 1 h fire separation	IP1220-2
IIP-OI 029	Complete an assessment of the Emergency Power Generators and Lube Oil tanks conditions to confirm the tanks suitability for the extended life of the station. Correct any deficiencies.	IP1220-14
IIP-OI 030	Complete the following actions related to Valves Controlling Water Supplies: 1 - test all private service main control valves to confirm operability	IP1220-14

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	2 - Replace the unlisted hoses downstream of the fire pumps with listed devices that will have an appropriate pressure rating or implement an alternate compliance	IP1220-14
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# Nuclear Program

## TITLE

## CONDUCT OF ENGINEERING

## AUTHORIZATION

OWNER: S. Lawrence  
Manager, Engineering Mechanics

APPROVAL FOR ISSUE: R.J. MacEacheron  
Director, Nuclear Regulatory Affairs

AUTHORIZATION AUTHORITY: M. Elliott  
Senior Vice President, Nuclear Engineering and  
Chief Nuclear Engineer

COMPLIANCE DATE: Immediate (See Exceptions)

## PURPOSE

This program provides a framework, which includes programs, standards, procedures and instructions, for performing engineering in a consistent manner across Ontario Power Generation Nuclear, (hereafter referred to as Nuclear). The program establishes the following practices for engineering:

- Ensures each plant and nuclear waste management facility configuration is maintained in accordance with the design and licensing bases, and operated within its Safe Operating Envelope (SOE). In the case of nuclear waste management facilities, the applicable term is Safety and Design Envelope in place of SOE which is used throughout this document.
- Ensures essential plant and nuclear waste management facility equipment performs safely and reliably.
- Complies with relevant legal, statutory, and regulatory requirements.
- Encourages continuous improvement in the conduct of engineering targeted at achieving safe, reliable, and competitive operation of nuclear power generating stations and nuclear waste

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management facilities.

Note: The words “facility” and “plant” are used interchangeably in this document.

### SCOPE

This program is applicable to organizations performing engineering activities within Nuclear. This includes contractors and design agencies performing engineering activities on behalf of Nuclear unless these organizations are performing these activities in accordance with a Quality Program approved by Ontario Power Generation (OPG).

This program does **not** apply to facilities, systems, equipment, and buildings, governed by N-PROG-MA-0024, Conduct of Nuclear East Facilities Maintenance and Engineering, under the authority of Projects and Modifications.

### EXCEPTIONS

The compliance date for Nuclear Waste Engineering Division and Nuclear Waste Design Engineering Department is December 31, 2012.

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### 1.0 DIRECTION

#### 1.1 Overview

N-PROG-MP-0007, and interfacing Engineering programs, standards, and procedures are consistent with the expectations established in:

- N-CHAR-AS-0002, Nuclear Management System
- N-POL-0001, Nuclear Safety Policy
- Codes and standards of record, including those of the Canadian Standards Association (CSA) [B-1] [B-2]
- Applicable regulatory and statutory requirements, including those of the Canadian Nuclear Safety Commission (CNSC)
- Guidelines of the Institute of Nuclear Power Operations (INPO) and the World Association of Nuclear Operators (WANO). [B-3]

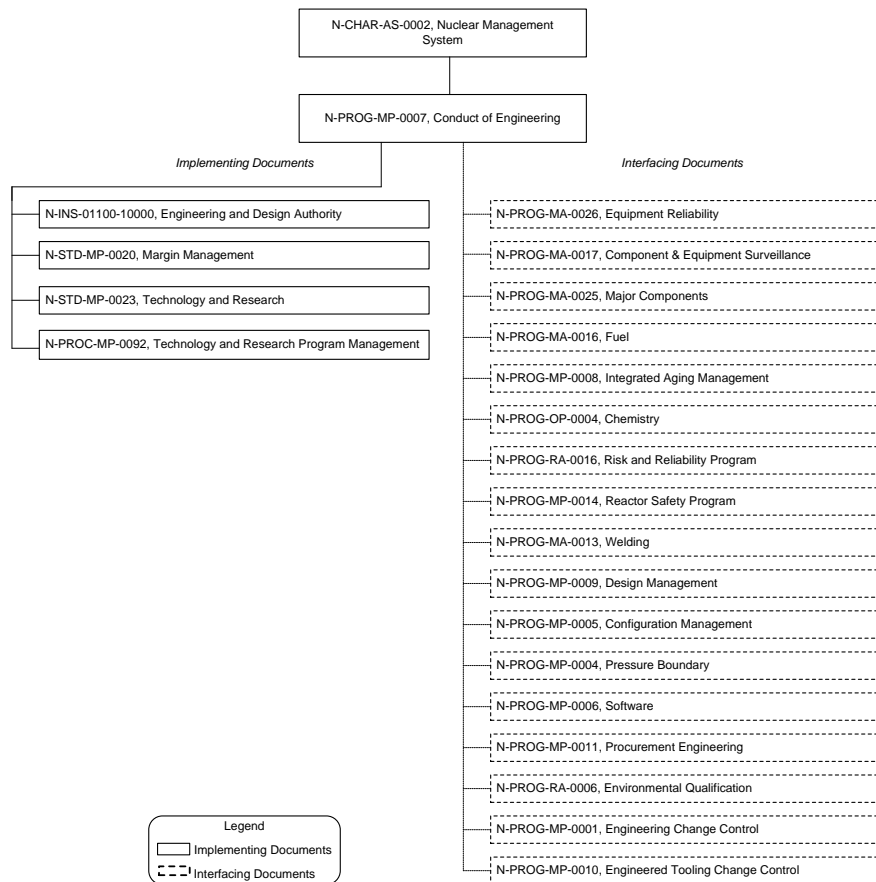
Figure 1, Conduct of Engineering Program Governance and Interfacing Documentation, provides a diagram of the Conduct of Engineering governance framework. It shows the implementing and interfacing documents.

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**FIGURE 1. Conduct of Engineering Program Governance and Interfacing Documentation**

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### 1.2 Engineering Program Requirements

- 1.2.1 Every Nuclear staff member, engaged in engineering activities, shall accept the unique and grave responsibility inherent in using nuclear technology, including great respect for the reactor core, its stored energy, decay heat, radioactive by-products, and spent nuclear fuel.
- 1.2.2 Engineering personnel at all levels of the organization shall consider nuclear safety as the overriding priority over schedule, cost, and production. Decisions and actions are based on this priority. Engineering Vice Presidents, Directors, and Managers follow-up to verify nuclear safety concerns receive appropriate attention.
- 1.2.3 Each member of the Engineering organization is expected to take responsibility for, and be committed to, protecting the operating, design and safety margins, and defence-in-depth. The work environment, attitudes and behaviours of engineering personnel, and programs, standards, and procedures shall foster this safety culture.
- 1.2.4 Engineering personnel practice the use of engineering human performance event free tools to implement barriers to minimize the occurrence of errors. These tools include, but are not limited to the following:

- Validation of Assumptions
- Questioning Attitude
- Pre-job briefing and Post-Job debriefing
- Peer *Review* and *Verification*
- Precision in Communication and *Signature*

Details of when and how to use these tools, are described in N-GUID-01900-10000, Human Performance Event Free Tools for Knowledge Work.

- 1.2.5 Whenever questions are raised, confusion exists, or change is required, Engineering staff should seek resolution and not proceed until resolution is achieved in accordance with approved change control processes.
- 1.2.6 Part of executing Nuclear business with integrity includes being duly diligent in checking that information which is signed for is correct and holding those that prepared, *reviewed*, *verified* or *approved* the work, to the highest standard in that area. Engineering *signatures* indicate that the product meets this quality standard. All signatories of a document are held accountable for the work they performed. The following standards are applicable to the preparation, verifications and approval *signatures* of design outputs.
- (a) Design outputs shall be prepared and signed by individuals fully *qualified* to execute the task. Personnel not fully qualified may be identified as a contributor as evidence of experience.

**Note:** A contributor may provide their signature as a co-signer or note in the document (e.g. list of contributors) to indicate their contribution.

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- (b) Design outputs shall be independently verified by *qualified* individuals. Individuals assigned to perform verification shall not verify their own work, or work they have directly supervised.
  - (c) Approvers should be the line managers of the preparers.
  - (d) Approvers may also perform verification subject to (b) above.
- 1.2.7 Identification and discussion of safety concerns are encouraged, rewarded, and aggressively pursued to resolution. Where warranted, early communication of potential concerns to senior management is also expected and encouraged.
- 1.2.8 Engineering actions arising from internal OPG departments or organizations external to OPG are documented, assessed, and tracked.
- 1.2.9 Adverse conditions are identified and corrective action plans are developed in accordance with N-PROC-RA-0022, Processing Station Condition Records.
- 1.2.10 Engineering staff should act in accordance with the following INPO principles of Technical Conscience taken from INPO 10-005 [B-3]:
- (a) **Engineers Identify, Communicate, and Advocate Resolution of Technical Concerns.** Engineers identify trends and emerging technical issues, communicate concerns, advise management of potential consequences, and advocate their solution of conditions that affect design requirements or operating, design, or safety margins.
  - (b) **Engineers Adhere to Sound Engineering Principles.** Engineers ensure products are of high quality when they “sign off” on the product as complete. Engineers develop technical products, recommendations, and decisions using appropriate facts, engineering practices, codes, standards, operating experience, and *review* and *verification* processes. The probabilities and consequences of negative outcomes are thoroughly evaluated, documented, and communicated.
  - (c) **Engineers Challenge Conditions and Decisions When Needed.** Engineers professionally challenge the technical bases of decisions that might compromise nuclear safety or design requirements. In decisions, engineers advocate actions to preserve and recover operating and design margins to support reliable operation. Advocacy positions are formulated based on the best available technical facts, codes, standards, and analytical techniques. For decisions that affect reliability, engineers ensure that technical considerations are given appropriate priority and that decision-makers thoroughly understand the probability and potential consequences of problems.
- 1.3 **Engineering Management and Leadership**
- 1.3.1 Engineering Vice Presidents, Directors, and Managers shall, by leadership, commitment, and example, comply with and implement standards of performance established by Engineering programs, standards, and procedures.
- 1.3.2 Engineering Vice Presidents, Directors, and Managers should practice effective communication with their staff, hold planned and periodic staff meetings, and communicate

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priorities to affected personnel. This includes clear and frequent communication to staff not to proceed in the face of uncertainty.

- 1.3.3 Engineering Directors and Managers should routinely monitor, observe, and assess engineering work activities and conditions to maintain and reinforce high standards of performance. Assessments include:
  - Effectiveness of Engineering programs, standards, and procedures
  - Human performance
  - Work management practices and resource requirement
  - Staff training and qualification requirements
  - System status and configuration control
  - Modification initiatives
  - Adherence to safety and radiological protection procedures
  - Overall equipment performance and material condition
  - Quality of services and products provided by consultants, contractors, and vendors
  - Effectiveness of execution of engineering accountabilities for maintaining the SOE and the Design Basis of the station.
- 1.3.4 Engineering work should be identified, prioritized, planned, dispositioned, performed, and documented.
- 1.3.5 Engineering personnel should use relevant Operating Experience (OPEX) while planning and performing their work in accordance with N-PROG-RA-0003, Corrective Action.
- 1.3.6 Self-assessment measures, oversight techniques, and engineering-related performance indicators should be used to compare actual engineering performance to established standards of excellence, management expectations, and promptly address negative trends and areas needing improvement in accordance with N-PROC-RA-0097, Self-Assessment and Benchmarking.
- 1.3.7 Engineering Directors at each facility should establish an Engineering Review Board. The focus of this group is unit and station risk. Details are provided in N-GUID-01900-10001, Engineering Decision Making and includes consideration of the following:
  - Significant Station Condition Records (SCRs)
  - Technical Operability Evaluations (TOEs)
  - Discovery Issue Resolution Processes (DIRPs)
  - Operational Decision Making (ODM) actions
  - Engineering Decision Making (EDM) actions.

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Also considered are the impacts of these items on facility SOE, margins, *Design Basis*, Licensing Basis and aggregate risk.

- 1.3.8 Engineering Vice Presidents, Directors, and Managers should support justified improvements in system design margins by modification, replacement, test, inspection, or by modification of technical procedures.
- 1.3.9 Engineering leaders should act in accordance with the following INPO principles of Technical Conscience taken from INPO 10-005 [B-3]:
- (a) **All leaders Respect and Reinforce the Importance of Technical Considerations in Decision-Making.** Corporate and facility leaders understand, respect, promote, and reinforce the importance of technical considerations to ensure decisions reflect the need to operate and maintain the facility in accordance with design requirements and ensure preservation of operating, design, and safety margins. Leaders understand the need to apply conservative technical considerations in matters that affect nuclear safety and ensure the appropriate balance between technical considerations and business needs in matters that affect reliability. In all cases, leaders accept the responsibility to create a safe, positive environment for the identification and resolution of technical issues as part of the decision making process.
  - (b) **Engineering Leaders Accept and Exercise Technical Authority.** Engineering leaders recognize and accept their responsibility to address technical issues. They exercise a deep sense of personal obligation to uphold the design requirements and ensure appropriate operating, design, and safety margins are maintained.
- 1.4 **Implementing Documents**
- 1.4.1 **N-INS-01100-10000, Engineering and Design Authority**
- N-INS-01100-10000, Engineering and Design Authority, provides guidance on how to exercise and delegate Engineering Authority and Design Authority accountabilities. It also provides an explanation of Engineering *advice* and guidance on how to document Engineering *direction*.
- 1.4.2 **N-STD-MP-0020, Margin Management**
- N-STD-MP-0020, Margin Management, outlines expectations for the management of operating and design margins to support safe and reliable operation.
- N-INS-03600-10001, Margin Management Implementation, provides instruction and guidance for the implementation of N-STD-MP-0020.
- 1.4.3 **N-STD-MP-0023, Technology and Research**
- N-STD-MP-0023, Technology and Research, establishes the processes for effective management of Research and Development programs for Nuclear in support of safe, reliable and competitive performance of Nuclear Facilities. This standard establishes the scope, requirements and processes that govern consistent inputs, activities and outputs of all stakeholders to form an integrated managed system.

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#### 1.4.4 N-PROC-MP-0092, Technology and Research Program Management

N-PROC-MP-0092, Technology and Research Program Management, describes the life cycle and associated stakeholder activities for the development and implementation of Research and Development programs for Nuclear, starting from issue identification through program development, execution, application, close-out, and evaluation.

#### 1.5 Engineering Programs that Protect the Asset (Interfacing Documents)

##### 1.5.1 Preamble

- 1.5.1.1 This section outlines the Engineering programs that have been implemented in order to help protect the station assets.
- 1.5.1.2 Reliability is achieved by putting in place business processes that:
- Determine the condition of SSCs
  - Predict expected failure
  - React to the results in a timely manner.
- 1.5.1.3 Surveillance programs have been implemented to provide effective system performance monitoring, component and program health reporting, equipment performance trend reporting, and effective troubleshooting.
- 1.5.1.4 These processes are applied to equipment important to nuclear safety and power generation to ensure systems and equipment perform consistent with their design requirements. These programs establish requirements for predictive and preventative maintenance, inspection, test, surveillance, and monitoring necessary to ensure systems and equipment perform in accordance with their *design basis* and at levels optimum to meet needs of the business.
- 1.5.1.5 Tracking and trending of system and equipment performance, maintenance history, internal and external shared OPEX, and lessons learned from root cause analysis of critical equipment failures are used to determine any changes to design, maintenance, or operating practices necessary to achieve target reliability.

##### 1.5.2 N-PROG-MA-0026, Equipment Reliability

N-PROG-MA-0026, Equipment Reliability ensures the ongoing high levels of reliable performance of components and equipment important to nuclear safety, production, and environmental protection through the implementation of the following program elements:

- Identification of critical components
- Specifying and continuously improving maintenance strategies
- Executing predictive and preventative Maintenance
- Monitoring system and component condition and implementing plans to restore and maintain system and component health



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- Initiating prompt and effective corrective action for equipment failures
- Identifying and predicting aging and obsolescence issues.

### 1.5.3 N-PROG-MA-0017, Component and Equipment Surveillance

N-PROG-MA-0017, Component and Equipment Surveillance, provides requirements for establishing component programs that manage component health. Major components such as steam generators, fuel channels, and reactor components (including feeders) are not included in this program. Requirements include:

- Inspection.
- Maintenance.
- Certification.
- Testing.
- Defining interfaces with other engineering programs that can affect component health.

### 1.5.4 N-PROG-MA-0025, Major Components

N-PROG-MA-0025, Major Components, establishes a formal and systematic process in Nuclear for managing information related to four major component areas: Feeders, Steam Generators, Fuel Channels, and Reactor Components and Structures. This program provides a framework for integrating and *reviewing* existing governance and reporting of the component performance, condition, and compliance with *design basis* documents. This hierarchy of documents, procedures, and other governance ensures the four major components perform safely and reliably over the life of the stations maintaining the design and licensing basis and the operational safety requirements while optimizing production and cost-effectiveness.

### 1.5.5 N-PROG-MA-0016, Fuel

N-PROG-MA-0016, Fuel, establishes requirements to integrate and *review* nuclear fuel related data in order to ensure fuel performs safely and reliably over the life of the stations, consistent with design and licensing bases, while optimizing station reliability, production, and cost effectiveness.

Fuel related data includes any information which may impact fuel throughout its life-cycle including (but not limited to) manufacturing, inspection, research, station operating conditions, and fuel channel interactions. Also included is fuel channel data which may impact safety analysis, or the safety report. This program does not include responsibilities for fuel channel life-cycle management and fitness for service which are covered by N-PROG-MA-0025, Major Components.

### 1.5.6 N-PROG-MP-0008, Integrated Aging Management

N-PROG-MP-0008, Integrated Aging Management, provides the following:

- (a) Timely detection and mitigation of significant aging effects in SSC important to safety, reliability, and economics.
- (b) A sound technical basis for the achievement of design life and possible life extension.

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- (c) An interface with the business planning program to optimize major refurbishment and modifications consistent with Nuclear business plans.

#### 1.5.7 N-PROG-OP-0004, Chemistry

N-PROG-OP-0004, Chemistry, specifies processes, overall requirements, and staff accountabilities to ensure effective control of chemistry, including the provision of analytical services.

#### 1.5.8 N-PROG-RA-0016, Risk and Reliability Program

N-PROG-RA-0016, Risk and Reliability Program, provides organizational accountabilities, interfaces, and key program elements to ensure that risk from nuclear accidents are identified, monitored and controlled across Nuclear and that the Risk and Reliability Program is consistent with OPG Nuclear Safety Policy and best practice in the industry. The Program consists of Safety Goals, station-specific Probabilistic Risk Assessments (PRAs), associated risk models, unavailability models of systems important to safety and software applications, and Nuclear governing documents.

#### 1.5.9 N-PROG-MP-0014, Reactor Safety Program

N-PROG-MP-0014, Reactor Safety Program, defines the following:

- (a) Organizational responsibilities and key program elements for the management of issues related to Nuclear Safety Analysis, in particular Generic Action Items, and major components of safe operation such as:
- SOE
  - Safety Analysis Basis (Safety Report and Analysis of Record)
  - Severe Accident Management.
- (b) Standard and consistent methodologies for performing safety analysis and defining the SOE are developed and managed.
- (c) Requirements for implementation of the results of safety analysis and specification of SOE by the station Reactor Safety Engineering Departments.
- (d) When the ability of a SSC to carry out its safety-related function is questioned, a TOE is performed in accordance with N-PROC-MP-0045, Technical Operability Evaluation.
- (e) When the Safety Analysis of a Nuclear station is suspected to be less than adequate, a DIRP is performed in accordance with N-PROC-RA-0094, Discovery Issue Resolution Process.

#### 1.5.10 N-PROG-MA-0013, Welding

N-PROG-MA-0013, Welding, establishes standardized welding practices to safely and efficiently make sound welds that meet structural integrity, code and licensing requirements. This program also covers welding on components not governed by codes and standards.

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## 1.6 Engineering Programs that Control Design (Interfacing Documents)

This section outlines the Engineering programs that have been implemented to control station design.

Design changes are controlled to ensure the configuration is maintained in conformance with design and licensing bases. This maintains margins and ensures operation within the safe operating envelope.

### 1.6.1 N-PROG-MP-0009, Design Management

N-PROG-MP-0009, Design Management, provides the following:

- (a) Framework for the establishment, maintenance, and compliance with the *design basis* for Nuclear stations, including fidelity with the licensing basis.
- (b) Design Management provides assurance that the risk to Nuclear stations is minimized, for design and procedure changes, by preserving the *design basis*.
- (c) This program provides assurance that design and procedure changes are prepared, *reviewed, approved*, documented, and implemented in accordance with *approved* procedures, applicable regulatory requirements, standards, and industry practices.

### 1.6.2 N-PROG-MP-0005, Configuration Management

Configuration Management is an integral part of the change control processes, encompassing selected SSCs, computer software, electronic information, and documents important for safe and reliable operation.

- (a) Changes to configuration shall be controlled to maintain conformance between the *design basis*, license basis, SOE, and associated analyzed conditions.
- (b) N-PROG-MP-0005, Configuration Management, provides the framework to ensure:
  - (1) Physical configuration matches configuration documentation (documents or electronic data).
  - (2) Configuration control scope, responsibilities, authorities, and interfaces among all pertinent organizations in Nuclear are clearly defined.
  - (3) Changes are effectively managed by:
    - (i) Confirming proposed changes to any SSC, or element of configuration information conform to design and licensing bases, by specifically ensuring changes requiring regulatory *review, approval* and concurrence are identified, and if necessary, additional licensing *reviews* and safety evaluations are completed.
    - (ii) Ensuring proposed changes requiring a change to design and licensing bases receive appropriate *verification* and *approvals* before a change is made.

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- (iii) Ensuring proposed changes made to any physical configuration or element of configuration information be *reviewed* for impact so related configuration information is maintained consistent with the change.
- (iv) Managing changes from one configuration baseline to another to ensure configuration information is accurate, consistent, up-to-date, and readily accessible to Nuclear users of the information.
- (v) Ensuring change processes resulting in a change from one configuration baseline to a subsequent configuration baseline, work in accordance and consistency with each other for design, procurement, construction, installation, commissioning, operating and maintenance aspects of the station, including testing activities.
- (vi) Maintaining the documented configuration equivalent to the physical configuration through N-PROG-AS-0006, Records and Document Control.

#### 1.6.3 N-PROG-MP-0004, Pressure Boundary

N-PROG-MP-0004, Pressure Boundary, provides a managed process for performing repairs, replacements, and modifications on pressure retaining systems and components, including installation of new self-contained systems, at Nuclear facilities as follows:

- (a) Ensures compliance with applicable CSA Standards and American Society of Mechanical Engineers (ASME) Codes, Nuclear Station Power Reactor Operating Licenses (PROL) and Waste Facility Operating License (WFOL).
- (b) Allows nuclear facilities to plan, perform, and verify pressure boundary fieldwork as *authorized* by N-MAN-01913.11-10000, Pressure Boundary Program Manual.

#### 1.6.4 N-PROG-MP-0006, Software

N-PROG-MP-0006, Software, identifies the processes and overall requirements for development, maintenance, modification, procurement, qualification, and retirement of both real-time computing and analytical software. Quality Assurance (QA) for scientific, engineering and analysis software is performed in accordance with CSA N286.7 **[B-3]**.

#### 1.6.5 N-PROG-MP-0011, Procurement Engineering

N-PROG-MP-0011, Procurement Engineering, establishes requirements for a managed process of creating procurement specifications for materials, systems, components and services. "Services" refers to repair or refurbishment services performed on an item in the material catalogue. The Procurement Engineering function is to specify clear and adequate procurement requirements. Procurement Engineering activities will interface with other programs within the procurement chain in order to ensure purchased items perform their intended end-use design function(s).

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### 1.6.6 N-PROG-RA-0006, Environmental Qualification

N-PROG-RA-0006, Environmental Qualification, provides auditable assurance that essential safety related equipment, required to mitigate the consequences of a *design basis* accident, can perform its intended function when exposed to harsh environmental conditions resulting from that accident. Environmental Qualification includes programmatic controls necessary to maintain the qualified status of the equipment over the life of the facilities and ensures compliance with applicable CSA N290.13-05 and Update 1, and nuclear generating station power reactor operating license.

### 1.6.7 N-PROG-MP-0001, Engineering Change Control

N-PROG-MP-0001, Engineering Change Control, establishes procedural and management controls to ensure modifications to SSCs and engineered tools are controlled to be:

- (a) Within the SOE, *design basis* and licensing conditions, and to receive the appropriate *reviews* and *approvals*.
- (b) Designed in accordance with relevant codes and standards.
- (c) Designed to meet Nuclear objectives for safe, reliable, and cost effective energy production.
- (d) Performed with a graded approach to design and changes, where the rigor is consistent with the modification's effect on nuclear, environmental, and conventional safety, equipment and production risk, and safeguards and security.
- (e) Performed with sufficient analysis to be safe for foreseeable modes of operation.

**Note:** This includes modifications made outside the controlled plant boundary (CPB) and under N-PROG-MA-0024. It ensures that possible impacts on SSC's located within the CPB are addressed.

- (f) Performed such that sufficient operating and design margins are maintained.
- (g) Adequately *reviewed* by stakeholders and *approved* by Design Authority.
- (h) Installed in accordance with *approved* design and installation requirements.
- (i) Commissioned and tested in accordance with acceptance criteria as specified in commissioning specifications.
- (j) Made available for long-term operation and maintenance in full compliance with Nuclear standards and requirements.

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### 1.7 Engineering Programs that Provide Services (Interfacing Documents)

#### 1.7.1 N-PROG-MP-0010, Engineered Tooling Change Control

N-PROG-MP-0010, Engineered Tooling Change Control, provides *direction* for the design, and modification, of engineered tools by the stations and by Inspection and Maintenance Services (IMS) to provide safe and reliable equipment as follows:

- (a) Defines a systematic approach and changes to tool design.
- (b) Ensures tool designs and subsequent changes are *reviewed* by competent individuals and *approved* by the appropriate authority.
- (c) Ensures tools are designed, built, tested, and proven to stated requirements.

### 1.8 Engineering Program Ownership

#### 1.8.1 Program Owner Accountabilities

Program Owner accountabilities for Engineering programs are specified in N-PROG-AS-0001, Managed Systems. These include the following:

- (a) Seek involvement and input of key stakeholders.
- (b) Ensure compliance with internal and external requirements.
- (c) Lead business and strategic planning in program area.
- (d) Provide program oversight through monitoring and reporting on program.
- (e) Manage and communicate program requirements.

#### 1.8.2 Conduct of Engineering Working Group

Where deemed necessary, the Conduct of Engineering working group and other working groups are established in accordance with N-STD-AS-0026, Peer Teams and Working Groups.

### 1.9 Performance Indicators and Review

#### 1.9.1 Performance Reporting

- (a) N-PROC-RA-0023, Fleetview Program Health and Performance Reporting, documents a fleet-wide functional *review* and reporting process performed to monitor and routinely report on overall program effectiveness. The reports document the health of each program and contribute to meeting the requirements of CSA N286-05.
- (b) The reports include the following key areas:
  - Program oversight and leadership
  - Program execution performance indicators
  - Status of program initiatives

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- (c) The frequency is determined by the Chief Nuclear Engineer (CNO). The results are presented to the Nuclear Executive Committee by the Program SPOC or Owner in conjunction with the peer team or working group.

#### 1.9.2 Engineering Self Assessments

- (a) Engineering self-assessment activities are planned and carried out in accordance with N-PROC-RA-0097. The objective of self-assessments is to achieve continuous improvement. Current performance is compared to management expectations, industry standards of excellence, and regulatory requirements to identify areas needing improvement. Self assessments should help identify low level issues or trends for early resolution before more significant problems occur.
- (b) A divisional self-assessment should be performed for each program every four years. Stations should perform a focused self-assessment on program implementation with schedules set with stations Working Group input.
- (c) Station Engineering should conduct an annual self assessment to confirm:
  - (1) Effectiveness of the Station Engineering Director's accountability to act as the facilities overall Engineering authority, to interpret the *design basis*, to specify SOE limits, to perform aggregate assessments of risk, and to manage degradation of design margin.
  - (2) Effectiveness of continuing training on Engineering ethics and responsibility.
  - (3) Effectiveness of implementation of Engineering *direction* and recommendations.
- (d) Nuclear management should perform a self assessment to assess the use of the title "engineer" by staff at least once every five years.

#### 1.10 Personnel and Training Qualifications

- 1.10.1 N-PROG-TR-0005, Training, describes the Training Program for regular staff, contractors, temporary personnel and other staff assigned work. The Training Program provides the structure, processes, and tools for defining developing, implementing, documenting, assessing, and improving the training.
- 1.10.2 N-PROG-TR-0005 ensures nuclear staff have the appropriate knowledge, skill, and attitudes for safe and efficient operation.
- 1.10.3 Engineering managers ensure availability of staff with required core skills through effective succession planning done in accordance with N-PROC-HR-0026, Succession Management.
- 1.10.4 Engineering managers establish qualification requirements required for work in their duty areas, link staff to the Training Information Management System, Version II (TIMS II), qualification requirements required for work in their duty areas, and maintain qualifications of Design Engineers, Registered Professional Engineers, and Draftspersons.
- 1.10.5 Staff shall use the title "engineer" or "professional engineer" (P. Eng.) only if they are licensed by Professional Engineers Ontario (PEO) in compliance with the Professional Engineers Act.

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- 1.10.6 Engineering managers ensure that work is assigned to *qualified* individuals or that *qualified* individuals are assigned to work with and oversee *unqualified* contributors used during the preparation of the work. The *qualified* individuals are required to sign and take joint responsibility for the quality and accuracy of the final product. The *unqualified* contributors may co-sign or note their contribution to the final product.
- 1.10.7 Engineering managers ensure that the qualification requirements provided are specific and that they identify the need for continuing training.

## 2.0 ROLES AND ACCOUNTABILITIES

### 2.1 Chief Nuclear Engineer

- 2.1.1 Ensures Conduct of Engineering program and supporting processes are implemented and maintained across all engineering business units.
- 2.1.2 As designated Nuclear Design Authority prescribes:
- Overall requirements for the Conduct of Engineering program.
  - Scope, development, and implementation of Engineering programs.
  - Manner in which design activities are performed.
- 2.1.3 Requests audits of and monitors Nuclear Engineering activities.
- 2.1.4 Prescribes requirements and scope of station inspection and surveillance programs.
- 2.1.5 Prescribes specific actions to correct performance deficiencies.
- 2.1.6 Delegates, within specified limits and controls, station specific Engineering and Design Authority responsibilities. Delegation of Design Authority responsibilities is documented in N-INS-01100-10000.
- 2.1.7 For external organizations, providing design engineering services, ensures:
- (a) External organizations adhere to Nuclear procedures or *approved* procedures that meet the requirements of Nuclear procedures.
  - (b) Design activities are monitored and assessed.

**Note:** Any provider of outside design engineering services is considered a Design Agency, **not** a Design Authority.

### 2.2 Manager, Engineering Mechanics

- 2.2.1 Assumes Program Owner roles and accountabilities for the Conduct of Engineering program, Engineering Change Control Program, Design Management Program, Configuration Management Program and Pressure Boundary Program in accordance with N-PROG-AS-0001.



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### 2.3 Director, Engineering Services

- 2.3.1 Ensures engineering activities are performed in accordance with written and approved policies, programs, standards, and procedures that reflect the expectations of the CNO, Chief Nuclear Engineer (CNE), and all applicable rules, regulations, codes, standards, and requirements of the station operating licences.
- 2.3.2 Executes Performance Engineering, Aging Management, Design, and Project Execution roles for all plant computers, OH180 Programmable Logic Controllers (PLCs), and station perimeter security systems.
- 2.3.3 Manages the overall Equipment Reliability (ER) program, and ensuring that adequate monitoring of the ER program is occurring at the nuclear facilities so that equipment performance remains aligned with the business goals of the OPG organization.

### 2.4 Director, Nuclear Safety

- 2.4.1 Ensures engineering activities are performed in accordance with written and approved policies, programs, standards, and procedures that reflect the expectations of the CNO, CNE, and all applicable rules, regulations, codes, standards, and requirements of the station operating licences.
- 2.4.2 Accountable for the oversight of technical support and specialized services to the stations in the area of Nuclear Safety Analysis.
- 2.4.3 Provide Nuclear Safety programmatic support to Darlington Refurbishment.

### 2.5 Vice President, Engineering Strategy

- 2.5.1 Ensures engineering activities are performed in accordance with written and approved policies, programs, standards, and procedures that reflect the expectations of the CNO, CNE, and all applicable rules, regulations, codes, standards, and requirements of the station operating licences.
- 2.5.2 Perform duties as primary Nuclear Engineering liason with the IAEA and other industry groups.
- 2.5.3 Manage Engineering Projects including Probabilistic Risk Assessment (PRA), Fukushima Response and 37M Modified Fuel for Darlington.
- 2.5.4 Provide assistance to CNE in the development and implementation of strategic initiatives in Nuclear Engineering.

### 2.6 Director, Design Engineering

- 2.6.1 Ensures assigned engineering programs and activities are performed in accordance with approved policy, programs, standards and procedures that reflect the expectations of the CNE and all applicable rules, regulations, codes, standards, and requirements of the station operating licenses.

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- 2.6.2 Provides oversight of the Conduct of Engineering Program, Engineering Change Control Program, Design Management Program, Configuration Management Program and Pressure Boundary Program.
- 2.6.3 Assumes Program Owner roles and accountabilities for the Procurement Engineering, in accordance with N-PROG-AS-0001.
- 2.7 Vice President, Science and Technology Development**
  - 2.7.1 Ensures engineering activities are performed in accordance with written and approved policies, programs, standards, and procedures that reflect the expectations of the CNO, CNE, and all applicable rules, regulations, codes, standards, and requirements of the station operating licences.
  - 2.7.2 Maintains and regularly updates life cycle management plans for Feeders, Reactor Components, Pressure Tubes, and Steam Generators.
  - 2.7.3 Provides leadership on the content and direction of the Nuclear Research and Development program, and other technology development initiatives.
- 2.8 Director, Station Engineering**
  - 2.8.1 Ensures station engineering activities are performed in accordance with written and approved policies, programs, standards, and procedures that reflect the expectations of the CNO, CNE, and all applicable rules, regulations, codes, standards, and requirements of the station operating licences.
- 2.9 Director, Nuclear Waste Management**
  - 2.9.1 Ensures nuclear waste engineering activities are performed in accordance with written and approved policies, programs, standards, and procedures that reflect the expectations of the CNO, CNE, and all applicable rules, regulations, codes, standards, and requirements of the station operating licences.
- 2.10 Senior Manager, Plant Design**
  - 2.10.1 If required, ensures CNE is informed within 72 hours of actions taken where departure from applicable provisions or requirements are urgent in nature, in order to better assure Nuclear Safety or unit reliability.

## 3.0 DEFINITIONS AND ACRONYMS

### 3.1 Definitions

**Advice** means words offered as an opinion or recommendation about future actions, or knowledge input into other's deliberations. *Advice* is informal, does not necessarily require *verification* or formal record, even though it would be a good practice to document the *advice* at an immediate opportunity to prevent misinterpretation or taking the *advice* out of context. *Advice* is literally an opinion that can be used to support decisions which may require more formal assessment and *verification*.

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**Approval** ensures that the engineering product is prepared, *reviewed*, and verified by competent persons and that appropriate processes and/or procedures including codes and standards were applied as required.

**Note:** *Approval* of engineering design documentation may require a P. Eng. *signature* and seal. Such an *approval* means taking professional design responsibility for the engineering document. P. Eng. *Signature* requirements are specified in N-LIST-01300-10000, Bounded Document Set.

**Authorize** means to permit or allow the use of the engineering product by others.

**Design Basis** is the set of information that identifies the specific functions to be performed by a system, structure, or component and specific values or ranges of values chosen for controlling parameters as reference bounds for design. This includes the Safety Report and Safety Analysis.

**Direction** shows the way or provides instruction. *Direction* is formal, always in writing, and requires *verification* by an independent *qualified* person. *Direction* can be prescribed, such as in a work plan or a QA record, on letterhead or in a less formal manner such as Plan of the Day (POD) update through an e-mail provided the message identifies the persons who verified and approved the *direction*. *Direction* unless approved or *authorized* by the appropriate authority on the actual document, should always be prefixed by a phrase “This *direction* does not signify *approval* for execution which requires the *approval* from appropriate design and/or operating authority”.

**Review** is the act of providing expert input and/or feedback to a specific area of an engineering product to determine whether its content generally conforms to the design requirements.

The technical expert providing the *review* has to ensure feedback is provided to the preparer on the quality of the engineering product, and is accountable for reasonable duty of care in doing the *review* and providing the feedback. The extent of rigor applied varies depending on the context and is normally specified in the related process. The person performing the *verification* should sign as a reviewer if *review* is the only *verification* activity that occurs.

**Qualified** means being linked to and having completed the required TIMS II qualifications for the required task and being deemed competent, and experienced to perform the task independently by the manager or supervisor assigning the task.

**Signature** is a pen or electronic name or mark applied to a document or record uniquely identifying the individual having applied the name or mark.

**Verification** is the act of an individual *qualified* in the subject matter, *reviewing*, inspecting, testing, checking, or otherwise determining and documenting through evaluation of objective evidence whether the product conforms to specified requirements, including examining for the correctness of the engineering product being verified.

*Verification* activities shall be planned. Specific procedures or a *verification* plan may mandate specific *verification* activities; otherwise, select the set of *verification* activities to ensure *verification* scope and extent of rigour applied is appropriate for the context, use,

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extent, and risk level of the product. A pre-job briefing is recommended to assign the scope and form of *verification* activities to be performed. The person performing the *verification* should sign as a verifier if the *verification* activities extend beyond *review*.

### 3.2 Abbreviations and Acronyms

<b>ASME</b>	American Society of Mechanical Engineers
<b>CNE</b>	Chief Nuclear Engineer
<b>CNO</b>	Chief Nuclear Officer
<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>CPB</b>	Controlled Plant Boundary
<b>CSA</b>	Canadian Standards Association
<b>DIRP</b>	Discovery Issue Resolution Process
<b>IMS</b>	Inspection and Maintenance Services
<b>INPO</b>	Institute of Nuclear Power Operations
<b>ODM</b>	Operational Decision Making
<b>OPEX</b>	Operating Experience
<b>OPG</b>	Ontario Power Generation
<b>P. Eng.</b>	Professional Engineer
<b>PEO</b>	Professional Engineers Ontario
<b>PRA</b>	Probabilistic Risk Assessment
<b>PROL</b>	Power Reactor Operating License
<b>QA</b>	Quality Assurance
<b>SCR</b>	Station Condition Record
<b>SOE</b>	Safe Operating Envelope
<b>SSC</b>	Systems, Structures, and Components
<b>TIMS II</b>	Training Information Management System, Version II
<b>TOE</b>	Technical Operability Evaluation
<b>WANO</b>	World Association of Nuclear Operators
<b>WFOL</b>	Waste Facility Operating License

### 4.0 BASES AND REFERENCES

#### 4.1 Bases

[B-1] CSA N286-05, Management System Requirements for Nuclear Power Plants

[B-2] CSA-N286.7, Quality Assurance of Analytical, Scientific, and Design Computer Programs for Nuclear Power Plants

[B-3] INPO 10-005, Principles for Maintaining an Effective Technical Conscience.

#### 4.2 References

##### 4.2.1 Performance References

N-GUID-01900-10000, Human Performance Event Free Tools For Knowledge Work

N-GUID-01900-10001, Engineering Decision Making

N-INS-01100-10000, Engineering and Design Authority

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N-INS-03600-10001, Margin Management Implementation  
 N-LIST-01300-10000, Bounded Document Set  
 N-MAN-01913.11-10000, Pressure Boundary Program Manual  
 N-PROC-HR-0026, Succession Management  
 N-PROC-MP-0045, Technical Operability Evaluation  
 N-PROC-MP-0092, Technology and Research Program Management  
 N-PROC-RA-0022, Processing Station Condition Records  
 N-PROC-RA-0023, Fleetview Program Health and Performance Reporting  
 N-PROC-RA-0094, Discovery Issue Resolution Process  
 N-PROC-RA-0097, Self-Assessment and Benchmarking  
 N-PROG-AS-0001, Managed Systems  
 N-PROG-AS-0006, Records and Document Control  
 N-PROG-MA-0013, Welding  
 N-PROG-MA-0016, Fuel  
 N-PROG-MA-0017, Component and Equipment Surveillance  
 N-PROG-MA-0024, Conduct of Nuclear East Facilities Maintenance and Engineering  
 N-PROG-MA-0025, Major Components  
 N-PROG-MA-0026, Equipment Reliability  
 N-PROG-MP-0001, Engineering Change Control  
 N-PROG-MP-0004, Pressure Boundary  
 N-PROG-MP-0005, Configuration Management  
 N-PROG-MP-0006, Software  
 N-PROG-MP-0008, Integrated Aging Management  
 N-PROG-MP-0009, Design Management  
 N-PROG-MP-0010, Engineered Tooling Change Control  
 N-PROG-MP-0011, Procurement Engineering  
 N-PROG-MP-0013, Field Engineering  
 N-PROG-MP-0014, Reactor Safety Program  
 N-PROG-OP-0004, Chemistry  
 N-PROG-RA-0003, Corrective Action  
 N-PROG-RA-0006, Environmental Qualification  
 N-PROG-RA-0016, Risk and Reliability Program  
 N-PROG-TR-0005, Training  
 N-STD-AS-0026, Peer Teams and Working Groups  
 N-STD-MP-0020, Margin Management  
 N-STD-MP-0023, Technology and Research

#### 4.2.2 Developmental References

INPO Guideline 90-009: Guidelines for the Conduct of Design Engineering - Revision 01 - February 1992

INPO Guideline 85-031: Guidelines for the Conduct of Technical Support Activities at Nuclear Power Stations - Revision 02 - March 1992

N-CHAR-AS-0002, Nuclear Management System

N-POL-0001, Nuclear Safety Policy

N-PROC-AS-0019, Action Item Management

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N-LIST-08130-10023, CSA N286-05 to OPGN Governance, Cross Matrix

W-PROG-WM-0001, Nuclear Waste Management Program

## 5.0 REVISION SUMMARY

This is an Intent revision.

- **COMPLIANCE DATE:** Compliance date for nuclear waste engineering functions deferred until 2012-DEC-31 to accommodate transition from NWMD governance (DCR 118099).
- **PURPOSE:** Updated text to include nuclear waste management facilities (DCR 118099).
- **FIGURE 1:** Removed box labelled “N-PROG-MA-0018, Non-Destructive Examination” (DCR 116161).
- Removed box labelled “N-INS-03600-10001, Margin management Implementation” per discussion with Gov Docs.
- Added box labelled “N-STD-MP-0023, Technology and Research” (DCR 116831).
- Added box labelled “N-PROC-MP-0092, Technology and Research Program Management” (DCR 116831).
- Removed box labelled “N-PROC-MP-0012, Technology and Research” (DCR 116831).
- Removed box labelled “N-PROG-MP-0013, Field Engineering”.
- SECTION 1.2.6: Added wording specifying standard requirements for preparers, verifiers, and approvers.
- **SECTION 1.3.6:** Updated title of N-PROC-RA-0097.
- **SECTION 1.4.3:** Added section regarding N-STD-MP-0023, Technology and Research (DCR 116831).
- **SECTION 1.4.4:** Added section regarding N-PROC-MP-0092, Technology and Research Program Management (DCR 116831).
- **SECTION 1.5.7:** Removed this section regarding Non-Destructive Examination (DCR 116161).
- **SECTION 1.5.9:** Removed this section regarding N-PROC-MP-0012, Technology and Research (DCR 116831).
- **SECTION 1.6.3:** Added reference to Waste Facility Operating License.
- **SECTION 1.6.4:** Replaced the word “technical” with “analytical” (DCR 113845).

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### CONDUCT OF ENGINEERING

- **SECTION 1.6.8:** Removed this section regarding N-PROG-MP-0013, Field Engineering.
- **SECTION 1.8.2:** Text revised to replace Conduct of Engineering Peer Team with Working Group (DCR 117690).
- **SECTION 1.10.3:** Updated title of N-PROC-HR-0026
- **SECTION 1.10.4:** Specified manager's responsibilities for staff qualification.
- **SECTION 1.10.6:** Managers accountability for assigning work to qualified staff clarified.
- **SECTION 2.0:** Removed roles and accountabilities associated with Engineering and Design Authority. These roles and accountabilities are provided in N-INS-01100-10000 (DCR 116917).
- Updated roles and accountabilities to include Manager, Engineering Mechanics for ownership of Conduct of Engineering program. .
- Revised roles and accountabilities in accordance with Business Transformation (DCR 117689)
- **SECTION 3.1:** The definition of "*DIRECTION*" has been updated (DCR 115757). Added definition of Qualified.
- **SECTION 3.2:** Added CNO and WFOL to list of acronyms.
- **SECTION 4.2.1:** Removed N-PROG-MA-0018, Non-Destructive Examination (DCR 116161).
- Updated title of N-PROC-HR-0026 and N-PROC-RA-0097.
- Added N-PROC-MP-0092, Technology and Research Program Management. (DCR 116831).
- Removed N-PROG-MP-0012, Technology and Research (DCR 116831).
- Added N-STD-MP-0023, Technology and Research (DCR 116831).
- **SECTION 4.2.2:** Added W-PROG-WM-0001, Nuclear Waste Management Program.



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## Nuclear Instruction

### TITLE

**CONTRACT ADMINISTRATION IN ONCORE**

### AUTHORIZATION

SINGLE POINT OF CONTACT: John Mauti  
Director, Nuclear Reporting

AUTHORIZATION AUTHORITY: Randy Leavitt  
Vice President, Nuclear Finance

COMPLIANCE DATE: Immediate

### PURPOSE

This instruction is intended for use by the Nuclear organization in administering contracts in the Oncore Contractor Management system. The users of this instruction include contractors, Nuclear Finance, Contract Owners (COs), Contract Administrators (CAs), and Cost & Schedule Analysts (CSAs) for the purposes of administering contracts within the Oncore system. Compliance to this instruction is mandatory for administering contracts for select vendors who are setup to use the Oncore Contractor Management System.

### EXCEPTIONS

None

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### CONTRACT ADMINISTRATION IN ONCORE

## 1.0 DIRECTION

### 1.1 Introduction

This instruction documents the processes to administer contracts using the Oncore Contractor Resource Management System. The instruction provides direction on all activities that need to be performed from contract initiation through contract closeout as it relates to Contract Administration in the Oncore system. The instruction clearly identifies the roles and responsibilities of the parties involved in administration of contracts within Oncore.

Oncore helps project and cost control managers keep track of contractor costs such as labour and non-labour expenses such as equipment rentals and provides them with information to assess the performance of the contractor.

Once a contractor is setup in Oncore, all contracts/Purchase Orders (POs) issued to that contractor shall be setup and tracked in Oncore.

The processes identified in this instruction are supported by N-GUID-00150-10000, Contractor Management Guide as well as Oncore desktop user guides and the Oncore User Manual.

#### 1.1.1 Responsibility, Accountability, Consult, Information Chart

Each section of this instruction contains a Responsibility, Accountability, Consult, Information (RACI) chart indicating which role:

- Is responsible and accountable for the process
- May be consulted to support execution of the process
- Needs to be informed of decisions or outcomes of the process.

The following legend applies to these charts:

**Responsible:** Executes the process on behalf of the person accountable.

**Accountable:** Is accountable for the performance and/or completion of the process.

**Consulted:** Provide input in the form of review/advice, as required, to support the process.

**Informed:** Informed of decisions or outcomes of the process.

### 1.2 Contractor Setup

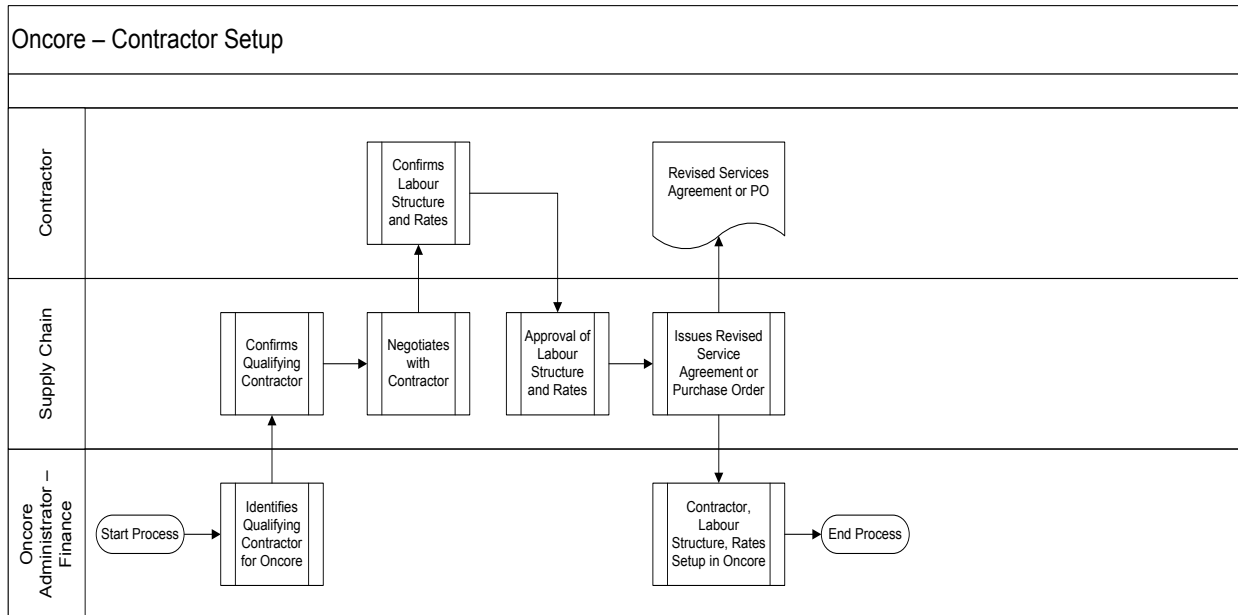
The purpose of this section is to establish the rules and processes to qualify and setup a contractor in Oncore with appropriate labour structures and rates.

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### 1.2.1 Process Overview



**Figure 1 – Contractor Setup**

### 1.2.2 Accountabilities

**Table 1 – Contractor Setup RACI Chart**

Task	Responsible	Accountable	Consulted	Informed
Identification of contractors who qualify to be setup in Oncore.	Oncore Administrator – Finance, Supply Chain, Contract Management Office	Oncore Administrator – Finance	Supply Chain	Contract Management Office
Confirms acceptability for contractor to participate in Oncore, negotiates with contractor, and issues revised Services Contract (Master Services Agreement [MSA] or Engineering Services Agreement [ESA]).	Supply Chain	Supply Chain	Contractor, Oncore Administrator - Finance	Contract Management Office
Confirmation of Labour Structure and approval of rates to be setup in Oncore	Supply Chain	Supply Chain	Contractor	Oncore Administrator - Finance
Contractor “Organization”, labour structure, and rate schedules setup in Oncore.	Oncore Administrator – Finance	Oncore Administrator - Finance	Supply Chain	Contractor, Contract Management Office

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#### 1.2.3 Qualifying a Contractor to be Setup in Oncore

- (a) In order to be setup in Oncore, a contractor shall meet **all** of the following requirements:
- (1) Perform services for Nuclear, have sufficient volume (sum total of all invoices is > \$500k per year) and performing work for Ontario Power Generation (OPG) continually throughout the year to warrant the use of Oncore. Services may include, but are not limited to, Design Agency services and Building Trades Union (BTU) trade services (Managed tasks and/or Augmented Staff Services). Services may be billable as fixed price (milestone or progress based), target price, time and material, or cost plus.
  - (2) Billings are in Canadian dollars.
  - (3) On OPG's approved suppliers list.
  - (4) Billing rates are agreed upon in advance of work performance and are generally applied annually by organization or site through the issuance of a contract or other agreement.
- (b) Once a vendor is identified, the Oncore Administrator – Finance, and Supply Chain, shall ensure the vendor meets the above qualifications prior to negotiating with the contractor to be setup in Oncore.
- (c) Only Supply Chain may negotiate with the contractor on behalf of OPG.
- (d) The Oncore Administrator – Finance shall obtain all required information from Supply Chain and the contractor representative and setup the contractor as an organization in Oncore.
- (e) Once a contractor is setup in Oncore, all work awarded to that contractor after the setup date shall be processed through Oncore.

#### 1.2.4 Contractor Rate Management

- (a) Contracts or agreements, e.g., a MSA or an ESA, are established between OPG and contractors.
- (b) A required component of these contracts is a billing rate schedule for labour and occasionally non-labour expenses such as equipment rentals. These schedules are used to establish the labour structure and rates that the contractor shall use when billing OPG within Oncore. Billing rate schedules normally include:
- A resource level, e.g., Pipefitter Apprentice 3
  - An effective period (start and end date)
  - Shift (days, afternoons, and nights)
  - Time type (straight time, overtime, double-time).

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- (c) Rates shall require periodic adjustments due to negotiated union agreements, regulatory burden changes, or annual review of rates as prescribed in the contract. When this occurs, the contractor shall forward an electronic rate table to Supply Chain.
- (d) Supply Chain shall review and negotiate rates/rate changes with the contractor and upon approval, shall update the contract with the new rate tables, and notify the Oncore Administrator – Finance.
- (e) All MSA rates shall be approved by the Manager of Contract Management - Supply Chain prior to loading into Oncore. All IM&CS vendor rates shall be approved by the IM&CS Supply Chain Manager prior to loading in to Oncore.
- (f) When possible, rate changes shall be approved by Supply Chain one month prior to the effective date of new rates so Oncore may be updated in advance to ensure that correct rates are used for contractor payments and to avoid retroactive rate changes.
- (g) Written notification (email or memorandum) of approval from Supply Chain to the Oncore Administrator – Finance shall initiate the rate setup or change process in Oncore.
- (h) The Oncore Administrator – Finance shall update the labour structure and rates in Oncore manually or by using the Oncore bulk data import utility.
- (i) Oncore Section Manager reviews and approves the rate tables.
- (j) The Oncore Administrator – Finance is accountable for setting up the correct rate tables in Oncore based on the approved rate schedules provided by Supply Chain.
- (k) Oncore shall determine the appropriate rate based on data input by the timesheet entry staff (e.g., contractor occupation, shift, time type, project and PO).
- (l) Retroactive rate changes may be required if the effective date of a new rate is in the past. The Oncore Administrator – Finance shall update the rates in Oncore.
- (m) The Oncore Administrator – Finance shall run the retroactive rate process. This process shall reverse transactions on timesheets where the rates have changed and repost with the new rates. Approved timesheets do not need to be re-approved due to rate changes.

### 1.3 Contractor Resource Setup

- (a) All Contractor resources shall first be setup in TEMPUS by TEMPUS staff.
- (b) These resources shall automatically be setup in Oncore on a nightly basis.
- (c) The vendor shall complete the OPG-Nuclear Request for Employee Number for Non-Nuclear Employees form.

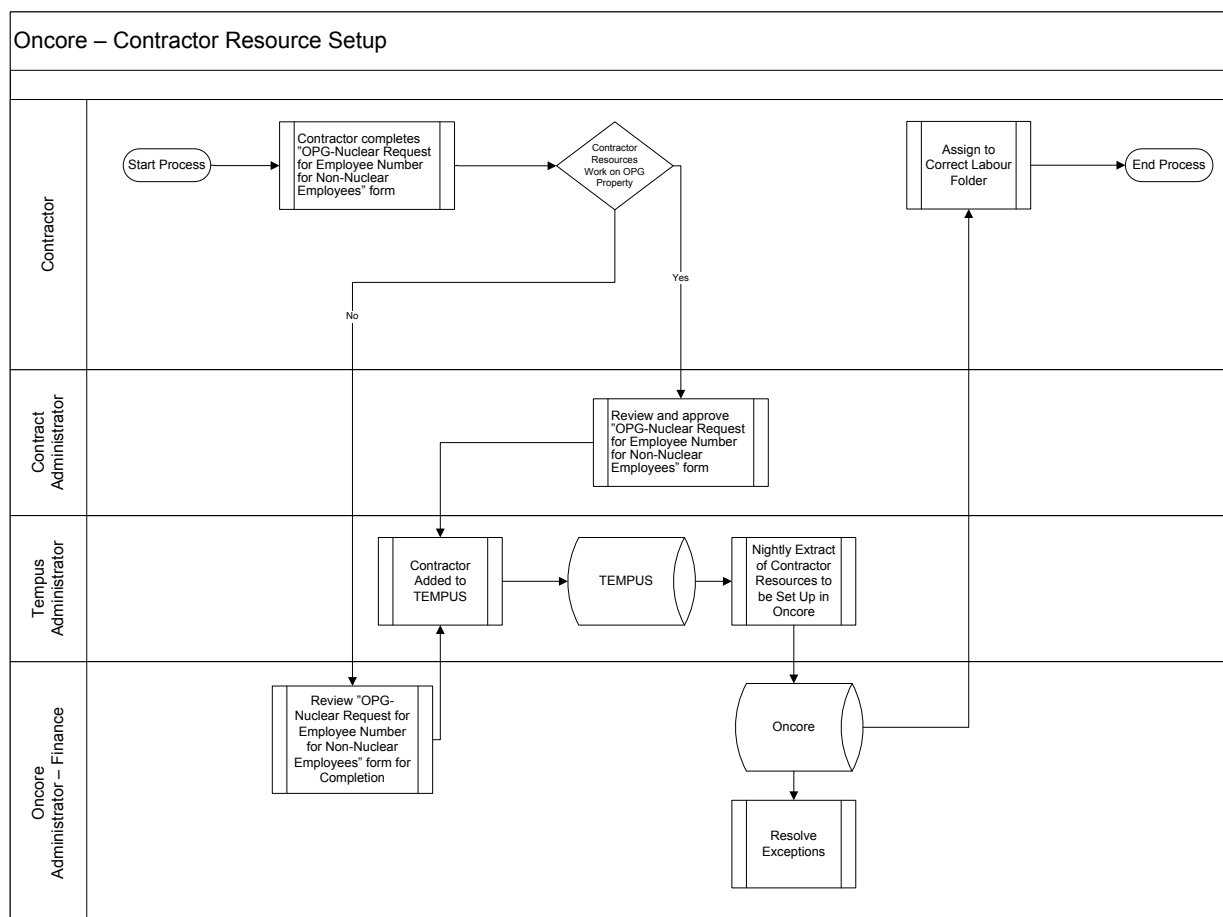
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- (d) If a contractor resource is going to work on OPG property, the vendor shall forward the completed form to the Contract Administrator for approval. The Contractor Administrator shall review and approve the form and send to Tempus for processing.
- (e) If a contractor resource is not going to work on OPG property, the vendor shall forward the completed form to Oncore Administration for review and processing.

### 1.3.1 Process Overview



**Figure 2 – Contractor Resource Setup**

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### 1.3.2 Accountabilities

**Table 2 – Contractor Resource Setup RACI Chart**

Task	Responsible	Accountable	Consulted	Informed
Contractor completes OPG-Nuclear Request for Employee Number for Non-Nuclear Employees Form	Contractor	Contractor	CA	CA (for <b>on-site</b> contractors)
				Oncore Administrator – Finance (for <b>off-site</b> contractors)
<b>For on-site contractors:</b> Review and approve OPG-Nuclear Request for Employee Number for Non-Nuclear Employees Form	CA	CA	Contractor	TEMPUS Administrator
<b>For off-site contractors:</b> Review OPG-Nuclear Request for Employee Number for Non-Nuclear Employees Form	Oncore Administrator – Finance	Oncore Administrator – Finance	Contractor	TEMPUS Administrator
Contractor Resource setup in TEMPUS	TEMPUS Administrator	TEMPUS Administrator	Contractor	Oncore System (Integration)
Contractor Resources are setup in Oncore in the Unassigned folder, Exceptions resolved	Oncore System (Integration)	Oncore Administrator – Finance	Contractor	CA
Contractors are moved to the appropriate labour folder	Contractor Time Entry Staff	Contractor	Contract Management Office	Contract Management Office

### 1.3.3 Initiating Contractor Resource Setup

- In order to include a contractor resource on a timesheet for billing purposes, the contractor resource shall be setup in Oncore.
- The contractor resource shall first be setup in Tempus and assigned an OPG employee number.
- Prior to the work start date, the contractor shall complete the OPG-Nuclear Request for Employee Number for Non-Nuclear Employees Form for all resources that shall perform the scope of work as documented in the contract.
- If the contractor will be working on OPG property, the completed form shall be sent to the CA for review and approval. The CA confirms that the contractor resource(s) are required to complete the scope of work. Upon approval, the CA shall forward the form to the TEMPUS Administrator for setup in TEMPUS.



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If the contractor will not be working on OPG property, the completed form shall be sent to the Oncore Administrator – Finance for review. After review, the Oncore Administrator – Finance shall forward the form to the TEMPUS Administrator for setup in TEMPUS.

- (e) Contractor resources added in TEMPUS shall automatically be setup in the Contractor's Unassigned labour folder, within Oncore, each night.
- (f) All contractor resources shall be setup in Oncore prior to the commencement of work.

#### 1.3.4 TEMPUS to Oncore Interface

- (a) Contractor resources are added to the Unassigned folder in Oncore by a nightly interface between TEMPUS and Oncore.
- (b) The nightly TEMPUS to Oncore electronic interface shall perform the following activities:
  - (1) Add new contractor resources to the Unassigned folder of a specific contractor organization.
  - (2) Deactivate contractor resources that are no longer active in TEMPUS and move deactivated contractor resources to the Terminated Labour folder.
  - (3) Move contractor resources from one contractor organization to another based on a change in reporting relationship within TEMPUS.
- (c) The Oncore Administrator – Finance shall review daily transaction logs and review and resolve any exceptions.

#### 1.3.5 Contractor Resource Labour Folder Assignment

- (a) Contractor resources are added to the contractor's unassigned folder in Oncore each night.
- (b) The contractor time entry staff moves the contractor resource to the appropriate labour folder, based on the labour hierarchy in Oncore (e.g., Pipefitter – Journeyman: PF-J). This determines the applicable billing rates for the resource.
- (c) The contractor time entry staff may record their employee's contractor employee number. This helps facilitate reporting for the contractor.

#### 1.3.6 Contractor Resource Termination/Deactivation

- (a) When a contractor resource is no longer working at OPG, they shall be terminated in TEMPUS and deactivated in Oncore.
- (b) Upon contract completion and/or contractor resource termination, the CA shall provide the TEMPUS Administrator, via email, a listing of contractor resources to be terminated in TEMPUS which results in deactivation in Oncore seven days after the termination date in Tempus. This seven day allowance provides the Contractor Time Entry Staff

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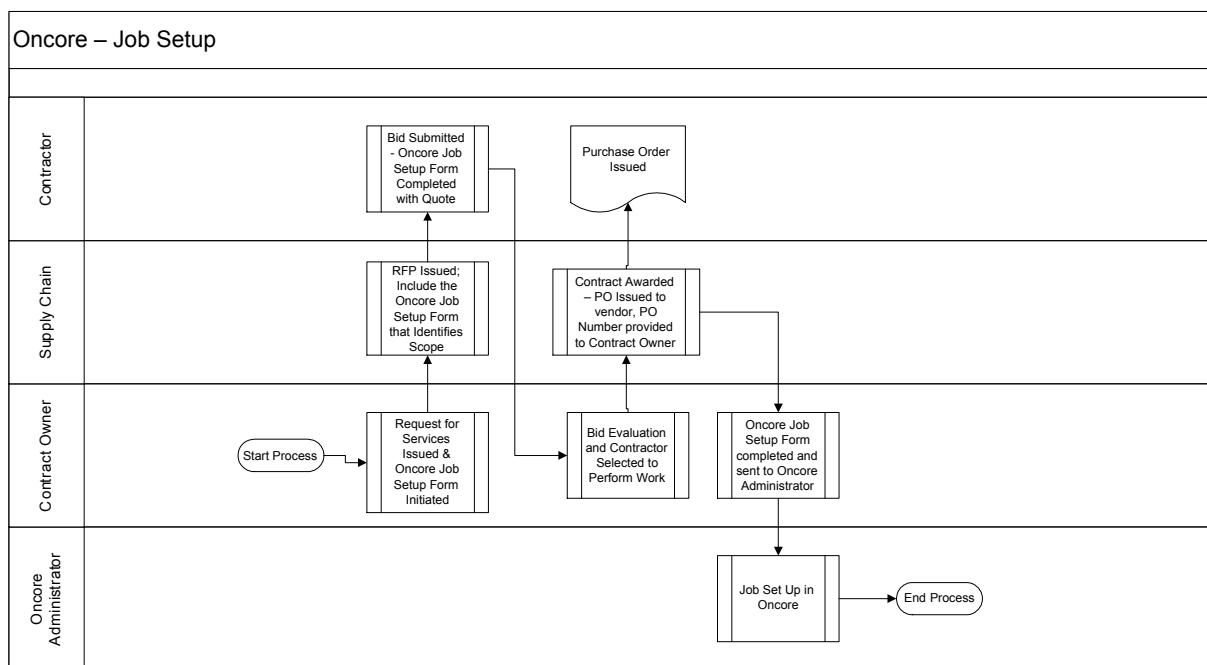
time to enter all timesheets and charges into Oncore for those resources after work has been completed.

### 1.4 Job Setup in Oncore

A job in Oncore is a group of work events or activities that the contractor shall charge time, non-labour expenses, or progress payments against. Each Oncore job shall relate to a single PO, PO Release. Work events or activities shall also relate to a PO Line Number.

A job shall be setup in Oncore before a contractor is able to create a timesheet and bill OPG. A job shall not be setup in Oncore until an approved PO has been issued by Procurement in Supply Chain.

#### 1.4.1 Process Overview



**Figure 3 – Job Setup**

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### 1.4.2 Accountabilities

**Table 3 – Job Setup RACI Chart**

Task	Responsible	Accountable	Consulted	Informed
Request for Services (N-FORM-10029, Services – Request for Purchasing) Issued; the CO identifies the contract scope (direct work) on the “Quotation” tab of the Oncore Job Setup Form and sends it to Supply Chain	CO or delegate	CO	CA	Supply Chain (Purchasing Agent)
Request for Proposal (RFP) Issued; Include the Oncore Job Setup Form that Identifies Scope	Supply Chain (Purchasing Agent)	Supply Chain (Purchasing Agent)	CO CA	Contractor
Oncore Job Setup Form (with Quote) included as part of Bid Response	Contractor	Contractor	CO Supply Chain CA	Supply Chain
Bids Evaluated and Contractor Selected	CO, CA, Supply Chain	CO	Contractor Finance	N/A
PO Issued	Supply Chain (Purchasing Agent)	Supply Chain (Purchasing Agent)	CO, CA	Contractor
Oncore Job Setup Form Completed	CO or delegate	CO	CA, Contractor, Supply Chain	Oncore Administrator – Finance
Job Setup in Oncore	Oncore Administrator – Finance	Oncore Administrator – Finance	CA, CO or delegate, Contractor, Supply Chain	Contractor, CO, CA

For projects, the CO delegate is normally the Project CSA. However, some organizations do not have a CSA and thus the job setup package is prepared by the CO themselves, or by maintenance support for outages, and/or by finance.

It is the CO's accountability to ensure that the job setup package is completed and sent to the Oncore Administrator – Finance prior to the contractor starting work.

### 1.4.3 Purchase Order Requirements

- The Oncore Job Setup package shall reference an approved PO + Release (if applicable) and each work event or activity shall have a PO line number.
- Jobs shall not be setup in Oncore without an approved and valid PO.
- No contractor or consultant may commence work without a valid PO number or the authority of the Vice President, Nuclear Supply Chain or his/her delegate.

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- (d) All non-compliance with this requirement shall be tracked and reported to senior management (OPG-PROC-0058, Procurement Activities).

#### 1.4.4 Oncore Job Setup Form

- (a) The CO is accountable for completing the Oncore Job Setup Form in order to have all new jobs setup in Oncore. The CO may delegate the responsibility for completing the Oncore Job Setup Form to others, e.g., the CSA. The Oncore Job Setup Form is available on the Oncore website – see Section 1.12 for Oncore website information.
- (b) The CO shall initiate the Oncore Job Setup Form by completing the OPG Job Information Section and identifying the contract scope (direct work) on the “Quotation” tab.
- (c) In the Quote Detail Section, the CO shall identify how the work shall be tracked, either by PASSPORT WO, by PASSPORT Work Order (WO)-Task, or by Work Activity (if PASSPORT WO-Task not available).
- (d) The information provided on the Oncore Job Setup Form shall be used to setup the job in Oncore in order to manage contractor performance.
- (e) The CO shall send N-FORM-10029 and the electronic version of the Oncore Job Setup Form to Supply Chain.
- (f) The Oncore Job Setup Form shall be issued as part of the RFP.
- (g) The bidding contractor is required to complete the “Quotation” tab within the Oncore Job Setup Form by completing the following:
- Provide an estimate for the scope (i.e., the direct work) that has been identified
  - Select the indirects which are applicable to the job by providing their appropriate estimates.
- (h) Once the contract is awarded, the CO shall review the information on the “Quotation” tab that has been provided by the bidding contractor.
- (i) Once the CO deems the information is acceptable, they shall complete the following:
- PO number
  - Approvers
  - Accounting information
  - Contract Type
  - Holdback, if any
  - Rate table information.
- (j) Upon thorough completion of the Oncore Job Setup Package, the CO shall send it to the Oncore Admin - Finance mailbox (oncore@opg.com) for setup at least ten (10) days prior to the start of work, providing sufficient time for the job to be setup.

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- (k) For indirect charges, e.g., supervision and training, the standard indirect list on the Oncore Job Setup form shall be used to ensure consistency in cost measurement between jobs enabling comparability.
- (l) All mandatory fields on the Oncore Job Setup Form shall be completed in order to set the job up in Oncore, including:
  - Contract Type
  - The scope and description of work activities including the PASSPORT description for WO tasks
  - Estimated hours and cost
  - PO number + release + line, project number
  - Accounting information
  - Identification of the CA and CO, and
  - Contractor name
  - Rate table.
- (m) It is highly recommended that the CO assign Alternate Approvers at each approval step when initially setting up the job. This allows for timely approvals when the CA/CO is unavailable.
- (n) Alternately, this can be done immediately prior to a planned absence by emailing the required information to the Oncore Admin – Finance mailbox (oncore@opg.com).
- (o) If there is an unplanned absence, please contact the Oncore Administrator – Finance for assistance.
- (p) The Oncore Administrator – Finance shall review the Oncore Job Setup Form for completeness and return it to the initiator if not complete.
- (q) The Oncore Administrator – Finance shall set the job up in Oncore on a first-come, first-serve basis – this may take up to ten (10) days from the receipt of a completed Oncore Job Setup Form.
- (r) The same turnaround time applies for revisions to existing Oncore jobs.
- (s) The Oncore Job Setup Form is to be used for ORIGINAL setup of a job in Oncore based on a PO being issued with a contractor quote. Additionally, the Oncore Job Setup Form shall be used to document revisions to existing scope and/or to setup NEW scope.
- (t) The CO remains accountable for submitting the revised Oncore Job Setup Form.

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#### 1.4.5 Job Setup in Oncore

- (a) The basis for a job setup in Oncore is the completed Oncore Job Setup Form.
- (b) The general hierarchy for setting up jobs in Oncore is as follows:  
Division → Site → Project Number → PO-Release-Line → Work Event or Activity
- (c) Work events or activities, and/or progress milestones are contained within the PO-Release-Line folder within a Project, referred to as a “job”. This provides the ability to link timesheets, which are charged at the work event or activity level to a PO-Release-Line for billing rate application and payment purposes.
- (d) Once the job is setup in Oncore, the Oncore Administrator – Finance shall advise the contractor, CA, CO, and CSA when the work events or activities are available so timesheets may be entered.
- (e) The Oncore Administrator – Finance shall verify that all Step 3 approvers have Stratum III authority level in accordance with the Organizational Authority Register (OAR) prior to assigning them as the Step 3 Approver of a job in Oncore.

#### 1.5 Timesheet Entry

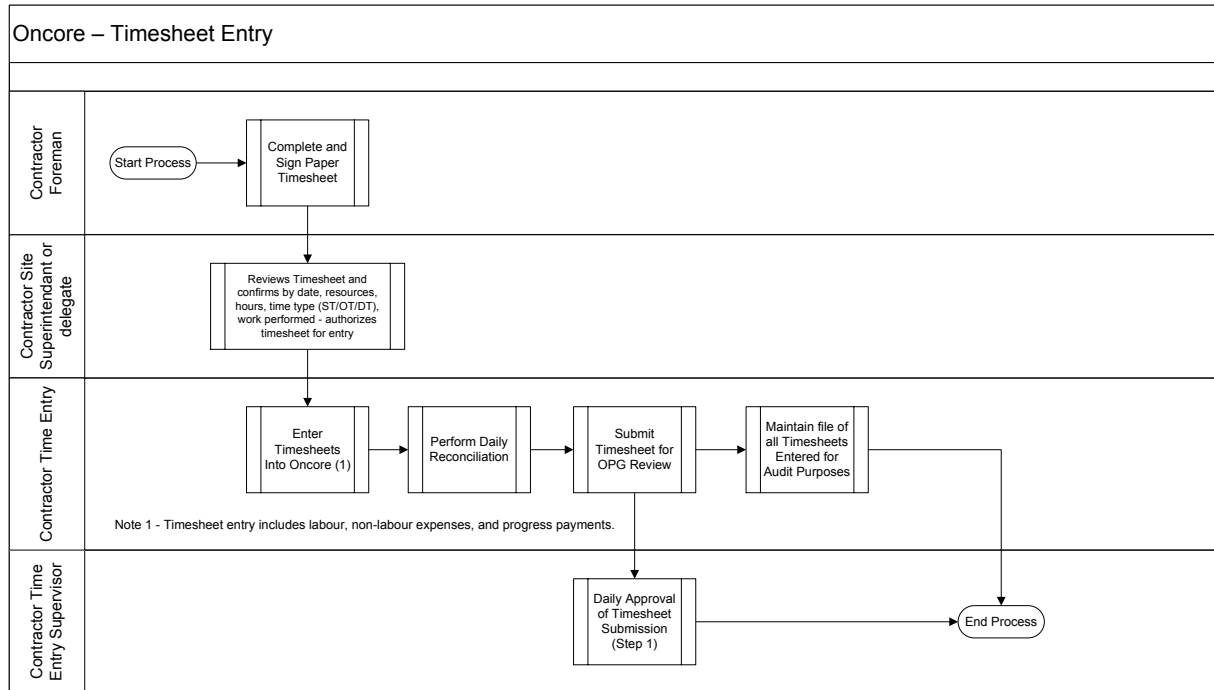
- (a) A timesheet is the document used in Oncore to record labour and non-labour expenditures, or milestone achievements in order to process progress payments.
- (b) Timesheets shall be entered by contractor time entry staff once jobs are setup in Oncore. This process also identifies the requirements for reconciliation of timesheets collected in the field and the entry into Oncore.

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### 1.5.1 Process Overview



**Figure 4 – Timesheet Entry**

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### 1.5.2 Accountabilities

**Table 4 – Timesheet Entry RACI Chart**

Task	Responsible	Accountable	Consulted	Informed
Paper timesheets completed	Contractor Foreman	Contractor	CA	Contractor Site Superintendent or Delegate
Timesheets reviewed by date with respect to resources, hours, time type, and work performed and authorized for entry	Contractor Site Superintendent, or Delegate	Contractor	CA	Contractor Time Entry Staff
Timesheets Entered into Oncore	Contractor Time Entry Staff	Contractor	CA	Contractor Time Entry Staff Supervisor
Timesheets reconciled with Oncore report	Contractor Time Entry Staff	Contractor	Contractor Foreman, Contractor Site Superintendent	Contractor Time Entry Staff Supervisor
Timesheets filed and maintained by Contractor in case of review by OPG and/or Audit	Contractor Time Entry Staff	Contractor	N/A	N/A
Timesheets submitted (Step 1 Approval)	Contractor Time Entry Supervisor	Contractor	Contractor Time Entry Staff	CA

### 1.5.3 Timesheet Entry Process

- (a) Contractor foreman shall complete paper timesheets.
- (b) Contractor Site superintendent or delegate shall review and authorize that the timesheet accurately:
  - Reflects the work that was performed
  - By whom
  - Exceptions incurred, i.e. delays
  - Hours worked
  - Time type (i.e., straight time (ST), overtime (OT), double time (DT), etc.).
- (c) Contractor Site superintendent or delegate forwards authorized paper timesheets to the contractor time entry staff for input.
- (d) Contractor time entry staff:



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- Input the time and material timesheets into Oncore on a daily basis.
  - Escalate issues preventing entry (e.g., job not setup in Oncore, WO-Task not setup in Oncore) to the CA for resolution.
  - Additional timesheets are entered into Oncore for non-labour expenses and/or for milestones met/progress payments due.
  - Timesheets for non construction work, i.e., engineering design work, may be entered weekly where daily entry is not reasonable. This shall be approved by the CO in advance.
  - Perform a daily reconciliation of timesheets with time entered into Oncore.
  - Print a report from Oncore and ensure reconciliation in terms of hours charged by project, date, activity (correct WO-Task #), time type (ST, OT, DT) and resource (correct Trade/Class).
  - Standard reports have been developed in Oncore to support this reconciliation; e.g., Daily Timesheet Detail by Contractor.
- (e) Contractor time entry supervisor shall approve the reconciliation prior to submitting the timesheet in Oncore (Step 1 Approval) attesting that all hours entered into Oncore for the period are supported by authorized (contractor foreman and contractor site superintendent or delegate) paper timesheets.
- (f) The authorized paper timesheets and the Oncore report shall be filed for a period of seven (7) years and provided to OPG upon request.
- (g) If a timesheet is not entered within 15 days of when the work was performed, the contractor, prior to entry, shall inform the CA. Rationale for late entry shall be documented in the comments field on the timesheet. This rule also applies to resubmitting rejected timesheets.
- (h) Under normal circumstances, any timesheet entered after 30 days of when the work was performed, shall be rejected.
- (i) Exceptional situations shall be pre-approved by the CA and CO for work being entered 30 or more days late.

#### 1.5.4 Recording Delays

- (a) Delays may be incurred while executing work. A delay is only billable to OPG when not caused or created by an action or inaction of the contractor or its subcontractors.
- (b) If a delay is incurred, the contractor shall take appropriate actions to ensure quick resolution and to minimize unproductive charges.

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- (c) The CA shall be notified within 30 minutes of a delay occurring in the field, whether billable or non-billable) so they can help facilitate resolution of the delay situation.
- (d) A Station Condition Record (SCR) is to be filed and referenced on any documentation and Oncore timesheets.
- (e) All billable delays in excess of 30 minutes shall be specified by the contractor on the Oncore timesheet by using the appropriate delay billing code.
- (f) The reason for the delay, SCR# and actions taken to minimize the delay shall be recorded in the comments section of the timesheet.
- (g) The duration of delays is captured in Oncore for tracking purposes and may lead to a change in the following:
  - Progress Schedule
  - Contract Schedule
  - Contract Price
- (h) All delays shall be noted on the contractor paper timesheet for auditability of time entered into Oncore.

#### 1.5.5 Recording Rework

- (a) Contractor rework may be required due to quality of performance, failed quality inspection test, changes in engineering requirements or other.
- (b) Rework shall be reviewed and approved by the CA and CO in advance.
- (c) This review shall also determine what portion of the rework, if any, is non-billable to OPG, consistent with the terms and conditions of the Contract Agreement.
- (d) All rework hours and costs, whether billable or not-billable shall be recorded in Oncore using the appropriate rework billing code.
- (e) Non-billable rework shall be coded as such using the Non-Billable time type code.
- (f) The reason for the rework and actions taken to minimize rework costs shall be recorded in the comments section of the timesheet.
- (g) The duration of rework is captured in Oncore for tracking purposes and may lead to a change in:
  - Progress Schedule
  - Contract Schedule
  - Contract Price
- (h) All rework shall also be noted on the contractor paper timesheet for auditability of time entered into Oncore.

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#### 1.5.6 Contractor Employee Step-Ups or Step-Downs

- (a) The contractor may be required to temporarily step-up/step-down an employee to a different pay classification. Step-ups shall be approved by the CA prior to occurrence.
- (b) All step-ups/step-downs shall be noted on the contractor paper timesheet for auditability of time entered into Oncore.
- (c) All step-ups/step-downs shall be recorded in Oncore on the electronic timesheet in order to ensure correct billing amounts.
- (d) This is done in Oncore by “dragging & dropping” a different class onto the timesheet.
- (e) It is permitted to have more than one class on the timesheet simultaneously, for example, an employee who is journeyman for part of the day and a foreman for part of the day.
- (f) Notations (see Section 1.5.9) shall be added on the electronic timesheet as to the nature of the step-up and reference the pre-approval by the CA.

#### 1.5.7 Recording Non-Labour Charges Such as EPSCA Allowances

- (a) The following non-labour expenses shall be entered into Oncore once these charges are incurred and supporting documentation is available:
  - Materials
  - Rentals
  - EPSCA allowances
  - Sub-contractor billings.
- (b) Contractor time entry staff shall attach a .PDF copy of all supporting documentation to timesheet for the CA to review. Attachments are available for all approvers to review during the approvals process.
- (c) The comments field on the timesheet for these charges shall be utilized to clearly indicate the nature of the charge.
- (d) All billings shall be consistent with the terms of the contract/PO.
- (e) Where possible, all employee-related charges, i.e., EPSCA allowances, shall be entered against the contractor resource that has incurred the expense.

#### 1.5.8 Rejected Timesheets

- (a) The CA or CO shall reject transactions on Oncore timesheets if they are not acceptable or appropriate based on their review.
- (b) Comments shall be added to the timesheet detailing the reason for the rejection. This allows the contractor time entry staff to follow up accordingly and resolve the issue.

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- (c) Timesheets shall not be rejected merely for a clarification of timesheet entry; dialogue with the contractor shall be the first course of action when clarification on the timesheet entries is required.
- (d) Rejected timesheets are routed back to the contractor time entry staff for revision.
- (e) The contractor time entry staff shall review the rejected timesheet and resolve the issue as quickly as possible to ensure that rejected transactions are processed and resubmitted to OPG on a timely basis.

#### 1.5.9 Adding Comments to a Timesheet

Oncore allows users to add comments to events to let them better track the exact information contained in an event. For example, if the duration of a work activity was increased resulting in a contractor being required to work beyond the normal shift duration or a contractor employee was stepped up, information shall be captured in a comment.

A comment is represented by a red triangle in the upper left corner of the cell. Comments are identified by user name, so that you can tell who entered each comment. Multiple comments are listed in chronological order (from most recent to the least recent).

Comments may be added to a timesheet at any time; however, the use of comments is mandatory for the following situations:

##### (a) Contractor Employee Step-ups

If a contractor employee is stepped up for a period of time, this shall be noted on the timesheet. Information required includes reason for step-up and statement of pre-approval.

##### (b) Timesheet Adjustments

If a timesheet is adjusted after it is submitted and approved, the nature of the adjustment shall be documented on the timesheet. This provides the CAs and COs with an explanation as to why they are required to approve a timesheet a second time.

##### (c) Timesheet Rejections

If a timesheet approver rejects a timesheet, they are required to provide comments on the timesheet detailing the reason why the timesheet has been rejected. This allows the contractor time entry staff to follow up accordingly and resolve the issue.

##### (d) Delay & Rework Codes

The contractor is required to provide comments noting the specific details associated with delay and rework costs recorded on the timesheet.

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#### (e) Non-Labour Charges

- (1) The contractor is required to provide comments for all non-labour charges including progress/milestone billings.
- (2) The comments shall clearly indicate the nature of the charge.
- (3) Any third-party invoice numbers (i.e., subcontractor invoice) shall be documented in the reference field on the timesheet.

#### (f) SCR

The use of the SCR process is often required to record certain events. If an SCR has been filed and relates to timesheet entries, it shall be recorded in the reference field on the timesheet.

## 1.6 Timesheet Approvals and Rejections

This section outlines the accountabilities for those involved in the timesheet approval or rejection process within Oncore.

### 1.6.1 Process Overview

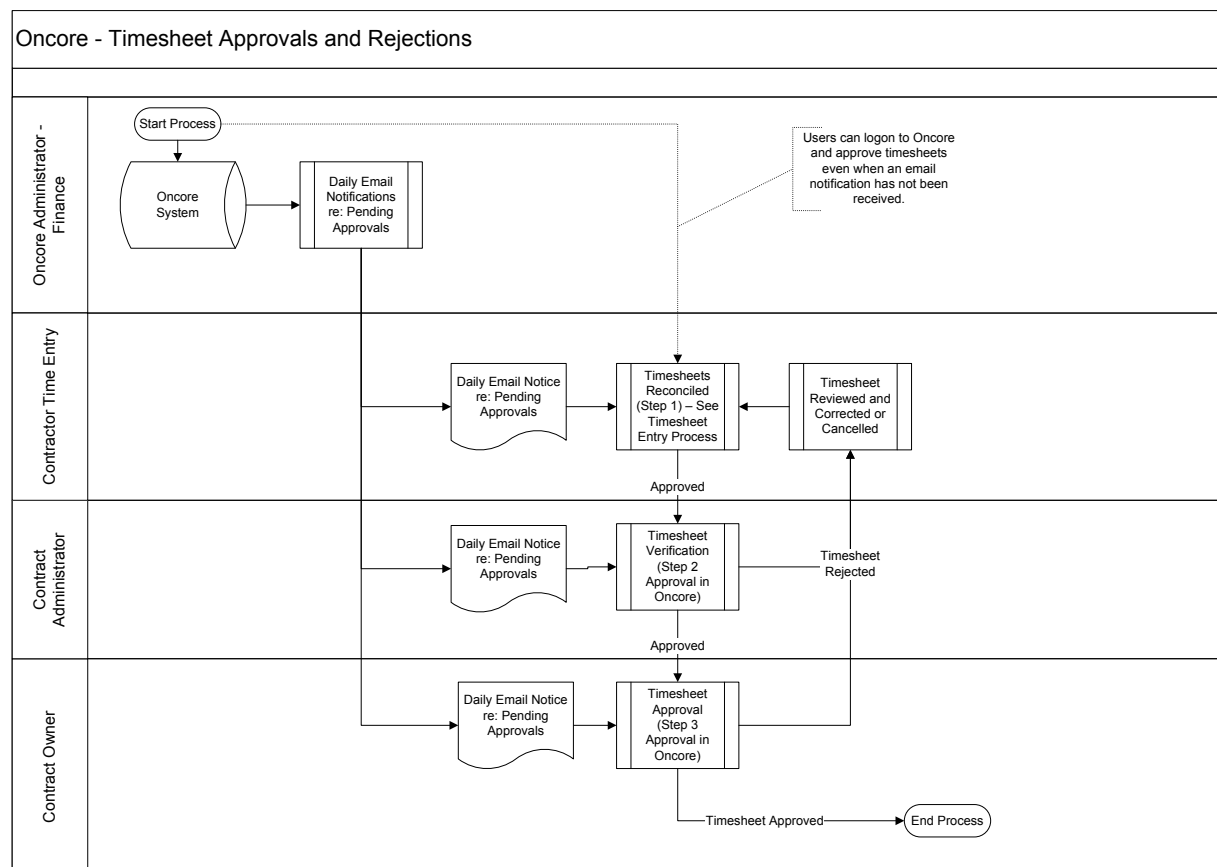


Figure 5 – Timesheet Approvals and Rejections

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### 1.6.2 Accountabilities

**Table 5 – Timesheet Approvals & Rejections RACI Chart**

Task	Responsible	Accountable	Consulted	Informed
Daily email notifications issued for timesheets pending review and approval.	Oncore System	Oncore Administrator – Finance	N/A	Contractor, CA, CO
Timesheet Entry Verified and Submitted in Oncore on a daily basis (Step 1 Approval) and Reconciliation Complete	Contractor Time Entry Staff	Contractor Time Entry Supervisor	N/A	CA
Timesheet Entry Verified and Submitted in Oncore on a daily basis (Step 2 Approval)	CA	CA	Contractor	CO
Timesheet Entry Approved and Submitted in Oncore on a daily (preferred) or weekly basis (Thursday's) (Step 3 and Final Approval Step)	CO	CO	CA	Contractor
For pending timesheets, an approval Aging report is issued monthly for management action.	Oncore Administrator – Finance	Oncore Administrator – Finance	N/A	CA, CO, Controllers and Project Management

### 1.6.3 Overview of Timesheet Approval Process

The timesheet approval process includes the verification and approval of time charged within Oncore and confirmation that the time is appropriately recorded in terms of quantity of hours, worker classification (i.e., Pipefitter – Journeyman), time type (i.e., straight time, overtime, double-time), and that charges are to the correct work activity or event. Additionally, all exceptions including delays charged, rework, etc. are reviewed. For new scope, the timesheet approval process shall ensure that charges are added to the new work activities representing the new scope. Approval in Oncore is a confirmation that OPG has received value for money for the work performed, i.e., charges in Oncore are for actual effort in the field consistent with the scope of work identified on the approved PO.

Before given rights to approve timesheets, the CA and CO shall first complete the Oncore Contract Approver Course (Course/PEL # 67847). This can be done by completing the Computer Assisted Learning (CAL) session available through OPG's eLearning Portal or attending a classroom session.

- (a) The Oncore Administrator – Finance shall verify that the approvers (CA and CO) have completed the Oncore Contract Approver training and then shall setup the approvers at the same time the job is setup in Oncore. The CA and CO are identified on the Oncore Job Setup Form. If an approver has not yet completed the training, the Oncore

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Administrator – Finance will send an e-mail to the approver, advising that the Oncore Contract Approver training shall be completed before the approver can be setup as an approver in Oncore.

- (b) Oncore shall issue a daily email notification to contractors, CAs, and COs who have timesheets in Oncore pending their review and approval. The purpose of this email notification is to prompt the required daily approval by CAs and COs.
- (c) Timesheets may be approved prior to the issuance of an email notification by logging onto Oncore and reviewing and approving all pending timesheets.
- (d) The primary approver shall receive email notification daily for outstanding transactions.
- (e) If alternate approvers are assigned, they shall also receive the email.
- (f) The alternate approver only needs to take actions when the primary approver is away and approval has been delegated to the alternate.

#### 1.6.4 Approving Timesheets

Within Oncore, timesheets are to be entered on a daily or weekly basis (see Section 1.5.3). Timely approval is required for timely costing in our cost systems as well as timely contractor payment.

Within Oncore, there are multiple approval steps, as noted below. Once transactions are approved in one approval step, they move onto the next approval step. Once the final approval step is completed, the approved transactions are the basis for updating costs in OPG's general ledger Systems, Applications and Products (SAP), in the Nuclear Finance Reporting and Analytics (NFRA) system, and for creating invoices electronically in PASSPORT and automatically setting to approved status for payment.

OPG uses the following three approval steps to manage the timesheet approval process:

##### **Step 1 Approval – Performed by the Contractor Time Entry Supervisor:**

The contractor time entry supervisor attests that timesheets entered into Oncore are reconciled to supporting timesheets and invoices for non-labour expenses (Step 1 "approval" in Oncore). Please see Section 1.5.3 of this Instruction for further details on this step.

##### **Step 2 Approval – Performed by the CA:**

The CA is accountable for verifying all timesheets entered into Oncore on a daily basis as follows:

- (a) The CA may generate reports (e.g., PO Summary Report, WO Detail – Approval Status) in Oncore to support the approval process. Please see Section 1.7 of this Instruction for further information on reporting.
- (b) It is not the accountability of the CA or CO to validate rates; they are validating and approving work performed in terms of contractor occupation and hours worked.

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- (c) The CA shall review the Oncore timesheets daily (as submitted) for the following:
- That timesheets being reviewed are current (within 15 days of work date),
  - Where timesheets are not current (> 15 days past work date), there is a clear understanding as to why timesheets are entered late,
  - The hours are charged to the correct work activity or event (including indirect charges such as Supervision, Holder of Record, in accordance with the terms of the contract) and only against current work activities; i.e. Oncore charges reflect actual field activity for the current stage of work or “plan-of-the-day”; there shall not be any demobilization charges when the work has just started,
  - New scope is charged to work activities or events setup for the new scope and that all Contract Change Requests (CCRs) have been processed for the new scope; i.e., charges for new scope are not charged to the original scope work events or activities,
  - Contractor resource names and occupation codes, hours charged, time types, delays incurred, and rework billed, are as expected per the contract and consistent with the spot checks recorded in the log book during contract monitoring and/or attendance records provided by the contractor,
  - That non-labour charges, including EPSCA charges, third-party sub-contractor charges, and others, are supported by documentation provided by the contractor and are billable in accordance with terms and conditions specified in the contract,
  - That progress billings are for milestones that have been achieved, as documented in the contract, and are supported by clear documentation provided by the contractor, and
  - Goods and services have been received in accordance with the contract terms and OPG has received value for money for the work performed; i.e., the timesheets in Oncore are fully representative of activities that have occurred in the field and represent the recorded progress (% complete) on the job and exceptions are minimized to the extent possible.
- (d) The CA shall be satisfied that all the above criteria have been fully met. If in doubt, a call shall be placed to the contractor for additional information and follow-up.
- (e) If additional information is provided, this shall be recorded in the log book and/or the comments field in Oncore.
- (f) Once satisfied, the CA shall approve the timesheets in Oncore and, by pressing “Submit”, is agreeing to the following statement:

“I hereby certify that the (above 8) timesheet review activities have been completed and all the results are acceptable and appropriate and the timesheet is being recommended for approval.”



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- (g) If any of the above are not acceptable or appropriate, dialogue with the contractor shall occur prior to rejecting the timesheet.
- (h) CA shall reject the Oncore timesheet and include comments describing the reason for the rejection.

#### Step 3 Approval – Performed by the CO:

The CO is accountable for approving timesheets in Oncore on a daily (preferred) or weekly basis. When approvals are done on a weekly basis, they shall be done by end of day Thursday to ensure appropriate costs are sent to OPG's financial systems.

Timesheets shall only be routed to the CO for approval after the CA has performed their review. By receipt of a timesheet for approval, the CA is recommending it for approval.

By approving timesheets in Oncore, the CO is approving them for payment. Approved timesheets are consolidated into an invoice which is automatically uploaded to PASSPORT, automatically approved, and paid monthly.

- (a) The CO may generate reports (e.g., PO Summary Report, WO Detail – Approval Status) in Oncore to support the approval process. Please see Section 1.7 of this Instruction for further information on reporting.
- (b) The CO, in reviewing and approving timesheets in Oncore, is approving payment on behalf of OPG where OPG is contractually obligated to pay after they are satisfied that:
  - The timesheet is for valid labour and non-labour charges for scope completed to date within the contract terms and conditions,
  - Exceptions, delays, rework, and extras are identified, understood, justifications are documented and OPG is only paying where contractually obligated,
  - The quality of goods and services received meets expectations and contract requirements,
  - Cost, scope, or schedule deviations are known, documented, and corrective and/or mitigation actions are in place by the contractor and OPG, and
  - The contractor is managing the work and costs to achieve value for money (e.g., limiting use of overtime when ahead of schedule).
- (c) To perform the above task, the CO shall review the timesheets and, if needed prior to approval, discuss with the CA, field engineering, project staff, or contractor to ensure it is appropriate to pay the contractor's timesheet.
- (d) If approvals are delegated to an individual other than the CO, this delegation shall be consistent with corporate policies and required to be in writing indicating the period of the delegation.

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- (e) This written delegation shall be maintained by the CO and shall be made available in case of an audit.

#### 1.6.5 Rejecting Transactions

- (a) Dialogue with the contractor shall be the first course of action when clarifications are required on timesheet entries. It is best to avoid rejecting transactions if possible.
- (b) The CA and CO shall reject transactions on Oncore timesheets if they are not acceptable or appropriate based on their review.
- (c) Comments shall be added to the timesheet detailing the reason for the rejection. This allows the contractor time entry staff to follow up accordingly and resolve the issue.
- (d) Rejected transactions shall be routed back to the contractor time entry staff for revision and shall be resolved and resubmitted or cancelled as quickly as possible.

#### 1.6.6 Aging Report for Oncore Transactions Pending Approval

On a weekly basis, the Oncore Administrator – Finance shall issue a detailed aging report to CAs, COs, Finance Controllers and selected senior management for action. The purpose of this report is to show the CA, CO & Controllers what payables are outstanding and which ones need to be dealt with on an urgent basis because they have been overdue for a long period of time. It highlights the following:

- The amounts of outstanding timesheets pending approval – this is what OPG owes to its Vendors.
- Which approval step the timesheet pending approval is currently on. It also includes the name of the Primary Approver associated with that approval step.
- Tab 1 of the Aging Report lists the number of days the timesheets have been pending approval (calculated as: date of Aging Report minus timesheet creation date). Note: it is not the number of days the timesheet has been sitting at a particular approval step. Tab 2 of the Aging Report is broken down into 1 to 7, 8 to 30 and over 30 day increments.

Note: This is not a standard report that users can generate from the Oncore Reporting module.

#### 1.7 Reporting

Contractors, CAs, and COs shall rely on Oncore reports to support reviews of Contract performance. A number of standard reports have been developed in Oncore to meet the needs of Oncore users.

The CA and/or CSA shall generate and review reports on a timely basis to ensure timesheet entries are complete and timely, and delays and non-billable work are entered accurately into Oncore.

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These reports shall be printed and reviewed with the CO and appropriate mitigating actions taken to correct any issues highlighted by the reports, i.e., submission of N-FORM 10029 to deal with a contract over-spending situation.

Due to the loading of actual hours into Oncore, the contractor is not required to create or submit similar reports unless identified by the CO and agreed to by both the contractor and CO.

#### 1.8 Processing Changes in Oncore

- (a) The CA is responsible for managing contract changes, during the post-award phase through to closeout and termination.
- (b) The CA shall document the change, obtain approval from the CO and have the change executed through the purchasing agent prior to commencement of work.

**Note:** In emergency situations, the work may be authorized in advance of processing contract changes and/or changes in Oncore.

- (c) When changes are required to the setup of a job in Oncore in order to measure contractor performance and/or to track new scope, the CO delegate shall update the Oncore Job Setup Form and send it to the Oncore Administrator – Finance.

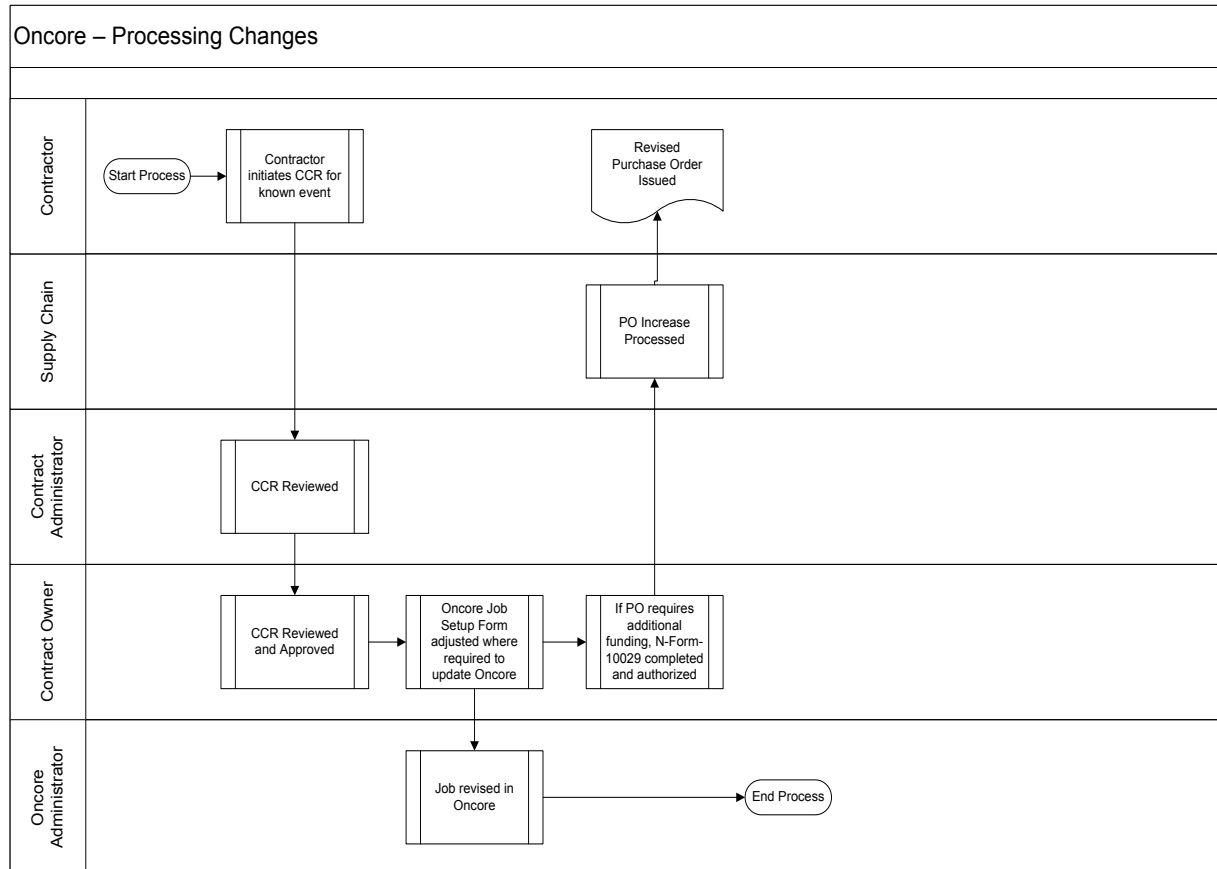
**Note:** Refer to Section 1.4 of this instruction for further information on the Job Setup process. Refer to N-GUID-00150-10000 for additional tools on identifying, managing, and recording contract changes.

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### 1.8.1 Process Overview



**Figure 6 – Processing Changes**

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### 1.8.2 Accountabilities

**Table 6 – Processing Changes RACI Chart**

Task	Responsible	Accountable	Consulted	Informed
CCR initiated by Contractor due to change event in executing the contract.	Contractor	Contractor	CA	CA
CCRs Reviewed and Approved	CA	CA	Contractor	CO
Oncore Job Setup Form Revised	CO or delegate	CO	CA	Oncore Administrator – Finance
Job Revised in Oncore	Oncore Administrator - Finance	Oncore Administrator - Finance	CA, CO or delegate, Contractor, Supply Chain	Contractor, CO, CA
Request to Purchase N-FORM-10029 submitted if PO increase required. Note Contract Change Notice (CCN) Form used if Contract is Fixed Price.	CO or delegate	CO	CA	Supply Chain (Purchasing Agent)
PO Revised	Supply Chain (Purchasing Agent)	Supply Chain (Purchasing Agent)	CO	Contractor

For projects, the CO delegate is normally the Project CSA. However, some organizations do not have a CSA and thus the job setup package is prepared by the CO themselves, or by maintenance support for outages, and/or by finance.

It is the CO's accountability to ensure that the job setup package is completed and sent to the Oncore Administrator – Finance prior to the contractor starting work.

### 1.8.3 What Constitutes a Change in Oncore

Generally, a CCR is submitted for approval if any of the following has taken place:

- Scope Change – as a result of a new or revised business requirement; a change to an existing contract deliverable; a new deliverable being added; or an existing deliverable is no longer required.
- Cost/Forecast Change – as a result of an increase or significant decrease in estimated contract costs. On the Oncore Job Setup Form, the forecast estimated costs and/or hours is adjusted. A cost increase may be due to more overtime, delays, or rework than planned for in the contract.
- Deferral – as a result of a decision to defer an active contract to a later date. The job would be closed (deactivated) in Oncore.
- Re-activation – as a result of a decision to re-activate a contract that has been deferred. The job would be re-activated in Oncore.

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- (e) Cancellation – as a result of a decision to cancel a contract that no longer fits within the business strategy. The job would be closed (deactivated) in Oncore.

#### 1.8.4 Job Change Form and Process

- (a) When a Contract is changed for any of the above reasons, the PO in Passport is revised if additional funding is required.
- (b) Additionally, the Oncore Job Setup Form shall be adjusted and re-issued to the Oncore Administrator – Finance in order to add new scope or revise the existing estimates in Oncore for tracking purposes. All requirements as identified in Section 1.4 of this instruction apply.
- (c) When new scope is added to a job in Oncore, the activity shall be identified as “NEW” on the Oncore Job Setup Form. This shall allow tracking of added scope.
- (d) For changes, the CCR Number shall be recorded in the CCR# column on the Oncore Job Setup Form. This shall provide documentary evidence of the reasons for the changes to Oncore.

#### 1.9 Cost Reporting

The cost reporting system used at OPG is SAP. NFRA is used by Nuclear to provide further details of what is contained in SAP.

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### 1.9.1 Accountabilities

**Table 7 – Cost Reporting RACI Chart**

Task	Responsible	Accountable	Consulted	Informed
Weekly cost files generated & processed based on approved transactions in Oncore.	Oncore Administrator – Finance	Oncore Administrator - Finance	N/A	N/A
Report of outstanding timesheets not entered into Oncore using the Oncore standard electronic template	Contractor Time Entry Staff or Supervisor	Contractor	N/A	Oncore Administrator – Finance CO CA
Weekly accruals processed for transactions in Oncore that were not approved and/or transactions that were not entered into Oncore at time of weekly cost file being generated.	Oncore Administrator – Finance	Oncore Administrator – Finance Section Head	Contractor	CO CA CSA

### 1.9.2 Weekly Cost Reporting

- On a weekly basis, the Oncore Administrator - Finance posts approved transactions (timesheets, expenses, materials, etc.) to SAP/NFRA so costs are available for timely project reporting. To review Oncore transactions in NFRA, refer to Financial Source System 36. When costs are posted to a project or outage, the offsetting Financial Account Classification (FAC) is accounts payable liability account 41308. When the invoice is paid, the liability account is cleared.
- The Oncore Administrator – Finance shall reconcile the total amount posted each week with the amounts actually posted in SAP/NFRA to confirm completion.
- Finance shall, through weekly cost reviews, identify accounting issues, e.g., invalid project number, and provide details to the Oncore Administrator – Finance to correct.
- Corrections in Oncore shall only be for future cost reporting; Finance shall create journals to adjust costs processed in the past.

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#### 1.9.3 Accruals

OPG uses the accrual basis of accounting – this means that income and expenses are recorded in the accounts when the transaction takes place, rather than at the time the cash is received or paid.

- (a) On a weekly basis, the Oncore Administrator – Finance is responsible for accruing the following items:
- (1) Transactions (timesheets) in Oncore that were pending approval when the weekly cost batch was generated, typically Friday mornings by 9 a.m. These timesheets shall include transactions for time and material contracts, expenses, milestone and progress payments.
  - (2) Where the PO is already setup in Oncore, timesheets that have not yet been input in Oncore.
    - (i) Contractors shall provide the Oncore Administrator – Finance with a report of hours and costs incurred life-to-date for timesheets that have not been entered into Oncore.
    - (ii) These amounts shall be accrued for cost reporting purposes.
    - (iii) The Oncore Accrual Report (template) shall be used and data provided on a PO + Release + Line basis (i.e., by Oncore Job).
    - (iv) Due to the importance of recording accurate costs for reporting purposes, it is important for contractors to provide accurate accrual information.
- (b) On a monthly basis, the Oncore Administrator – Finance shall also accrue costs for retroactive trade rate increases that have not yet been approved by Supply Chain and/or processed in Oncore.
- (c) On a quarterly basis, the Oncore Administrator – Finance shall analyze contractor performance with respect to providing accurate accrual information and may recommend improvements to the accrual process, where warranted.

**Note:** The Oncore Administrator – Finance shall not process accruals for rejected transactions or for partial completion of planned milestones or progress payments where a timesheet is not yet entered into Oncore. These accruals shall be processed by the local finance unit. If a timesheet is entered into Oncore and contains milestone or progress payment information, and is not approved, the costs shall be included in the weekly accrual.

#### 1.10 Invoice Payment

Invoices are paid in accordance to the payment terms noted on the approved contract/PO.



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### 1.10.1 Accountabilities

**Table 8 – Invoice Payment RACI Chart**

Task	Responsible	Accountable	Consulted	Informed
Monthly invoices created & interfaced with PASSPORT for payment.	Oncore Administrator - Finance	Oncore Administrator - Finance	N/A	Contractor
				Supply Chain
				CA
				CSA
Resolve non-payment issues (funding increases).	CSA	CO	CSA	Supply Chain
	CA		CA	

### 1.10.2 Reverse Invoicing

- Oncore utilizes a streamlined invoicing process known as reverse invoicing. This simply means that invoices are created by OPG rather than the contractor. A single, aggregate monthly invoice for each PO-Release-Line is generated through this automated invoicing process. These invoices are created through an Electronic Data Interface (EDI) with PASSPORT and automatically set to approved status.
- These invoices may be viewed in PASSPORT by selecting Invoice Type = "AUTO-EDI".
- When invoices are processed, they clear the offsetting accounts payable liability account 41308 created during the weekly SAP/NFRA costing process (See Section 1.9.2); PASSPORT invoices do not create costs directly to the project or outage.
- The contractor is not required to provide OPG Accounts Payable with an invoice for items processed in the Oncore system.

### 1.10.3 Holdbacks

- If holdbacks are required, e.g., Construction Lien Act, Oncore shall hold back the appropriate amount on each invoice.
- The invoice shall indicate the amount of the holdback.
- Upon contract closure, a Holdback Clearance invoice shall be submitted by the contractor to Accounts Payable for final payment.

### 1.10.4 Invoice Payment Cycle

- OPG's normal payment terms are that payment is made on the 25<sup>th</sup> of the current month for approved invoices dated on the 25<sup>th</sup> of the previous month provided the PO has sufficient funding; i.e., the invoice is not in "Mismatch".

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- (b) In order to comply with these payment terms, the Oncore Administrator – Finance shall generate invoices at 3:00 p.m. on the 15<sup>th</sup> of each month for payment on the 25<sup>th</sup> of the same month. Included in this invoice shall be approved transactions on timesheets with a date worked on or prior to the 25<sup>th</sup> of the previous month.
- (c) This cycle provides a 20-day grace period to ensure entry and approval of timesheets to maximize eligible payment to the contractor on the 25<sup>th</sup> of each month.
- (d) It is imperative that transactions be approved daily by the CAs and COs so that there are no delays in paying contractors and to avoid increased cost to OPG for late payments.

#### 1.10.5 Invoice Mismatches

- (a) The CO shall be responsible for closely monitoring the status of their contracts/POs and take appropriate actions to increase PO funds, if necessary – this shall be done at least once per month, weekly during outages. This rigorous monitoring shall eliminate invoices in MISMATCH due to PO-exceed conditions.
- (b) If an invoice has an Invoice Status of MISMATCH in PASSPORT, the CO shall resolve this; the most common invoice mismatch is due to insufficient funding in the PO.
- (c) When the CO determines that additional funding is required for their contract/PO, they are responsible for completing the necessary paperwork (N-FORM-10029) to increase the funds in the PO.
- (d) The CSA and CA work in conjunction with the CO and shall be fully engaged in this regard in order to avoid the worst-case scenario, i.e., when OPG is required to stand-down a contractor on a project because OPG is in arrears.
- (e) In Oncore, timesheets may still be processed and approved against a PO that is out of funds because the mismatch is PASSPORT system related and not Oncore system related. They shall automatically clear once sufficient funds have been added to the PO in PASSPORT.

#### 1.11 Purchase Order and Project Closure Process

- (a) The CO shall be responsible for closing the PO / Project in Oncore in order to reduce the risk of further charges to OPG.
- (b) The CO or delegate is required to send an email to Oncore Administration – Finance once all vendor charges to the PO have been entered and approved.
- (c) Oncore Administration – Finance will close the PO in Oncore which prevents the vendor to charge to that PO.
- (d) Each month, Oncore Administration – Finance will review a report of the last posted charges against all open POs. Where an open PO has been inactive for 6 months, the Oncore Administrator - Finance will close the PO.

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#### 1.12 Oncore Administration

The Oncore system is normally accessible 24 hours per day, 365 days per year, within OPG and via *Virtual Private Network (VPN)*.

There are two groups involved in supporting the Oncore system:

- (a) Oncore Administration Group – provides administrative support.

Administrative support is available during normal business hours only, via email or phone.

Email: Internal email address: Oncore Admin – Finance

External email address: [oncore@opg.com](mailto:oncore@opg.com)

Phone numbers for the Oncore Administrator – Finance may be found on the Oncore website (see below).

- (b) New Horizons System Solutions – provides technical support and password resets.

Technical support is available during normal business hours only. If a technical issue occurs after business hours, notify the New Horizons System Solutions (NHSS) Help Desk.

Pickering – local extension 4357

Darlington – local extension 4444

700 University and other OPG locations – (416) 592-6400

The Help Desk is staffed from 7:00 am – 6:00 pm Monday to Friday, excluding statutory holidays. At all other times, calls to the Help Desk shall be taken by the NHSS Information Systems Management Centre (ISMC). Calls after business hours shall be addressed next business day.

- (c) Oncore Website

URL:

<http://cmsprod.corp.opg.com/OPG/Content/Finance/Line+Financial+Support/Oncore+Contractor+Management.htm>

Intranet Path (from the OPG Nuclear Website Home Page):

- Quick Links → OPG Today → Quick Links → OPG Today Index → Finance → Cost Reporting → Oncore Contractor Management, OR
- Index tab → Finance → Cost Reporting → Oncore Contractor Management

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The purpose of this website is to provide users with the information and support resources they need to get the most out of Oncore. The website features online documents such as:

- Forms & Templates
- Governing & Supporting Documents
- Oncore Administration Group - Contact Information
- User Manual from Coreworx – Not OPG specific
- User Training Documentation – OPG specific
- List of Vendors Currently Setup in Oncore

Our website is constantly evolving and new and updated information shall appear on a regular basis. The Oncore website is available 24 hours per day, 365 days per year.

#### 1.12.1 Accountabilities

##### (a) Oncore Administration Group

The Oncore Administration Group is responsible for the strategic planning and management of the Oncore system. This entails:

- Managing and providing operational support
- Ensuring security administration
- Providing extensive staff training and documentation
- Problem resolution is provided for system-related problems
- Incidents experienced by users are appropriately tracked and resolved.
- Review and report on any internal control issues with respect to the Oncore Contract Management Process
- Generate exception reports each month and review with contractors, CAs, COs, and OPG Management. Typical exception reports may include:
  - (1) Time Entry exceptions – e.g., Contractors who worked > 16 hours in a day.
  - (2) Time Entry Cycle Review - Days to enter by contract.
  - (3) Approval Cycle Review - Time to approve timesheets.
  - (4) PO Issuance Check - Identification of time worked prior to issuance of PO.
- Periodically confirm that this Instruction is being adhered to and shall request supporting evidence; i.e., record of daily contractor reconciliation.

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#### (b) New Horizons System Solutions

NHSS is responsible for all technical aspects of Oncore. This entails:

- Applying updates, patches, and configuration changes
- Performing daily backups of Oncore data.

#### 1.12.2 New User Setup

All requests to be setup as a new Oncore user shall be initiated through the Information Technology Service Request (ITSR) system. All users of Oncore shall have an OPG identification number, including contractors.

##### (a) Users shall request one of the following specific roles:

- Report generation only
- Timesheet Inputter (usually the Contractor); includes report generation
- Timesheet Approver – Step 2 (OPG CA); includes report generation
- Timesheet Approver – Step 3 (OPG CO); includes report generation.

##### (b) The Oncore Administrator – Finance shall verify that all Timesheet Approvers (Step 2 and Step 3) have completed Oncore Contract Approver training prior to initial setup in Oncore. The Oncore Administrator – Finance shall send an e-mail to any Approvers who have not yet completed the training, advising that they shall complete the Oncore Contract Approver training before they can be setup with approver rights in Oncore.

##### (c) All requests shall be reviewed by the Oncore Administration group prior to setup. Once setup, a new user shall be notified by email of all the particulars (login name, password, etc.) and provided with training material relevant to their role.

#### 1.12.3 Security Roles

The Oncore Administrator – Finance shall maintain the User Account Groups in Oncore. User Account Groups represent a standard set of permissions that applies to more than one user account. In general, there are four standard roles:

- Administrator (Oncore Administration Group)
- Timesheet Inputter (usually the Contractor)
- Timesheet Approver (OPG CA & CO)
- Reporter.

#### 1.12.4 Deactivation of Users

All requests for deactivating Oncore users shall be submitted by the user's supervisor/manager through the ITSR system on the employee's end/termination date. Once the ITSR is approved, the Oncore Administrator – Finance shall deactivate the Oncore user.

Each month, Oncore Administration – Finance will review a report of user accounts. Where a user account has been inactive for 6 months, the Oncore Administrator – Finance will deactivate the account.

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## CONTRACT ADMINISTRATION IN ONCORE

## 2.0 DEFINITIONS AND ACRONYMS

### 2.1 Definitions

**Actual Cost (AC):** The actual costs of work performed, as recorded in Oncore in terms of hours or dollars.

**Internal Control over Financial Reporting (ICOFR):** is required by the Ontario Securities Commission. For Ontario Power Generation, it means that for financial statement accounts over an annually determined materiality threshold (e.g., \$25 million), the processes that contribute to the development of that amount shall be documented. Any risks to the integrity of the transactions shall be identified and, for each risk, all controls in place to mitigate that risk shall be listed. These controls are then tested to make sure they really would prevent that risk. Once that is done, the Process Owner signs off as final confirmation that they are satisfied with the documentation and confident that the controls are sound.

**Planned Value (PV):** The estimated value of work planned in terms of hours and dollars, also referred to as the budget.

**Scope:** The sum of the products and services to be provided as a project.

**Scope Change:** Any change to the project scope and results to be achieved. A scope change almost always requires an adjustment to the project cost, schedule or both.

**Variance at Completion (VAC):**  $VAC = \text{Budget at Completion} - \text{Estimate at Completion (EAC)}$ ; this shall provide an estimate of how much the project shall be over/under the current budget based on the current Cost Performance Index and calculated EAC. This can be used to determine if additional Purchase Order funding is required.

**Virtual Private Network:** A VPN is a communications network tunneled through another network. Security tokens are used to connect to the Ontario Power Generation network via a VPN.

### 2.2 Abbreviations and Acronyms

BTU	Building Trades Union
CA	Contract Administrator
CAL	Computer Assisted Learning
CCN	Contract Change Notice
CCR	Contract Change Request
CO	Contract Owner
CSA	Cost & Schedule Analyst
CV	Cost Variance
EDI	Electronic Data Interface
EPSCA	Electrical Power Systems Construction Association
ESA	Engineering Services Agreement
EV	Earned Value
FAC	Financial Account Classification
ISMC	Information Systems Management Centre

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<b>ITSR</b>	Information Technology Service Request
<b>MSA</b>	Master Services Agreement
<b>NFRA</b>	Nuclear Financial Reporting and Analytics
<b>NHSS</b>	New Horizons System Solutions
<b>OPG</b>	Ontario Power Generation
<b>PO</b>	Purchase Order
<b>RACI</b>	Responsibility, Accountability, Consult, Information
<b>RFP</b>	Request for Proposal
<b>SAP</b>	Systems, Applications and Products
<b>SCR</b>	Station Condition Record
<b>VPN</b>	Virtual Private Network
<b>WO</b>	Work Order

### 3.0 RECORDS AND REFERENCES

#### 3.1 Records

None

#### 3.2 References

##### 3.2.1 Performance References

N-FORM-10029, Services - Request for Purchasing  
N-GUID-00150-10000, Contractor Management Guide  
OPG-PROC-0058, Procurement Activities

##### 3.2.2 Developmental References

FIN-MAN-CM-001, Contractor Management Process Manual  
N-INS-00100-10000, Project Estimating Instruction  
N-PROC-MM-0001, Retention of Contracted Services  
Oncore User Manual

### 4.0 REVISION SUMMARY

This is a non-intent revision.

July 2011 Revised to identify the requirement for approvers (CA and CO) to complete the Oncore Contract Approver training prior to being granted approver authority in Oncore.

- Section 1.6.3: Update to Overview of Timesheet Approval Process
- Section 1.12.2: Update to New User Setup

July 2011 Revised to identify specific Supply Chain authorities responsible to provide rates to Oncore Administration.

- Section 1.2.4: Contractor Rate Management

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July 2011 Revised to clarify Contractor Resource Setup process to distinguish when contractor resources are on OPG Site or not on OPG Site and form to be used.

- Section 1.3.1: Contractor Resource Setup Process Overview
- Section 1.3.2: Contractor Resource Setup RACI chart
- Section 1.3.6: Contractor Resource Termination/Deactivation

July 2011 Added new information on Attachment capability.

- Section 1.5.7: Recording Non-Labour Charges Such as EPSCA Allowances

July 2011 Added new section on Purchase Order and Project Closure Process

- Section 1.11: Purchase Order and Project Closure Process

July 2011 Removed reference to OAR Element 5.3

- Section 1.6.4: Approving Timesheets

July 2011 Removed section (1.6.6) Cancelling Timesheet

July 2011 Removed section (1.7) on Work Progress Recording and Reporting

July 2011 Removed reference to SCORES and replaced with NFRA

July 2011 Removed reference to Contract Change Authorizations (CCA)





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# Nuclear Standard

## TITLE

**CONTRACT MANAGEMENT STANDARD**

## AUTHORIZATION

SINGLE POINT OF CONTACT:      Riyaz Habib  
Director, Projects and Modifications

DOCUMENT OWNER:                  Art Rob  
VP, Projects and Modifications

## DOCUMENT RELATIONSHIP

Applicability:	All of Nuclear
Receives Authority from:	N-PROG-AS-0007, Project Management

Document is Related to Pressure Boundary      ☐      Document Requires CNSC Notification      ☐

## PURPOSE

This standard provides the criteria and behavioral requirements for Contract Management of contracts developed, managed, executed and closed out in Ontario Power Generation – Nuclear (OPG-N). This includes the typical contracting process, deliverables, and the key elements required in the sound commercial development and management of contracts.

## DATES (YYYY-MM-DD)

PDF Creation Date:	2015-11-26
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**EXCEPTIONS**

None

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**CONTRACT MANAGEMENT STANDARD**

### 1.0 DIRECTION

This standard provides requirements for the development, management, execution and close out of contracts within OPG-N. The amount of detail and effort applied to contract management shall utilize a graded approach based on contract and project risk and complexity.

Contract management is the process that enables both parties to a contract to meet their obligations in order to deliver the objectives required from the contract. It also involves building a good working relationship between OPG and the supplier. It continues throughout the life of a contract and involves managing proactively to anticipate future needs as well as reacting to situations that arise.

An important element of contract management is the oversight of supplemental personnel (contractors) to ensure they are meeting safety, quality and performance requirements. N-STD-AS-0032, Oversight of Supplemental Personnel provides the oversight principles and requirements to be applied to work packages initiated and/or executed within OPG by supplemental personnel.

The project manager is accountable for the management of contracts which will deliver project objectives.

It is acknowledged that the means by which different executing organizations implement this standard may vary taking into consideration the risk profile and complexity considerations of the particular contract being undertaken.

### 1.1 Key Contract Management Elements

The following elements are important in the contracting process:

(a) Principles to be followed:

- (1) Adhere to safety and regulatory requirements, laws, codes, and standards.
- (2) Obtain value for money in the delivery of goods and services to maximize the value to shareholders by optimizing total lifecycle costs.
- (3) Ensure quality of service so that the right goods and services are received, when and where they are needed, and per the terms and conditions of the contract.
- (4) Be accountable for the results.
- (5) Be fair to suppliers while protecting OPG interests.
- (6) Engage internal and external stakeholders to ensure alignment and use of best practices, contracts, rates, and terms and conditions.

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- (7) Improve efficiencies and leverage resources.
- (8) Strive for continuous improvement in the creation and lifecycle management of a contract.
- (9) Foster trust and improved supplier relationships including:
  - Being open and transparent
  - Proactively communicating with suppliers and stakeholders
  - Striving for mutual success
  - Sharing of risks and rewards
  - Driving opportunities for cost reduction and efficiency improvements
- (b) Monitor and report key OPG and supplier contract performance indicators. Performance indicators should allow for the detection of at risk deliverables and other risks, and support the implementation of any corrective actions needed to address such issues.
- (c) Leverage the existing and potential future relationships and contracts between OPG and the supplier across multiple contracts and/or projects.
- (d) Manage commercial relationships between multiple suppliers in large projects and programs.
- (e) Execute effective contract administration including:
  - Contract maintenance and change control
  - Cost monitoring
  - Work order and payment control
  - Management reporting
- (f) Ensure safe and effective management of contractors, including:
  - (1) Standards, expectations, and accountabilities for performance are clearly identified, thoroughly communicated to, and understood by, contractors, and then reinforced.
  - (2) Contractors understand their roles and responsibilities specific to the tasks they are performing.

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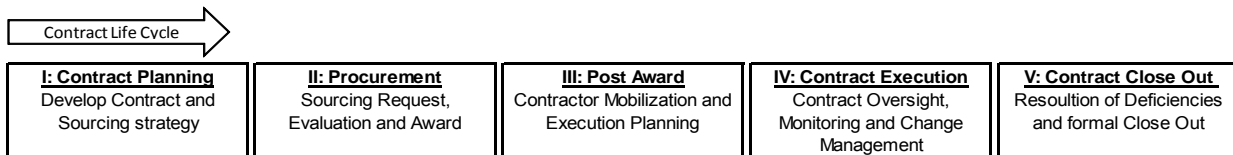
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- (3) Contractors understand the safety significance of the work they are performing, including nuclear, conventional, environmental and radiological safety and also the impact to station reliability.
- (4) Contractors exhibit safety and human performance behaviours expected in the nuclear industry.
- (5) The responsibility for the monitoring and oversight of contractors is clearly identified and effectively performed.
- (6) Feedback is provided to contractors promoting continuous improvement in their performance.

## 1.2 Contracting Process

The contracting process typically consists of five stages as illustrated in Figure 1, Contract Management Stages.



**Figure 1: Contract Management Stages**

Detailed process instructions, guides, work aids and good practices for all key elements of contract management in OPG-N are stored in the controlled documents module of Asset Suite and can also be accessed via N-MAN-09701-10003, Nuclear Contract Management Manual which is available on the OPG intranet through “PowerSearch” or as an E-Manual under the Nuclear Projects webpage.

### 1.2.1 Stage I – Contract Planning

The following is to be well understood in order to develop an effective contracting and sourcing strategy:

- (a) The scope of work must be sufficiently detailed to effectively communicate requirements (i.e., specifications, objectives, and deliverables).
- (b) Risk management strategy (e.g., what risks are acceptable and how are they distributed to the contracting parties?).
- (c) Type of contract (i.e., use existing OPG standard contract or master agreement or develop a custom contract for the project).

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- (d) Pricing model (e.g., firm fixed, time and materials, target).
- (e) Management processes (i.e., interface requirements, oversight, end of life, dispute resolution).
- (f) Negotiations strategy for the contract.
- (g) Proposal evaluation criteria and methodology.
- (h) Contractual terms and conditions.
- (i) Project estimate.
- (j) Sourcing (e.g., single supplier versus multiple suppliers, supplier qualifications, current supplier relationship with OPG, and existing contracts).

Contract planning should include consideration of relevant information such as:

- (1) Internal and external stakeholder input.
- (2) Possible contract innovations, strategies and costs gained from Operating Experience (OPEX), market evaluation and other sources.
- (3) Alignment with other OPG business units regarding strategy and lessons learned.

All contracts should have an assigned contract manager. In some instances the project manager may also be the contract manager. Decisions on the separation of these functions should consider relevant factors including:

- Risk or complexity of the contract
- Sufficient commercial experience

The contract manager will be accountable to and support the project manager.

### 1.2.2 Stage II – Procurement

The procurement stage of the contract management life cycle includes sourcing and awarding of contracts for materials and services in accordance with the contracting and sourcing strategy.

### 1.2.3 Stage III – Post Award

Post award activities typically include the following:

- (a) Site meetings, contractor orientation and mark-up meeting.

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- (b) Execution planning and preparation.
- (c) Contractor mobilization.
- (d) Training of supplier personnel.

### 1.2.4 Stage IV - Contract Execution

Contract management activities during execution include:

- (a) Utilizing the resources in the project team to ensure work (delivery of goods and services) by the suppliers or performed by the contractors is managed and executed in accordance with all applicable quality and regulatory requirements, laws, codes and standards, expectations, roles and responsibilities, accountabilities and in accordance with the terms and conditions of the contract.
- (b) Timely and accurate review and approval of supplier invoices to ensure payments reflect agreed terms and conditions, and completed work.
- (c) Relationship management to keep the relationship between the two parties open and constructive, aiming to resolve or ease tensions and identify problems early in the best interests of both parties.
- (d) Managing, documenting and controlling disputes and/or changes to scope, cost and schedule in accordance with the process defined in the contract and OPG requirements.
- (e) Prompt communication and escalation of issues and risks to reduce potential impacts and set course correction.
- (f) Frequent and effective formal and informal communication with suppliers to ensure objectives and deliverables are understood.
- (g) Regular review of contract status, deliverables, issues and risks as a proactive means of identifying potential issues and implementing correct actions when required.
- (h) Proactive monitoring of supplier and OPG performance to verify adherence to contract terms and conditions to ensure safety, quality, performance and value is maintained to meet OPG and project objectives.

### 1.2.5 Stage V - Contract Close Out

Contract close out typically includes:

- (a) Resolution of outstanding deficiencies and claims related to warranty, insurance, and breach of contract.

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**CONTRACT MANAGEMENT STANDARD**

- (b) Confirmation that all obligations of both the supplier and OPG have been successfully completed.
- (c) Verification of receipt of all required documentation, completion of required payments, and release of project securities.
- (d) Identification and documentation of lessons learned as appropriate.
- (e) Final evaluation of the supplier's performance.
- (f) Formal close of contract.

## 2.0 ROLES AND ACCOUNTABILITIES

### Contract Manager

The Contract Manager is accountable for the following:

- Support the Project Manager throughout all of the contract management stages
- Comprehend fully the commercial and contractual terms and conditions of the contract.
- Interpretation and clarification of the contract terms and conditions to ensure all obligations and compliance with the contract are being met.
- Ensuring that adequate resources are assigned for the management of the contract(s)
- Confirming and periodically verifying that the original signed contract and amendments are in place
- Developing, periodically reviewing, and updating the Contract Management Plan (CMP)
- Identifying high risk terms and conditions within the contract and ensuring mitigation programs or measures are in place
- Coordinating the development and implementation of management procedures, systems and processes to facilitate effective management of the contract
- Participating in project review meetings to support the project team on commercial and contractual matters for the assigned contracts
- Ensuring that all contractual conditions regarding safety, environment, quality, scope, legal requirements, cost and schedule are met in a timely manner during execution of the contract.



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- Coordinating resolution of contractual claims and disputes
- Ensuring that appropriate oversight of supplemental personnel is in place to meet safety, quality and performance requirements.
- Maintaining communication with the Supplier to ensure the ongoing relationship between the parties continues
- Supporting closure of the contract

All contracts will have an assigned contract manager. In some instances the project manager may also be the contract manager. Decisions on the separation of these functions should consider relevant factors including:

- Risk or complexity of the contract
- Sufficient commercial experience for the person assigned the accountability

### 3.0 DEFINITIONS AND ACRONYMS

#### 3.1 Definitions

None

#### 3.2 Abbreviations and Acronyms

None

### 4.0 BASES, RECORDS AND REFERENCES

#### 4.1 Records

- 4.1.1 Any controlled documents which may be produced as a result of this document should be managed in accordance with OPG-PROC-0178, Controlled Document Management.
- 4.1.2 Any records which may be produced as a result of this document should be managed in accordance with OPG-PROC-0019 Records and Document Management, and N-MAN-00120-10001-RDM Nuclear Projects Records and Document Management.

#### 4.2 References

##### 4.2.1 Performance References

N-MAN-09701-10003, Nuclear Contract Management Manual

N-PROG-AS-0007, Project Management

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N-STD-AS-0032, Oversight of Supplemental Personnel

### 4.2.2 Developmental References

Excellence in Nuclear Project Management, INPO 09-002

N-PROG-AS-0006, Records and Document Control

OPG-PROC-0058, Procurement Activities

OPG-PROC-0060, Requisitioning Items and Services

OPG-PROG-0006, Investment Management

Supplemental Personnel Process Description, INPO AP-930, Rev 2

## 5.0 REVISION SUMMARY

This is an **intent** revision.

- SPOC and Document Authority updated
- Purpose statement updated
- Sec 1.0 Direction: The last sentence added to the last paragraph.
- Sec. 1.2 Contracting Process: last paragraph added
- Incorporated DCR 0000120901



## Guideline

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Title:

## CONTRACTOR MANAGEMENT PROCESS

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## Contractor Management Process

**N-GUID-00120-10008-R002**  
2015-10-21

Order Number: N/A  
Other Reference Number:

### Internal Use Only

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Senior Advisor  
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Approved By: Dave Stiers  
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Nuclear Projects

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Title: <b>CONTRACTOR MANAGEMENT PROCESS</b>		

## Revision Summary

Revision Number	Date	Comments
R000	2012-10-22	Initial Issue
R001	2014-02-20	Corrected retention period from T20 to T10
R002	2016-04-27	For records table in section 5.1: under N-FORM-11487, added the option to use an alternative means such as "maintain a daily log book".

## Guideline

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Title: <b>CONTRACTOR MANAGEMENT PROCESS</b>		

### 1.0 PURPOSE

This document identifies the minimum process requirements for monitoring a contractor during the field execution of contracted work at Ontario Power Generation Nuclear (OPGN).

### 2.0 EXCEPTIONS

- Contracts issued for the purchase of manufactured goods delivered to site, or for work being done for OPG in a contractor's workplace.
- Other contracts where the company is only on site for delivery, e.g., items handled through warehousing, courier, and bottled water delivery. The process DOES apply to contracts where the company requires craning and rigging to load and unload the delivery or when the delivery involves physical connections to OPG systems on OPG property; e.g., fuel oil, bulk chemicals, pressurized gases.
- Owner Only contracts
- Contracts excluded with the approval of the Stratum IV Manager or greater.

### 3.0 DIRECTION

To guide Project/Contract Managers responsible for a contractor during execution of work at OPGN facilities, if OPGN's roles and duties are *Owner/Constructor* or *Owner/Employer* as defined by the Ontario Occupational Health and Safety Act (OHSA). Oversight of the Contractor(s) in the field will be incorporated in the Project's Oversight Plan (POP) per N-STD-AS-0030 and N-MAN-09701-10002.

## Guideline

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### 4.0 OVERVIEW OF THE PROCESS

Once a contract has been successfully awarded, the Project Manager/Contract Manager will ensure the following is completed:

- 4.1.1 Assign a qualified supervisor, as per OHSa Section 14 of O. Reg. 213.  
  
Note: Direct supervision of contractor workers is always provided by the contractor, not OPG.
- 4.1.2 Report and document deficiencies, incidents and deviations to the contract.
- 4.1.3 Conduct a Project Kick-Off/Orientation Meeting with the Contractor and other applicable OPGN stakeholders including review of Human Performance and work expectations.
- 4.1.4 Ensure that the Contractor has conducted a Mark-up Meeting to determine jurisdiction for Building Trades Union work.
- 4.1.5 Verify Contractor qualifications and provide OPGN-based training as required. For BTU Training requirements, refer to N-TQD-510-00001.
- 4.1.6 Appoint competent person(s) for oversight of work to ensure safety, quality, performance and value are maintained and to verify adherence to contract terms and conditions.

Activities in support of the above may include but are not limited to the following:

- Stop any work activities that pose an immediate danger.
- Attend Contractor Pre-Job Briefings at a frequency determined by the Project Manager/Contract Manager and in accordance with the Project Oversight Plan.
- Maintain a log to record Contractor activities, discussions and deficiencies

**Note:** Job aids providing guidance for the tasks listed above are available in the Contract Management Toolkit on the Projects and Modifications website.

### 5.0 RECORDS AND REFERENCES

#### 5.1 Records

- 5.1.1 Any controlled documents which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0003, Controlled Document Management.

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### CONTRACTOR MANAGEMENT PROCESS

5.1.2 Any records which may be produced as a result of this document should be managed in accordance with OPG-PROC-0019, Records and Document Management and N-MAN-00120-10001-RDM, Nuclear Projects Records and Document Management.

5.1.3 The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.

Record Created	Associated Form Number	QA Record Y/N?	Filing Information/Retention
Site Contract Management (CM) File	n/a	N	Site Project Management File, issued in Asset Suite by Purchase Order number. Retention = 10 Years after purchase Order closed (RRC) - N02-0049. Retention = T10
Contract Management Template	N-FORM-11473	N	Issued in Asset Suite as Record. Retention = T10. RRC: N02-0049
Contractor Work Release	N-FORM-11470	N	Issued in Asset Suite as Record. Retention = T10. RRC: N02-0049
Contract Inspection Check List	N-FORM-11479	N	Issued in Asset Suite as Record. Retention = T10. RRC: N02-0049
Safety Certification of Contractor's Equipment	N-FORM-11482	N	Issued in Asset Suite as Record. Retention = T10. RRC: N02-0049
Daily Log	N-FORM-11487 OR equivalent such as a Daily Log Book	N	Issued in Asset Suite as Record. Retention = T10. RRC: N02-0049

## 5.2 References

### 5.2.1 Performance References

- N-PROG-AS-0007, Project Management

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### 5.2.2 Developmental References

- N-STD-AS-0028, Project Management Standard
- N-STD-AS-0029, Contract Management Standard
- Ontario Occupational Health and Safety Act (OHSA Green Book)

### 5.3 Job Aid

- N-FORM-11473: Contract Management Template
- N-FORM-11470: Contractor Work Release
- N-FORM-11479: Contract Inspection Checklist
- N-FORM-11482: Safety Certification of Contractors Equipment
- N-FORM-11487: Daily Log





Contractor/Owner Interface  
Agreement

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CONTRACTOR/OWNER INTERFACE REQUIREMENTS FOR NUCLEAR

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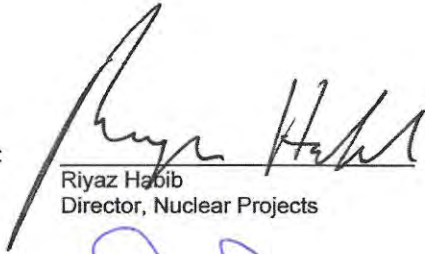
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CONTRACTOR/OWNER  
INTERFACE REQUIREMENTS  
FOR NUCLEAR

2013-07-19

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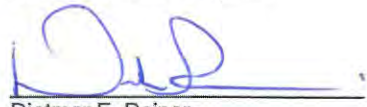
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Riyaz Habib  
Director, Nuclear Projects

Date:

Aug 20/2013

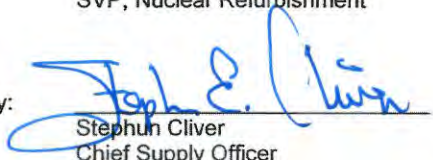
Approved by:

  
Dietmar E. Reiner  
SVP, Nuclear Refurbishment

Date

Aug-23, 2013

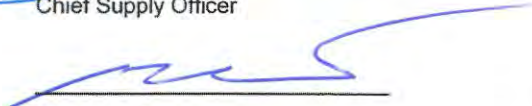
Approved by:

  
Stephen Cliver  
Chief Supply Officer

Date

Sept. 5, 2013

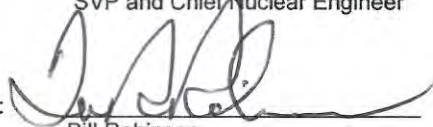
Approved by:

  
Mark Elliott  
SVP and Chief Nuclear Engineer

Date:

Aug 27, 2013

Approved by:

  
Bill Robinson  
SVP, Nuclear Projects

Date:

Sept 13, 2013

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**Revision Summary**

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R000	August 2013	Initial Issue

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**CONTRACTOR/OWNER INTERFACE REQUIREMENTS FOR NUCLEAR**

## 1.0 INTRODUCTION

### 1.1 Scope

This Interface Requirements (COIR) outlines the responsibilities and accountabilities, activities, deliverables and interfaces between OPG and the Contractor while performing activities in support of work at OPG Nuclear.

### 1.2 Purpose

The purpose of the COIR is to facilitate the successful implementation of work at OPG Nuclear by ensuring that Engineering, Procurement, and Construction activities are in conformance with OPG and regulatory requirements.

### 1.3 Safety

Safety is our core value when conducting any business activity in OPG Nuclear. Safety includes Nuclear, Conventional, Environmental, and Radiological safety aspects.

The safety of OPG's personnel, the Contractor's personnel, individuals at or near the Sites, and the public is of paramount concern to OPG. OPG will require that Contractors and their Subcontractors maintain a level of safety equivalent to that of OPG employees while at OPG workplaces.

Our business needs to comply with OPG Requirements and applicable Federal and Provincial regulatory requirements.

#### 1.3.1 Nuclear Safety Culture

OPG and the Contractor's management shall use their respective management systems to understand and promote a nuclear safety culture by

- a) Issuing a statement committing workers to adhere to the management system;
  - b) Defining and implementing practices that contribute to excellence in worker performance;
  - c) Providing the means by which the business supports workers in carrying out their tasks safely and successfully, by taking into account the interactions between individuals, technology, and the organization;
  - d) Monitoring to understand and improve the nuclear safety culture; and
  - e) Promoting the practice of the Nuclear Safety Traits in the development and execution of work.
-

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## 2.0 DESCRIPTION

### 2.1 Process

Work of a commercial or non-complex nature may utilize a simplified or different process. Additionally, specific projects may be executed using only sub-portions of this document (e.g. engineering only projects), or with modified accountabilities particular to a project or Contractor. A list of deviations to this document or a separate stand alone process for such work will be included in a project specific Worksheet.

Contractor steps may not apply to all work and are illustrative to support the OPG/Contractor Interface Requirements.

Sections 3 to 6 of this document details typical deliverables or items related to work where there is an OPG/Contractor interface in the delivery of work. Any section of the Contractor/Owner Interface Requirements (COIR) which is applicable will be identified in the worksheet or scope of work.

### 2.2 Contractor Responsibilities

The Contractor shall have and maintain full working knowledge of OPG's Design and Configuration Management standards and procedures to ensure that design basis and plant configuration management standards are maintained throughout the project life cycle.

The Contractor has responsibility for maintaining accuracy of technical content and compliance with the Contractor's Quality Assurance Program.

#### 2.2.1 Governing Procedures

All modifications shall be carried out in accordance with the OPG Nuclear Engineering Change (EC) N-PROC-MP-0090.

Maintenance activities will have defined interfaces which will be reviewed and approved by OPG.

OPG procedures shall be followed and OPG requirements met for all work unless otherwise approved by OPG.

#### 2.2.2 Professional Engineers of Ontario (PEO)

The Contractor shall comply with the Professional Engineers of Ontario (PEO) guidelines on sealing engineering drawings and documents.

### 2.3 OPG Roles and Accountabilities

OPG shall appoint an overall project single point of contact (OPG Representative) for each specific Purchase Order utilizing this document. The OPG Representative shall prepare a contact list detailing specifically who within OPG will interface and / or accept related deliverables or items as defined in sections 3 to 6 of this document.

OPG roles / accountabilities as defined in sections 3 to 6 of this document are defined as follows:

(1) Review

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Review means that when stated in the Design Plan or in the approved COIR document or in the agreement between OPG and Contractors, a signed copy of the specific Engineering Document will be transmitted to OPG for comments, and an acknowledgment of receipt is to be recorded by the Contractor.

Contractor Project Representative will maintain a Comment / Disposition file for all deliverables in the project file until final acceptance by the Contractor and OPG at which point the Contractor will file a PDF version of the accepted Comment / Disposition Forms in the working files.

An OPG review is to ensure that the deliverable satisfies the project scope & design requirements, procedural compliance and OPG's quality expectations. OPG reserves the right to conduct a further detailed review of the deliverable if OPG feels necessary.

Asking questions and clarifications and providing suggestions and alternative approaches with respect to design issues when required. This is not to be misinterpreted as direction or advice from OPG to the Contractor.

OPG is not accountable for the accuracy of technical content of any document produced by the Contractor, including validation of any assumptions regarding existing condition of the equipment/system interfacing with the new modification. For greater certainty, the Contractor bears the entire risk for design & implementation of the work in accordance with the OPG Specification.

### (2) Accept

Accept means that the document or deliverable is suitable for its intended use, and meets process, format and content requirements as required for its input into OPG's approved information management system.

OPG will indicate acceptance of a document by a suitable stamp on the document signatory page, or by an OPG Coversheet, identifying OPG accepting signatories, which is then attached to the document being accepted, or by an electronic signature in the OPG Asset Suite program. OPG's acceptance of the product does not relieve the Contractor from responsibility for errors or omissions or from any obligations or liability under the contracted OPG Specification.

Asking questions and clarifications and providing suggestions and alternative approaches with respect to design issues when required. This is not to be misinterpreted as direction or advice from OPG to the Contractor.

OPG is not accountable for the accuracy of technical content of any document produced by the Contractor, including validation of any assumptions regarding existing condition of the equipment/system interfacing with the new modification. For greater certainty, the Contractor bears the entire risk for design & implementation of the work in accordance with the OPG Specification.

### (3) Authorize

---

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For the Contractor deliverables like Design Manuals, and Design Plans , OPG site Design Authority will sign-off for 'Authorized for Use'.

Asking questions and clarifications and providing suggestions and alternative approaches with respect to design issues when required. This is not to be misinterpreted as direction or advice from OPG to the Contractor.

OPG is not accountable for the accuracy of technical content of any document produced by the Contractor, including validation of all assumptions regarding existing condition of the equipment/system interfacing with the new modification. For greater certainty, the Contractor bears the entire risk for design & implementation of the work in accordance with the OPG Specification.

#### (4) Support

As applicable, Support means to lend the Contractor verbal and process guidance by:

- Attending and contributing at meetings.
- Participating in discussions and providing informal undocumented comments.

Asking questions and clarifications and providing suggestions and alternative approaches with respect to design issues when required. This is not to be misinterpreted as direction or advice from OPG to the Contractor.

OPG is not accountable for the accuracy of technical content of any document produced by the Contractor, including validation of any assumptions regarding existing condition of the equipment/system interfacing with the new modification. For greater certainty, the Contractor bears the entire risk for design & implementation of the work in accordance with the OPG Specification.

#### (5) Approve

1. Engineering Approval is conducted by the Contractor under the Contractor's QA program. Approval of engineering design documentation may require a Professional Engineer's (P. Eng) signature and seal. Such approval means taking professional design responsibility for the engineering document.
  2. OPG or Design Authority (DA) approval shall be performed by OPG to signify OPG's acceptance that the product(s) is prepared, reviewed, and verified by competent persons and that appropriate processes/procedures including codes and standards were applied. In addition, the approval shall ensure that the document or deliverable is suitable for its intended use, and meets process, format and content requirements as required for its input into OPG's approved information management system.
  3. Director of Operations & Maintenance (DOM) approval signifies the deliverable has no significant impact on Plant Operations and License obligations (e.g., Safety, Environmental, Production etc.)
-

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Asking questions and clarifications and providing suggestions and alternative approaches with respect to design issues when required. This is not to be misinterpreted as direction or advice from OPG to the Contractor.

OPG is not accountable for the accuracy of technical content of any document produced by the Contractor, including validation of any assumptions regarding existing condition of the equipment/system interfacing with the new modification. For greater certainty, the Contractor bears the entire risk for design & implementation of the work in accordance with the OPG Specification.

## 2.4 Deviations from the COIR

Deviations are changes to the roles and responsibilities for the applicable elements of the COIR. Deviations from this COIR will be documented in the approved Deviation List (N-Form-11583). Some of the accountabilities performed by the Contractor require Purchase Service Agreement (PSA) with unions representing OPG staff. Based on PSAs obtained, deviations from the COIR may be required.

## 2.5 Asset Suite Updates

All Asset Suite activities should be completed as the Engineering Change is progressed through the EC process.

Submit documents to OPG's Information Management Services (IMS) with proof of OPG representative acceptance. As appropriate, submissions can be completed via the Supplier Document Hub (SDH) or through one of the following emails

- a) Internal: DNGD:REFURB DM –NUCLEAR or
- b) External: [nrdocmgmt@opg.com](mailto:nrdocmgmt@opg.com)

### Notes:

- 1. Do not include any other IMS mailboxes/contacts in email submissions.
- 2. OPG is replacing the SDH with a new Nuclear Projects custom Electronic Document Management System (EDMS).

## 2.6 Abbreviations and Acronyms

ADL	- Affected Document List
AEL	- Affected Equipment List
AFS	- Available for Service
AIA	- Authorized Inspection Agency
ANI	- Authorized Nuclear Inspector
BOM	- Bill of Materials (Spare Parts for Equipment)
CCD	- Computer & Control Design Specialist
CD	- Control Document
CNSC	- Canadian Nuclear Safety Commission
COAT	- Check Out And Test



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COMS	- Constructability, Operability, Maintainability and Safety
DA	- Design Authority, Pickering / Darlington Nuclear
DBOM	- Drawing Bill of Materials
DE	- Design Engineer
DLA	- Designated Licensing Authority
DO	- Drawing Office
DOM	- Director of Operations and Maintenance
DP	- Design Plan
DR	- Design Requirements
D_SCL	- Design Scoping Checklist
EBOM	- Equipment Bill of Materials (Spare Parts)
EC	- Engineering Change
EDMS	- Electronic Document Management System
EQ	- Environmental Qualification
FIC	- Field Initiated Change
FTL (C)	- Field Team Leader, Commissioning
FTL (I)	- Field Team Leader, Installation
HFE	- Human Factor Engineering Specialist
IMS	- Information Management Services
INTEC	- Fuel Handling Online Wiring for Darlington
JHSC	- Joint Health and Safety Committee
MDR	- Modification Design Requirements
MEL	- Master Equipment List
MO	- Modification Outline
MR	- Material Request
NGET	- Nuclear General Employee Training
O_HSA	- Occupational Health and Safety Act
OLW	- On-Line Wiring
P. Eng	- Professional Engineer designation licensed by Professional Engineers Ontario
PDRI	- Project Definition Rating Index
PMID	- Preventative Maintenance ID
PSR	- Pre-Start Health and Safety Review
QA	- Quality Assurance
RDL	- Reference Document List
RFP / Q	- Request for Proposal / Quote
SCL	- System Classification List
SDH	- Supplier Document Hub
SM	- Section Manager
SME	- Subject Matter Expert
SPMP	- System Performance Monitoring Plan
SPOC	- Single Point of Contact

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SRE	- System Responsible Engineer
SSC	- System, Structure or Component
TSSA	- Technical Standards and Safety Authority

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### 3.0 PROJECT MANAGEMENT MATRIX

#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
3.1	Reservation, Superseding & Obsolescence of Controlled Document	N-PROC-AS-0003 N-FORM-10027	<b>SUPPORT</b> OPG Representative to provide support if required	<b>ACCOUNTABLE</b> Prepare Controlled Document Request Form as per procedure and template and forward electronically to OPG Controlled Documents inbox (See 2.5 for details).  For Superseding and Obsoleting, obtain concurrence from OPG Document Owner prior to submission.  Copy OPG Representative for information.	N-FORM-10027
3.2	Submission of Controlled Documents / Records to OPG Information Management Services (where not otherwise specified in this document).	N-PROC-AS-0003 N-FORM-10027 N-FORM-10653 N-MAN-00120-10001-RDM-03 N-PROC-AS-0042 OPG-PROC-0019	<b>REVIEW / ACCEPT</b> OPG Representative to accept and return to Contractor	<b>ACCOUNTABLE</b> Prepare Control Document Form / Document Transmittal Form and submit document to OPG IMS with proof of OPG acceptance (See 2.5 for details).  Upon acceptance by OPG, submit documents to OPG Records (See 2.5 for details).	N-FORM-10027 N-FORM-10653
3.3	Comment & Disposition	N-PROC-MP-0090 N-STD-MP-0009 OPG Comment & Disposition Form N-FORM-11109 or Approved template per Contractor Quality Assurance Plan	<b>REVIEW / ACCEPT</b> OPG Representative to provide comments as required to Contractor.  OPG to accept final disposition.	<b>ACCOUNTABLE</b> Submit signed documents to OPG Representative for Review and Comments.  One (1) Review Cycle will be the target (complete when Dispositions have been dispositioned by OPG Representative)  Correction of errors or OPG rejection is not counted as a review cycle.	N-FORM-11109 or approved equivalent template per Contractor QA plan

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
				Contractor Representative to file the finalized/signed Comment / Dispositions electronically as part of the working file.	
3.4	Station Condition Records (SCR)	SCR Database N-PROC-RA-0022	<b>SUPPORT</b> OPG Representative to provide other support if required..  Set up Contractor specific alert group in SCR Program and Asset Suite.	<b>ACCOUNTABLE</b> Issues related to OPG (eg. Safety, Configuration Management, Delays) are to be documented by the Contractor via the SCR Process.  Contractor Representative or appropriate representative will input into OPG SCR program.  Contractor is responsible for development and completion of Corrective Action Plan identified through the OPG SCR Process.  Non-conformances related to the Contractors own QA program are to be resolved by the Contractor outside the SCR Process.  Provide and execute SCR coordinator duties for Contractor related SCRs.	
3.5	Value Engineering (If required)	N-GUID-00120-10005	<b>SUPPORT / REVIEW / ACCEPT</b> Participate in Value Engineering Session.  Review and accept report.	<b>ACCOUNTABLE</b> Organize and Chair Value Engineering Session.  Incorporate Value Engineering output into project design.  Forward summary report to OPG.	Value Engineering Summary Report

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
				Submit report to OPG (See 2.5 for details).	
3.6	Project Definition Rating Index (PDRI) (If required)	Construction Industry Institute Implementation Resources: 113-2 (Industrial Projects) 155-2 (Building Projects) 268-2 (Infrastructure Projects)	<b>SUPPORT</b> Participate in PDRI Session.	<b>ACCOUNTABLE</b> Organize PDRI Session / provide facilitator.  Maintain status in project working files.	
3.7	COIR List of Deviations	N-FORM-11583 N-GUID-00120-10009	<b>ACCOUNTABLE</b> OPG to provide an approved List of Deviations to this COIR as part of RFP/Work Request (where this COIR is to be referenced).	<b>SUPPORT / ACCEPT</b> Contractor to Review & Accept COIR List of Deviations as part of Contract Award process.	N-FORM-11583
3.8	Chemistry Control		<b>SUPPORT</b> Provide support as required.	<b>ACCOUNTABLE</b> Interface with designated OPG SPOC to ensure 1) chemicals and chemical products are received, labelled and stored properly per OPG requirements and 2) only approved chemicals and chemical products are used.	Records of oversight and any non compliances.
3.9	Environment Program / Plan		<b>SUPPORT / REVIEW / ACCEPT</b> Provide input as requested.  Review and accept Environmental Plan.	<b>ACCOUNTABLE</b> Develop and approve project specific Environmental Plan for OPG acceptance.	Project Specific Environmental Plan
3.10	Access Protocol	N-FORM-11584	<b>SUPPORT</b> OPG Representative to provide direction on access to work.	<b>ACCOUNTABLE</b> Contractor to identify to OPG issues with access to work due to other Contractor at the same place.	Access Protocol for Work

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### 4.0 ENGINEERING INTERFACE MATRIX

#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
	<b>REPORTS</b>				
4.1	Technical / Design Review Report,		<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to accept.	<b>ACCOUNTABLE</b> When directed to in the OPG Specification, Setup and conduct Technical / Design Review  Coordinate review and comment process.  Prepare, Verify / Review, and Approve the report and submit to OPG Representative for acceptance.  Provide report to OPG Representative with Controlled Documents form required for Asset Suite Issuance (See 2.5 for details).	Technical/Design Review Report
4.2	Assessment Report / Assumption Validation Report		<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to provide stakeholder input and accept via signature on coversheet or stamp.	<b>ACCOUNTABLE</b> Coordinate participation in the review and providing comments.  Prepare, Verify / Review, Approve the report and submit to OPG Representative for acceptance.  Submit to OPG Information Management Services for issue with proof of OPG Acceptance (See 2.5 for details).	Assessment Report/Assumption Validation Report
4.3	Pre-Start Health & Safety Report	Section 7 of O. Reg. 851/90 under OH&S Act. N-FORM-10853 or equivalent	<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to provide stakeholder input and accept.	<b>ACCOUNTABLE</b> Where a review is required, Contractor Representative to coordinate review and disposition review comments.	PSR Report

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
		N-INS-08121.3-10000		<p>Prepare PSR report if required based on the assessment.</p> <p>Perform any required pre-start inspections as required by the review before the apparatus, structure, or protective element is operated or used, and confirm the report has been provided to OPG JH&amp;SC.</p> <p>Submit report to OPG with Controlled Documents form required for Asset Suite Issuance and proof of OPG acceptance (See 2.5 for details).</p>	
4.4	Miscellaneous Reports e.g. Seismic, Feasibility etc.		<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to provide stakeholder input and accept via signature on coversheet or stamp.	<p><b>ACCOUNTABLE</b> Where a review is required, Contractor Representative to coordinate review and disposition review comments.</p> <p>Prepare, Verify, and Approve.</p> <p>Submit accepted report to OPG with Controlled Documents form required for Asset Suite Issuance and proof of OPG acceptance (See 2.5 for details).</p>	
4.5	Conceptual Design Report	N-STD-MP-0009	<b>ACCOUNTABLE</b> Prepare & Approve.	<b>ACCEPT</b> Utilize the Conceptual Design Report as Reference Document	Conceptual Design Report
4.6	Design Review Meetings (DRM)		<b>SUPPORT</b> Support and participate as required to provide stakeholder input in each meeting.	<b>ACCOUNTABLE</b> As required facilitate review meetings throughout the Design Phases.	Design Review Meetings

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
<b>REGULATORY APPROVALS</b>					
4.7	Preparation / Revision of System Classification List	N-FORM-10250 N-PROC-MP-0040	<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to provide stakeholder input and accept.  OPG Representative to support resolution of legacy issues related to SCL.	<b>ACCOUNTABLE</b> Prepare, Verify, & Approve, applicable Flow Diagram (Change Paper Format).  Request input as required from OPG Representative.  Consult with OPG Representative re resolution of legacy issues if necessary.  Prepare, Verify, & Approve System Classification List (Change Paper Format)  Submit to OPG Information Management Services upon completion.	System Classification List
4.8	Code Classification Approval and Exemptions  Code Class Exemption Assessment (if applicable)  Portable Assembly Exclusions	N-FORM-11003 N-FORM-11045 N-FORM-10250  N-FORM-11524 N-PROC-MP-0040 N-PROC-MP-0082	<b>SUPPORT / REVIEW / ACCEPT / APPROVE (if required)</b> OPG Representative to provide stakeholder input and accept.  OPG DA to approve Portable Assembly Exclusion N-FORM-11524, if required.	<b>ACCOUNTABLE</b> Prepare, Review, & Approve N-FORM-11003, N-FORM-11524  Prepare, Review / Verify, & Approve N-FORM-11045 (if applicable).  File as per requirements of N-PROC-MP-0040.	N-FORM-11003  N-FORM-11045 Code Class Exemption Assessment (if applicable).  N-FORM-11524
4.9	CNSC Code Class Approval Submission	N-PROC-MP-0040 N-PROC-RA-0047	<b>SUPPORT / REVIEW / APPROVE</b> OPG Representative will review the CNSC submission package as per N-PROC-MP-0040.	<b>ACCOUNTABLE</b> Prepare CNSC submission package as per N-PROC-MP-0040 and submit to OPG Representative for review.	Standard Submission Package



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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
			<p>OPG Designated Licensing Authority to approve and submit to CNSC.</p> <p>OPG to notify Contractor upon classification approval by the CNSC.</p> <p>OPG to submit records to Information Management Services.</p>	<p>Incorporate Reviewer Comments.</p> <p>Route final CNSC submission packages to OPG Designated Licensing Authority (Regulatory Affairs) for submission to CNSC.</p> <p>Provide support and prepare responses as required to resolve any issues raised by CNSC during the Classification Approval Process.</p> <p>Confirm with OPG Representative that CNSC approval has been received.</p>	
4.10	AIA (TSSA) Registration Submission and Associated Documentation	N-PROC-MP-0082	<p><b>SUPPORT</b> OPG Representative to issue Letter of Authorization to Contractor to process AIA (TSSA) submission on OPG's behalf.</p> <p><b>SUPPORT</b> OPG Representative will coordinate resolution of legacy issues related to registered systems.</p>	<p><b>ACCOUNTABLE</b> Prepare/assemble design registration packages and submit to AIA (TSSA) for registration on OPG's behalf.</p> <p>Consult with OPG Representative re resolution of legacy issues if necessary.</p> <p>Resolve any issues raised by AIA (TSSA) during the Registration Process.</p>	Registration Package
4.11	AIA (TSSA) Registration Requirements & Exemptions	N-PROC-MP-0082 N-PROC-MP-0040 N-FORM-11003 N-FORM-11524	<p><b>SUPPORT / REVIEW / ACCEPT / APPROVE (if required)</b> OPG to provide input and accept.</p> <p>OPG DA to approve Portable Assembly Exclusion N-FORM-11524, if required.</p>	<p><b>ACCOUNTABLE</b> Prepare, review and approve N-FORM-11003, N-FORM-11524.</p> <p>File as per requirements of N-PROC-MP-0040.</p>	N-FORM-11003 N-FORM-11524

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
4.12	Reconciliation Statement - no re-registration required	N-PROC-MP-0082 N-FORM-10971 (Class 6) N-FORM-10972 (Nuclear)	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to provide input and accept.	<b>ACCOUNTABLE</b> If required, prepare Reconciliation Statement for modification and as-builts (N-FORM-10971 for Class 6) / (N-FORM-10972 Nuclear).  Include signed Documentation as required.  Submit to OPG Information Management Services upon completion  Coordinate submission of Reconciliation Statements to ANI / AIA (TSSA), if required.	Reconciliation Statement - no re-registration required –nuclear class  Reconciliation Statement - no re-registration required class 6
4.13	CNSC Notification or Approval of Modification, and other Correspondence	N-FORM-10369	<b>SUPPORT/APPROVAL</b> Review CNSC letter.  Designated OPG Licensing Authority to approve and submit to CNSC.  OPG to notify Contractor upon approval or concurrence by the CNSC.  OPG to submit records to Information Management Services.	<b>ACCOUNTABLE</b> Prepare CNSC correspondence letter and submit to OPG for review.  Route final CNSC submission packages to Designated OPG Licensing Authority (Regulatory Affairs) for submission to CNSC.  Provide support and prepare responses as required to resolve any issues raised by the CNSC.  Confirm with OPG Representative that CNSC approval has been received.	Submission Package

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
4.14	Other Regulatory Approval correspondence (e.g. Ministry of Labour, Ministry of Environment, Coast Guard, Bldg Permits Electrical Safety Authority, etc.).		<b>SUPPORT / REVIEW</b> Review Regulatory letter.	<b>ACCOUNTABLE</b> Prepare Regulatory correspondence letter and submit to OPG.  Once letter has been reviewed by OPG proceed to obtain approval.  Provide support and prepare responses as required to resolve any issues raised during the Approval Process.  Submit to OPG Records with proof of OPG acceptance (See 2.5 for details).	Submission Package
<b>Master EC RELATED ACTIVITIES</b>					
4.15	Master EC: General	N-PROC-MP-0090 N-GUID-00700-10000 N-GUID-01920-10000	<b>APPROVE</b> OPG signs off Master EC milestone in Asset Suite and approves Master EC based on the signed Modification Outline.	<b>ACCOUNTABLE</b> Contractor to utilize Master EC package and populate Asset Suite.	Master EC Package
4.16	Modification Outline	N-FORM-10958 N-PROC-MP-0090 N-GUID-00700-10000	<b>ACCOUNTABLE</b> Provide approved Modification Outline.	<b>ACCEPT</b> Utilize approved Modification Outline as reference.	N-FORM-10958
4.17	Design Scoping Checklist	N-PROC-MP-0090 N-FORM-10959	<b>ACCOUNTABLE</b> Prepare Design Scoping Checklist and provide to Contractor.	<b>ACCEPT</b> Utilize Design Scoping Checklist as reference.	N-FORM-10959
4.18	Modification Design Requirements (MDR)	N-PROC-MP-0065 N-INS-00700-10007 N-TMP-10187	<b>SUPPORT / VERIFY / APPROVE</b> OPG to prepare, verify and approve document Coordinate reviews and comments from OPG stakeholders and execute challenge meeting.	<b>ACCEPT</b> Accept, utilize and identify any required changes.	Modification Design Requirements document / System Design Requirements

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
			OPG Design Authority to Authorize for use.		document
4.19	Design Plan	N-PROC-MP-0074	<b>SUPPORT / AUTHORIZE</b> OPG Representative to support.  Design Authority to Authorize.	<b>ACCOUNTABLE</b> Coordinate reviews and comments from OPG stakeholders.  Prepare, Review, Approve Design Plan document for the OPG Specification.  Submit to Project Representative for acceptance.  Submit final fully signed Design Plan with Control Document form and proof of OPG acceptance for issuing to OPG Information Management Services (See 2.5 for details)  Maintain Status & Accuracy of Design Plan.  As a minimum, revise Design Plan upon issue of Design Packages as per EC Release Plan.  Close out Design Plan upon completion of applicable EC(s).	Design Plan, as per OPG applicable template or approved equivalent template per Contractor QA plan
4.20	Constructability Operability, Maintainability, and Safety (COMS) Stakeholder Declaration	N-PROC-MP-0083 N-FORM-10007 N-FORM-10480 N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT</b> Stakeholders to participate in COMS.	<b>ACCOUNTABLE</b> Contractor to lead COMS process.  Contractor will send out COMS meeting and walkdown notices.  Take minutes, record actions and distribute to stakeholders.	N-FORM-10007 N-FORM-10480

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
				<p>Disposition any issues identified during COMS with the Stakeholder.</p> <p>Sign-off COMS stakeholder declaration as required.</p> <p>Coordinate and participate in COMS walkdowns.</p>	
4.21	Field Verification of existing plant configuration prior to start of design	N-PROC-MP-0047 N-PROC-MP-0090 N-GUID-00700-10000	<p><b>SUPPORT</b></p> <p>OPG Representative to provide Field Assistance if requested (e.g. Radiation Sponsorship etc)</p> <p>OPG Representative to review the discrepancies and resolutions.</p> <p>OPG Representative to process/handle scope changes for resolutions outside of Project Scope</p>	<p><b>ACCOUNTABLE</b></p> <p>Field verify all conditions related to modifications.</p> <p>Communicate risks to OPG re any cases where this is not possible/impractical and document in Master EC,</p> <p>File SCR and Inform OPG Representative re any field conditions not in alignment with plant documentation for OPG. Intent is that Contractor will normally incorporate addressing of configuration management issues as part of their design.</p> <p>Record actions required in Issues Tracking File.</p> <p>Where applicable process Walkdown Report as per 4.4.</p>	Walkdown Report or equivalent.
4.22	Review of Pending Changes Impacting Project Scope	N-PROC-MP-0090 N-GUID-00700-10000	<p><b>SUPPORT</b></p> <p>OPG Representative to support as required.</p>	<p><b>ACCOUNTABLE</b></p> <p>Contractor to review Asset Suite databases (impacted drawings, AEL etc.) for other modifications that might impact on this modification, and</p>	List of pending changes impacting project scope and their disposition.

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
				coordinate activities with other organization (e.g. Terminal Points).	
4.23	Design EC Release Plan	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT/ REVIEW / ACCEPT</b> OPG DA to accept Release Plan as part of Master EC release approval.	<b>ACCOUNTABLE</b> Contractor to document details of Release Plan in Asset Suite "Topic Notes".	Asset Suite Action
4.24	Issue Tracking File	N-GUID-00700-10000	<b>SUPPORT</b> OPG to initiate Issue Tracking File.  OPG to support as required.	<b>ACCOUNTABLE</b> Contractor to identify and maintain up to date Issue Tracking File in Asset Suite.  Incorporate OPG's identified issues in the Issue Tracking File.	Issue Tracking File
	<b>Design EC Related Activities</b>				
4.25	Design EC: General	N-PROC-MP-0090 N-GUID-00700-10000	<b>REVIEW / ACCEPT</b> OPG Representative to Accept/Approve via Asset Suite milestones.  Set EC Status to "Approved" upon receipt of required OPG approvals as per Modification Outline.	<b>ACCOUNTABLE</b> Prepare, Verify, Approve (in Asset Suite).  Ensure Contractor Name clearly identified in EC attributes.  Set EC Status to "Hold for Approval" in Asset Suite upon submission of EC approval binder to OPG.	Asset Suite Topic Notes for Release Plan
4.26	Design EC Milestones	N-PROC-MP-0090 N-GUID-00700-10000	<b>REVIEW</b> OPG Representative to review milestones to ensure consistent with approved Modification Outline	<b>ACCOUNTABLE</b> Set Up Design EC Milestones in Asset Suite as per approved Mod Outline and Design Plan.  Release # milestones (as applicable, one minimum per each design EC) on each design EC per release plan.  Any other milestones as required by Modification Outline.	Asset Suite Action

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
4.27	EC Release	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT / REVIEW / ACCEPT / APPROVE</b> OPG Representative to provide comments as required, and to communicate issues to Contractor.  Approval by DA/DOM or delegate, as required.	<b>ACCOUNTABLE</b> Contractor to coordinate review on Design EC and disposition of comments.  Contractor to coordinate review on Drawing / Change Papers for compliance with OPG Drafting standards, and disposition of comments.  Provide support as requested for resolution of issues communicated by OPG Representative and update Design EC accordingly.  Upon resolution of issues communicated by OPG Representative, Contractor Representative to obtain approval for each Release as required by the Modification Outline and/or per Design Plan.	Approved EC Release
4.28	Prepare ADL and Issue Change Papers	N-PROC-MP-0090 N-GUID-00700-10000 N-FORM-10653 N-MAN-08100-10000 N-PROC-MP-0077	<b>REVIEW / ACCEPT</b> OPG Representative to Accept Change Papers.  OPG Information Management Services to scan Change Papers into Asset Suite.	<b>ACCOUNTABLE</b> Populate ADL in Asset Suite.  Review ADL for completeness.  Review any Pending Changes on Affected Documents for potential conflicts.  Verify latest Revisions of Affected Documents are used for Change Paper.  Prepare, Verify, and Approve as part of Design EC.	Asset Suite Action ADL Items and Change Papers

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
				<p>Submit Change Papers to OPG Information Management Services with proof of OPG acceptance for scanning into Asset Suite (See 2.5 for details).</p> <p>Confirm all Change Papers have been scanned into Asset Suite.</p>	
4.29	Design Critical Characteristics	N-GUID-00700-10000	<b>REVIEW / ACCEPT</b> Accept as part of Design EC acceptance.	<p><b>ACCOUNTABLE</b> For aspects of modifications that cannot be fully commissioned (e.g. EQ, fire, seismic and others) document Critical Design Characteristics and associated individuals accountable in the Asset Suite NON-COMM attributes sub-category.</p> <p>Ensure that these are verified.</p>	Asset Suite Action
4.30	Drawing Change Papers	N-PROC-MP-0078 N-PROC-MP-0090 Drafting procedure: N-ST-01161-10000	<b>REVIEW / ACCEPT</b> OPG to Accept Change Papers per 4.28	<p><b>ACCOUNTABLE</b> Prepare list of drawings. Send drawing release request to OPG per site procedures.</p> <p>Prepare Drawing Change Papers.</p> <p>Prepare AutoCAD (version as identified in P.O) drawings as change papers.</p> <p>Prepare, Verify, and Approve Change Papers.</p> <p>Sign and print all names on the Change Paper stamp.</p>	Change Papers



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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
4.31	Non-drawing change papers of existing OPG documents (Safety Report, Operational Safety Requirements, Instrument Uncertainty Calculations, Reliability Report, Fire Safe Shutdown Analysis, Lists, SCL etc.)	N-PROC-MP-0090 N-GUID-00700-10000 N-PROC-MP-0086 N-ST-08131.02-10000 N-STI-03602-10000 N-STD-RA-0033 N-STD-RA-0038	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to Accept Change Papers per 4.28.	<b>ACCOUNTABLE</b> Review Document Scoping Checklist and other related EC Screens to identify OPG documents which are impacted by Design Change.  Prepare, Verify, & Approve Change Papers.  Print and Sign all names on the Change Paper stamp.	Change Papers
4.32	Drawing Bill of Materials (DBOM)	N-PROC-MP-0076 N-TMP-10191	<b>SUPPORT/ REVIEW / ACCEPT</b> OPG Representative to Accept Change Papers per 4.28.	<b>ACCOUNTABLE</b> Prepare, Verify, and Approve DBOM for each drawing / group of drawings for associated Design EC.  Refer to 4.38 for selection and creation of Cat ID's as required.	DBOM change paper on N-TMP-10191 or equivalent
4.33	Design Manuals – New / Change Paper of Existing Design Manual	N-PROC-MP-0065 N-INS-00700-10002	<b>SUPPORT/ REVIEW / ACCEPT</b> <b>New Design Manual &amp; Existing Design Manual Change Papers:</b> OPG Representative to support review process and provide comments on Change Papers as required.  OPG Representative to Accept Change Papers per 4.28.	<b>ACCOUNTABLE</b> <b>New Design Manual Change Paper:</b> Prepare Design Manuals as per procedure.  Submit document with signatures as part of Design EC.  <b>Existing Design Manual Change Paper:</b> Mark-up the latest revision of existing Design Manual from Asset Suite, for the changes.  Submit document with signatures as part of Design EC.	Design Manual Change Paper as per applicable OPG templates.
4.34	Reference Document List / RDL Items	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT</b> OPG Representative to support as	<b>ACCOUNTABLE</b> Populate RDL in Asset Suite	Asset Suite Action

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			required.	Prepare, Review, and Approve as part of Design EC  Ensure all RDL items are in OPG Records system (forward with required Controlled Documents paperwork to facilitate) prior to EC submission to OPG.	
4.35	Engineering Specifications for new equipment (including Tech Spec Data sheets)  Engineering Standards  Design Specifications	N-PROC-MP-0059 N-PROC-MP-0084 N-PROC-MP-0089 N-PROC-MP-0078	<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to review and accept.	<b>ACCOUNTABLE</b> Contractor to coordinate review and disposition review comments as required.  Prepare, Review, and Approve.  Issue OPG accepted document to OPG Information Management Services with proof of OPG acceptance (See 2.5 for details).  Create a Procurement Specification.	Engineering Specification, Engineering Standards, Design Specifications, on OPG applicable template or equivalent
4.36	Engineering Calculations  Any Scientific, or Safety Analysis, Engineering or Software used shall meet the applicable requirements of CSA N286.7.	As per Contractor approved Quality Assurance Plan (Reference N-PROC-MP-0044)	<b>REVIEW / ACCEPT</b> OPG Representative to support the review process and provide comments as required.  OPG to Accept.	<b>ACCOUNTABLE</b> Contractor to coordinate review and disposition review comments as required.  Prepare, Verify, and Approve.  Issue OPG accepted documents to OPG Information Management Services with proof of OPG acceptance (See 2.5 for details).	Engineering Calculation as per OPG applicable template or equivalent
4.37	Contractor/Vendor Technical Documents  For example: -Drawings	N-PROC-MP-0078	<b>SUPPORT / REVIEW / ACCEPT</b> Where OPG stakeholder input is required, OPG Representative will coordinate input and provide comments as required.	<b>ACCOUNTABLE</b> Review Subcontractor/equipment Contractor technical documents for accuracy of technical content and meeting design requirements.	Contractor Technical Documents

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	<p>-Operating &amp; Maintenance Manuals -Inspection Test Plans -Factory Acceptance Procedures -Recommended spare parts lists -etc.</p> <p>This includes documents submitted by Equipment Contractors or their representative and excludes documents produced by the Contractor.</p>		<p>OPG to accept final Contractor Technical documentation following Contractor acceptance of such documents and Contractor final recommendation for OPG acceptance.</p>	<p>Review and recommend for acceptance of results of any Factory Acceptance Testing (normally prior to equipment shipment).</p> <p>Resolve comments with Sub-contractor/equipment Contractor and accept documentation on behalf of Contractor, and recommend for OPG acceptance.</p> <p>Correspondence with Subcontractors of a technical nature to be copied to OPG Representative.</p> <p>Submit to OPG final contract and technical documentation.</p> <p>Issue OPG accepted documents to OPG Information Management Services with proof of OPG acceptance (See 2.5 for details).</p>	
4.38	Creation of New Cat IDs	<p>N-PROC-MP-0090 N-PROC-MP-0098 N-GUID-00700-10000 N-PROC-MM-0008 Appendix A</p>	<p><b>SUPPORT / APPROVE</b> OPG will approve action request for new CatID</p> <p>OPG will provide Asset Suite approval and set CatID to "Ready".</p>	<p><b>ACCOUNTABLE</b> Select and / or Initiate creation of Cat IDs for new items as required for Design EC / DBOM.</p> <p>Submit Action Request to initiate new Cat IDs (May require Appendix A for more clarity if requested by OPG).</p> <p>Consult with OPG prior to requesting new Cat ID to assist in finding an existing Cat ID where possible (utilize OPG standard stores items or already approved ASL Contractors if possible).</p>	CatID at "Ready" Status

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				<p>If CAT-Id's exist for a similar item but at a higher Quality Level, check if business case exists for having similar items at a lower quality in the warehouse stock.</p> <p>Prepare, verify and provide Asset Suite panel mandatory information using Appendix A of the COIR and submit to OPG Representative for setting Cat Ids to Ready.</p> <p>Complete ACB (Affected Catalogue BOM List) Panel for any new Cat ID's created. See also section 5.2.</p>	
4.39	Inventory CatID Reconciliation	N-PROC-MP-0090 N-GUID-00700-10000 N-PROC-MM-0008	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to accept recommendations.	<p><b>ACCOUNTABLE</b> Contractor to identify CatIDs to be retired and current materials to be surplus as required.</p> <p>Provide recommendations via AAA following AFS.</p>	Inventory CatID Reconciliation Report.
4.40	Affected Equipment List (AEL) Updates  And  Reserve New Equipment Codes	N-PROC-MP-0090 N-GUID-00700-10000 N-MAN-08135-10000 N-PROC-MA-0077 N-PROC-MP-0077 D-ED-01520-10001 N-INS-08135-10116 N-INS-03651-10025 P-ST-09020-00001 P-INS-09020-00001 N-GUID-00700-10005	<p><b>SUPPORT / REVIEW / APPROVE</b> OPG Representative to support review process and provide comments as required.</p> <p>OPG Plant Status Control approve new equipment AEL tagging.</p> <p>OPG Equipment Reliability Group &amp; Reactor Safety to review / approve new equipment criticality codes.</p> <p>OPG to provide serial code number for equipment.</p>	<p><b>ACCOUNTABLE</b> Contractor to coordinate and disposition of review comments on AEL updates as required.</p> <p>Obtain Plant Status Control input on new AEL tags.</p> <p>Identify Q List requirements and obtain OPG Reactor Safety support/input as required (refer to N-INS-08135-10116).</p> <p>Identify EQ requirements (refer to N-INS-03651-10025 &amp; 10007)</p>	<p>Asset Suite AEL EQ, Q-List, Seismic and Criticality Code Requirements Defined</p> <p>Configuration Report</p>

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			OPG Drawing Office to reserve Equipment Codes.	<p>Identify Criticality code requirements per N-PROC-MA-0077.</p> <p>Identify Seismic requirements.</p> <p>Populate AEL panel in Asset Suite with required information and formatting (including Q-Ist. Criticality Codes, and EQ requirements).</p> <p>Prepare, Verify, and Approve as part of Design EC.</p> <p>Request reserved equipment codes from OPG Drawing Office. Obtain OPG Plant status Control acceptance of new AEL tags prior to submission of EC for acceptance.</p> <p><b>Submit configuration report prior to Installation.</b></p>	
4.41	Spare Parts List/ Equipment Bill of Material / Maintenance Strategies	N-PROC-MP-0090 N-GUID-00700-10000 N-PROC-MP-0058 N-PROC-MM-0008 N-INS-00680-10000	<p><b>SUPPORT / REVIEW / ACCEPT</b> OPG Equipment Reliability, SRE, Maintenance Assessing, Supply Chain, stakeholder review of Spare Parts list &amp; Maintenance Strategies.</p> <p>OPG to accept the Spare Parts List, Maintenance and Stocking Strategy</p>	<p><b>ACCOUNTABLE</b> Prepare Spare Parts List for new parent</p> <p>Identify all Spare Parts to new parent</p> <p>Prepare spare parts list, maintenance and stocking strategy for OPG Acceptance.</p> <p>Solicit stakeholder input.</p> <p>Incorporate stakeholder feedback into Maintenance Strategy.</p>	<p>Spare Parts List Maintenance Strategy Stocking Strategy</p> <p>Equipment Bill of Materials</p> <p>Asset Suite spare parts CatIDs update with ROP/TMAX and Auto-reorder and/or Critical Spare flags.</p>
4.42	Lube List	N-PROC-MP-0090 N-GUID-00700-10000 N-PROC-MP-0058	<p><b>SUPPORT</b> OPG Components and Equipment Group to update station lube list.</p>	<p><b>ACCOUNTABLE</b> Provide information for Lube List Update to OPG Components and</p>	Lube List Update

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		N-PROC-MM-0008		Equipment Group and confirm lube list updated.	
<b>Miscellaneous Items – Electrical Design EC</b>					
4.43	Online Wiring updates (OLW) / INTEC Note: Accountability items includes numbering for sequence clarity.	N-PROC-MP-0076 N-INS-60110-10000 NA44-INS-57000-00001 P-FORM-20200  D-STE-60110-10001 P-STI-60000-00001  N-GUID-00700-10000	<b>SUPPORT / REVIEW / ACCEPT</b> OPG Drafting Office/INTEC to update OLW based on change papers and provide the printouts to Contractor Project Representative.  OPG Representative to accept as part of Design EC	<b>ACCOUNTABLE</b> (a) For each Design EC that affects On-Line Wiring (OLW)/INTEC information, Contractor to initiate a request to OPG DO to prepare an OLW Package and Independent Verification (IV) Report (if applicable) in accordance with the Design EC's change paper.  Ensure walkdowns / field inspections are completed re proposed OLW changes prior to Design EC approval.  Complete OLW Channelization reviews for PA wiring (refer to NA44-INS-57000-00001).  Obtain OPG DA Approval for separation/channelization standard deviations.  Verify, Approve, and issue OLW updates as part of Design EC.	OLW Package/ INTEC Package  Independent Verification Report for Safety Related Modifications.  OLW Channelization Review for PNGS A.
4.44	Electrical Distribution System analysis		<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to provide most current Station electrical distribution system model to Contractor Representative.  OPG to accept as part of Design EC acceptance.	<b>ACCOUNTABLE</b> Prepare, Verify and Approve electrical distribution system analysis (ETAP preferred).  Provide any updated models to OPG Representative along with Design EC.	Electrical Distribution Analysis (Calculation Report and Updated Model)

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
4.45	Protective Relay Setting Lists (PRLs) and Relay coordination study.	N-PROC-MA-0068 N-PROC-MA-0070 Templates as per OPG Field Equipment Calibration Program	<b>REVIEW / ACCEPT</b> OPG Representative to Accept relay coordination study and pre-install ICS or legacy PRL change paper as part of Design EC acceptance.  (Refer to 4.36 and 4.46)	<b>ACCOUNTABLE</b> Relay coordination study to be submitted as a design calculation (see 4.36).  Where legacy PRLs are to be superseded by ICSs enter new ICS data into ICS program (pre-install ICS) per Section 4.46, and prepare Controlled Docs form to supersede legacy PRL with new ICS document number, submitting both to OPG Representative as part of Design EC.  When installation commences and legacy PRL is no longer valid submit Controlled Document form for superseding legacy PRL to OPG Information Management Services with proof of OPG acceptance (See 2.5 for details).  Where legacy PRLs are to be retained, Prepare, Verify and Approve PRL change paper as part of Design EC.	Legacy PRL Change Paper or Pre-Install ICS
<b>Instrumentation and Control Design EC (other)</b>					
4.46	Instrument Calibration Sheets (ICS)	N-PROC-MA-0068 N-PROC-MA-0070 Templates as per OPG Field Equipment Calibration Program	<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to Accept pre-install ICS as part of Design EC acceptance.	<b>ACCOUNTABLE</b> Prepare & Verify pre-install ICS in OPG ICS program.  Print out hard copy of preinstall ICS and submit as part of Design EC.	Pre-install ICS

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4.47	Human Factors Engineering	N-PROC-MP-0090 N-FORM-10580 N-FORM-10221 N-INS-06700-10000 N-MAN-06700-10002	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to accept HFE report / Forms	<b>ACCOUNTABLE</b> Provide HFE Plan and HFE preliminary report(s) during engineering phase. Interface with OPG HFE Specialist as required.  Provide HFE final report during commissioning stage.  Incorporate OPG HFE Specialist comments relating to HFE.	HFE Plan HFE Report(s)  N-FORM-10221 (as required)
4.48	Software Review	N-PROC-MP-0049 N-PROC-MP-0090 N-FORM-10445 N-FORM-10446 N-FORM-10408 N-FORM-10409	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to accept SQA report /Forms	<b>ACCOUNTABLE</b> Interface with OPG CCD Specialist as required.  Ensure Software Quality Assurance (SQA) requirements are met.  Incorporate OPG CCD Specialist comments relating to Software.	Software Report
4.49	Software Maintenance Plan	N-STI-69000-10001 Software Maintenance	<b>SUPPORT / REVIEW / ACCEPT</b> OPG CCD Specialists to provide oversight reviews. OPG to accept.	<b>ACCOUNTABLE</b> Prepare/revise/issue Software Mtce Plan and Software Release for any new or revised software that requires it.	Software Maintenance Plan
	<b>Mechanical Design EC (other)</b>				
4.50	Over Pressure Protection Report	N-PROC-MP-0089	<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to provide comments as required.  OPG to Accept.	<b>ACCOUNTABLE</b> Contractor to coordinate review and disposition of comments.  Prepare, Verify, and Approve.  Contractor Representative to issue report to OPG Information Management Services with proof of OPG acceptance	Over Pressure Protection Report



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				(See 2.5 for details).	
4.51	Mechanical Piping Analysis	As specified by OPG  3D Models to be compatible with OPG requirements.	<b>SUPPORT</b> OPG Representative to provide latest piping Model / report where available. [Note: this will in most cases be a legacy non-QA'd model].  Provide guidance regarding acceptable software/versions for piping model to be used (to ensure future usability by OPG).  OPG to accept analysis Calculation / report and model.	<b>ACCOUNTABLE</b> Perform, verify and approve piping analysis in support of design ECs. Submit QA'd model(s) and associated analysis calculations/reports for acceptance along with associated design EC(s)	QA'd piping model in usable format (Software/Version).  Associated Calculations/Reports
4.52	Nuclear Design Report	N-PROC-MP-0089	<b>REVIEW / REVIEW / ACCEPT</b> OPG to Review and Accept.	<b>PREPARE/VERIFY/APPROVE</b> Prepare, Verify, and Approve Nuclear Design Report.  Submit Nuclear Design Report to OPG for acceptance.	Nuclear Design Report.
4.53	Third Party Fire Review Report	N-INS-09076-10004 Template as per Contractor approved Quality Assurance Plan	<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to provide comments as required.  OPG to Accept Third Party Fire Review Report.  OPG to submit to CNSC for acceptance.	<b>ACCOUNTABLE</b> Contractor to coordinate review and disposition of comments.  Third Party will Prepare the report.  Contractor will review and accept and resolve comments with Third Party, then submit to OPG for acceptance.  Arrange Third Party contract (with company acceptable to OPG).  Prepare CNSC submission of Third Party Report (refer to Section 4.13) and	Third Party Fire Review Report

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				<p>submit to OPG.</p> <p>Provide support and prepare responses as required to resolve any issues raised by CNSC.</p> <p>Contractor Representative to issue report to OPG Information Management Services with proof of OPG acceptance (See 2.5 for details).</p>	
<b>Project EC Related Items</b>					
4.54	Create Project EC	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT</b> As required	<b>ACCOUNTABLE</b> Create Project EC.	Asset Suite Project EC
4.55	Safety System Tests Operating Procedures Operator Field Instructions/Rounds Maintenance Procedures Chem. Lab Procedures	N-PROC-AS-0028	<b>SUPPORT / APPROVE</b> OPG to process procedure revisions and approval.	<b>ACCOUNTABLE</b> Initiate TPARs with procedure mark-ups for new or revised procedures.  Support, review and approval process.	TPARs and mark-ups
4.56	Operational Flowsheets, ESM II, Tagging, & Position Assured Components & Registered locks	N-PROC-MP-0076 (FS) N-PROC-OP-0023 (PAC) N-INS-09063-10000 N-ST-09063-10000	<p><b>SUPPORT / APPROVE</b> Support master mark-up process and approval.</p> <p>OPG Drawing Office to complete Flowsheet updates.</p> <p>Complete formal update prior to AFS.</p>	<p><b>ACCOUNTABLE</b> Initiate operational flowsheet ,ESM II, equipment tagging, and PAC list updates as part of installation and commissioning activities. Ensure completion of all items above.</p> <p>Ensure new registered locks in OPG Operations' possession and control prior to AFS.</p> <p>Support, review and approval process.</p>	Updated Flowsheets, PAC List and Registered Locks

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
4.57	System Performance Monitoring Plans	N-PROC-MA-0024	<b>SUPPORT</b> Finalize / implement SPMP revisions related to applicable systems.	<b>ACCOUNTABLE</b> Notify SRE of required changes needed to issued SPMP(s) in support of AFS process.  Develop new SPMPs for new systems.  Confirm that SPMPs are revised.	SPMP markups .
4.58	Components Programs / PIP (e.g. pressure vessel, periodic inspection, thermography, vibration monitoring, , valve / RV programs, Hangers, Buried Piping, etc.)	N-PROC-MA-0034 (Predictive Mtce) N-PROC-MA-0089 (Rotating Equip) N-PROC-MA-0090 (HX) N-PROC-MA-0092(POV) N-PROC-MA-0093(Check Valves) N-PROC-MA-0095 (Lubrication)	<b>SUPPORT</b> OPG Representative to identify Components Program Representatives to liaise with Contractor.  Components Program Representatives to provide guidance re: Information required from Contractor in order to allow OPG to update respective Components Program.	<b>ACCOUNTABLE</b> Provide information to update OPG Components Programs.  Status Components Program Updates at AFS meeting and track updates to completion.	Updated Components Program
4.59	Temporary Change Requests (TCRs)	N-PROC-OP-0027 (Temporary Change Requests) N-PROC-OP-0008 (Plant Status Tags) N-INS-08100-10014 (NEF)	<b>SUPPORT / APPROVE</b> Operations to support and approve TCR initiation and removal.	<b>ACCOUNTABLE</b> Ensure initiation and removal of TCRs associated with TMODs and temporary alterations.	Temporary Change Requests (TCR)
4.60	Predefined Mtce Program (Eg. Winterization and Summarization etc.)	N-PROC-MA-0020 N-INS-09100-10012	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to review Change Requests (CRs).  OPG to accept CR.  Implement CRs in Asset Suite.	<b>ACCOUNTABLE</b> Initiate PMID Change Requests in OPG Predefined System (PMLP). Provide technical basis for requests and facilitate SRE review and confirm acceptance.  Ensure implementation of critical change requests prior to AFS.	PMLP Request Accepted Asset Suite PMIDs setup complete.

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4.61	Power and Air Supply Lists / IEDS	D-PROC-MP-0025 D-PROC-MP-0011 P-INS-09260-00006	<b>SUPPORT</b> Support update process	<b>ACCOUNTABLE</b> Complete air and power supply list updates as part of installation and commissioning activities.	Updated Air and Power Supply Lists
4.62	Simulator Updates	N-PROC-TR-0023 (Simulator QA)	<b>SUPPORT</b> Schedule and complete simulator updates as required.	<b>ACCOUNTABLE</b> Initiate and support required simulator upgrades through OPG.	Request Update to Simulator
4.63	Corrective Mtce / Preventative Mtce Backlogs		<b>SUPPORT</b> OPG to support as required.  Provide concurrence or cancellation / credits.	<b>ACCOUNTABLE</b> Review Corrective Mtce and Preventative Mtce backlog on components impacted by applicable modifications and prior to AFS: 1) Recommendations for cancellation of any no longer required WO's 2) Recommendations to credit any predefined WOs via completed commissioning activities where possible  Provide summary into AFS Report.	Work Order Cancellation/Credit Recommendations to Work Control.
4.64	Training (for OPG Ops, Mtce, Chemistry and Engineering)	N-GUID-00700-10000	<b>SUPPORT</b> Initiate Action request for training needs assessments.  Perform Training needs assessments as required.  Participate in / attend training.	<b>ACCOUNTABLE</b> Develop SAT compliant training as required.  Deliver crew familiarization training when identified as required.  Prepare a training plan that defines the skills required for each trainee, identifies the type of training (i.e. classroom, on-the-job, vendor's premises, demonstration, etc.) and the training materials to be provided.	SAT Compliant Training as required by Needs Assessment.  Crew Familiarization Training (if required)

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				Deliver all engineering, operations and maintenance initial training required to operate and maintain the facility, as recommended by the Contractor and accepted/identified by OPG Training needs assessment.	
<b>INSTALLATION RELATED ACTIVITIES</b>					
4.65	Installation Field Technical Support	N-PROC-MA-0002 N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT / REVIEW</b> .	<b>ACCOUNTABLE</b> Provide Field Support during Installation of Design EC.  Review Field Installation issues and provide resolution.  Drafting and P.Eng support for scaffolding, Engineering Scaffolding, Pressure Boundary Item Releases, Valve Block approval, etc.  Address work planning holds.	Engineering Support for Field Installation
4.66	Design Intent Revision	N-PROC-MP-0090 N-GUID-00700-10000 N-FORM-11128	<b>REVIEW / ACCEPT</b> OPG to Accept/Approve via Asset Suite milestones.  Set EC Status to "Approved" upon receipt of required OPG approvals as per Modification Outline.	<b>ACCOUNTABLE</b> Review impact of Design Intent.  Prepare, Verify, Approve (in Asset Suite).  Ensure Contractor Name clearly identified in EC attributes.  Set EC Status to "Hold for Approval" in Asset Suite upon submission of EC approval binder to OPG.	Design intent Revision  Master EC Revision.

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4.67	Non Design Intent Design EC Revisions	N-PROC-MP-0090 N-GUID-00700-10000 N-FORM-11128	<b>SUPPORT / REVIEW / ACCEPT</b> Support as required.  Accept design EC revisions (approval in Asset Suite).	<b>ACCOUNTABLE</b> Provide Design EC revision (Non Intent) when requested within time frame required (refer to N-PROC-MP-0090).  Create Design EC Revision in Asset Suite. Document rationale for non-intent revisions.	Approved Design EC Revisions
4.68	Field Initiated Changes (FIC) Minor Field Initiated Changes (MINORFIC)	N-PROC-MP-0090, N-GUID-00700-10000	<b>SUPPORT / REVIEW / ACCEPT</b> Support / Review / Accept as required.	<b>ACCOUNTABLE</b> Contractor to initiate, review and approve FIC / MINORFIC.  Contractor Project Representative to document assessment that change is non-intent or MINORFIC in accordance with N-PROC-MP-0090 (NOTE: or as per approved procedure).  Contractor Design to Review and Approve FIC / MINORFIC and update Asset Suite within approved timeline.  Update Asset Suite MEL & BOM entries to reflect FICs. Resubmit revised configuration report.	Approved FIC/MINORFIC followed by EC Revision.  Updated Asset Suite MEL & BOM entries  Revised configuration report
4.69	Workplans / Installation Instructions (Prerequisites, Pre-testing/Calibration)	N-INS-08120-10011 N-PROC-MA-0013 N-PROC-MA-0022	<b>SUPPORT / AUTHORIZE</b> Provide SME reviews for particular subject areas.  Provide DOM or DA approval or authorization where required.	<b>ACCOUNTABLE</b> Prepare, verify and approve installation workplans (including Prerequisites, Pre-testing/Calibration) where required to coordinate field activities.  Contractor to coordinate, review and disposition comment resolutions  Prepare T-PARs and support preparation of CMPs, MMPs, CTPs.	Workplan, CMP, MMP, CTP and/or Installation Instructions

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
<b>COMMISSIONING RELATED ACTIVITIES</b>					
4.70	Commissioning Specifications and Pre-Commissioning (SAT / COAT) Spec	N-INS-00960-10000 N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to provide support as required.  OPG to review / accept Commissioning Specifications  OPG Reactor Safety to provide concurrence if required.	<b>ACCOUNTABLE</b> Identify Critical Attributes as per N-PROC-MP-0090.  Prepare, verify, review, and approve Commissioning Specifications.  Contractor Project Representative to issue Commissioning Specifications in Asset Suite (See 2.5 for details).	Approved Commissioning Specification
4.71	Commissioning Support and Acceptance of installation/Commissioning Results.	N-PROC-MP-0090	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to arrange, schedule staff to support commissioning activities, as required.  OPG to execute Commissioning Activities.  OPG to accept commissioning results.	<b>ACCOUNTABLE</b> Contractor to provide Commissioning Support. Provide Commissioning Support, fix outstanding issues when identified.  Provide qualified staff knowledgeable of the installation status to support Commissioning program and rectify outstanding issues when identified.  Prepare, verify and approve Commissioning Reports.  Contractor to provide documented evidence of design acceptance of commissioning results  Contractor to issue Commissioning Report in Asset Suite after OPG Acceptance (See 2.5 for details) .  Contractor Project Representative to complete the DSGN I/C ACCEPT milestone for each Design EC, adding notes as required	Commissioning Support.  Approved Commissioning Report.  Acceptance in Asset Suite

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
4.72	Work plans / Commissioning Instructions and Pre-Commissioning Site Acceptance Test (SAT)	N-INS-08120-10011 N-PROC-MA-0013 N-PROC-MA-0022	<b>ACCOUNTABLE / APPROVE / AUTHORIZE</b> Prepare, verify and approve commissioning work plans /Instructions where required to coordinate field activities.  Prepare and obtain approval for Commissioning Work Plan / Instructions as required.  DOM or delegate to authorize Workplan / Commissioning Instructions.	<b>SUPPORT</b> Contractor to provide support as required.	Commissioning Work Plan/Instructions
4.73	EQ Completion Assurance	N-FORM-10649	<b>SUPPORT / REVIEW / ACCEPT</b> Provide support as required.  OPG to accept N-Form-10649	<b>ACCOUNTABLE</b> Complete EQ Completion assurance as part of AFS process and submit to OPG.  Submit to Records to file under EC in Asset Suite with proof of OPG acceptance (See 2.5 for details).	N-FORM-10649
4.74	Available For Service (AFS) Strategy	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT / APPROVE</b> DA /DOM to approve the AFS Strategy Memo.	<b>ACCOUNTABLE</b> Prepare and obtain approval for AFS strategy memo/plan as required.	AFS Strategy Memo
<b>AVAILABLE FOR SERVICE AND RELATED ACTIVITIES</b>					
4.75	Available For Service (AFS), Walkdown, Declaration / OPS Acceptance	N-PROC-MP-0090 N-FORM-10091 N-PROC-MP-0098 N-GUID-00700-10000	<b>SUPPORT / REVIEW / ACCEPT / APPROVE</b> OPG Representative to participate in the AFS walkdown and meeting as required per Mod Outlines / Design Plan.	<b>ACCOUNTABLE</b> Where required based on the approved Modification Outline, Contractor Representative to prepare, review & submit for OPG acceptance the:	AFS Report prepared as per applicable OPG form or template.  Asset Suite EC



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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
			<p>OPG to accept AFS report.</p> <p>OPG to approve AFS declaration or OPS acceptance FORM.</p>	<p>- AFS Declaration/ Ops Acceptance and - Report (as required)</p> <p>Contractor Representative to sign AFS Declaration.</p> <p>Contractor Representative to coordinate and chair the AFS walkdown and meeting as required.</p> <p>Contractor to manage and track open item list and closeout process using Asset Suite action tracking.</p> <p>Contractor to update Asset Suite milestones to reflect completed AFSs (final or partial) and / or Ops Acceptances.</p> <p>Submit documents to Information Management Services for issuance in Asset Suite with proof of OPG acceptance (See 2.5 for details).</p>	Milestone Update
4.76	Update Status of Master Equipment List	N-PROC-MP-0090 N-GUID-00700-10000	<p><b>SUPPORT / REVIEW / ACCEPT</b></p> <p>OPG to provide support as required.</p> <p>OPG to review and accept configuration report.</p>	<p><b>ACCOUNTABLE</b></p> <p>Review AEL for accuracy prior to AFS and make any changes required.</p> <p>Submit configuration report prior to Installation</p> <p>Initiate launch of Asset Suite AEL / MEL to "Operating" status and confirm successful.</p> <p>Contractor DE to complete "MEL Update" milestone and resolve any MEL conflicts encountered during the launch</p>	MEL revised Configuration Report

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
				process	
<b>CLOSEOUT RELATED ACTIVITIES</b>					
4.77	Design EC / Project EC/ Master EC/ Close Out	N-PROC-MP-0090 N-GUID-00700-10000 N-FORM-10653	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to review / accept Contractor produced drawings and document revisions  OPG to issue documents in Asset Suite.	<b>ACCOUNTABLE</b> Review ADL / Change Papers of Final Design EC revisions for accuracy / completeness of final as-built configuration.  Project Representative / DE to coordinate any other Signatures for other  Issue original drawings/documents (electronic and paper format) to OPG with QA transmittal form (N-FORM-10653) filled in. Electronic 2D files to be AutoCAD .DWG format.  Electronic documents will be in editable format in compact discs with labelling and identifying the contents.  Pending Changes that may have been Incorporated into the same document revision.	Final Documents and electronic records.
4.78	Drawings: Incorporation of Change Papers to existing OPG Drawings	N-PROC-MP-0076 N-PROC-MP-0090	<b>SUPPORT / REVIEW / ACCEPT</b> OPG Drafting Office to revise OPG Drawings and route to Contractor Representative for Review & Signature.  OPG to Accept Drawings.  If other EC Closeouts are included in this revision, coordinate signatures.	<b>ACCOUNTABLE</b> Review latest Design EC Change Papers in Asset Suite for completeness and accuracy and provide As-Built Design EC revision as required.  For each ADL item, review "Pending Changes" in Asset Suite, and identify any other Engineering Changes which require incorporation and coordinate	Final Documents and electronic records.

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				<p>with the other EC owners, and update other documents and drawings. (i.e. Asset Suite status of "Installed or Modified") to OPG Drafting Office. Notify Project Representative that Change Papers are ready for Close Out and provide any AutoCAD files as required.</p> <p>Prepare, Verify, and Approve OPG Drawings upon revision by OPG Drawing Office.</p> <p>Prepare Control Document Form N-FORM-10027 to issue documents.</p> <p>Submit to Project Representative for Review &amp; Acceptance.</p> <p>If other EC Closeouts included in this revision, are not related to the Contractor, submit to Project Representative for coordination of other signatures. P. Eng sealing of final record drawings/documents is not required if the changes are related to the original Design EC's prepared by the Contractor.</p> <p>Contractor Representative to submit documents to OPG Information Management Services with proof of OPG acceptance for issuing (See 2.5 for details).</p>	
4.79	Drawings: Incorporation of Change Papers of – Contractor Drawings	N-PROC-MP-0076 N-PROC-MP-0090	<b>SUPPORT / REVIEW / ACCEPT</b> OPG Representative to Review & Accept Drawings.	<b>ACCOUNTABLE</b> Incorporate Change Papers as required. Preparer, Verifier, and Approve.	Final Documents and electronic records.

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
				<p>Prepare Control Document Form N-FORM-10027 to issue documents.</p> <p>Submit to OPG Representative for Review &amp; Acceptance.</p> <p>Contractor Representative to submit documents to OPG Information Management Services for Issuing.</p>	
4.80	Drawing Bill of Material	N-PROC-MP-0076	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to Accept Bill of Material.	<p><b>ACCOUNTABLE</b></p> <p>Incorporate Change Papers and revise Drawing Bill of Material as required. Prepare, Verify, &amp; Approve.</p> <p>Prepare Control Document Form N-FORM-10027 to issue document.</p> <p>Contractor Project Representative submit documents to OPG Information Management Services with proof of OPG acceptance for issuing (See 2.5 for details).</p>	Final Documents and electronic records.
4.81	Design Manuals – New / Revision of Existing Design Manuals	N-PROC-MP-0065	<p><b>SUPPORT / REVIEW / ACCEPT / AUTHORIZE</b></p> <p>OPG Representative to Accept.</p> <p>OPG Design Authority to Authorize.</p>	<p><b>ACCOUNTABLE</b></p> <p>Review Change Paper version of Design Manual and revise if required based on As-Built information.</p> <p><b>Existing Design Manual Change Paper:</b> Request electronic copy of existing Design Manual from OPG Word Processing via Control Document Form N-FORM-10027.</p> <p>If Word-editable version not existing, convert paper copy to Word editable</p>	Updated/New Design Manual as per applicable OPG template.

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
				<p>version, use OPG template. Review outstanding DCRs against DMs. Revise electronic version, incorporating outstanding DCRs, and submit to OPG Representative for review</p> <p><b>New Design Manual:</b> Use OPG Template for new Design Manual</p> <p>Review formatted document and submit to OPG Representative for review. Return reviewed document back to OPG Representative for revision if required and sign Prepared, Verified, and Approved Design Manual. Route to OPG Representative, other OPG reviewers, and OPG Design Authorities for remaining signatures. .</p> <p>Issue approved final document to OPG Information Management Services/Asset Suite with proof of OPG acceptance (See 2.5 for details) and confirm issued.</p>	
4.82	System Classification List (SCL)	N-FORM-10250	<p><b>SUPPORT / REVIEW / ACCEPT</b> OPG provides support as required.</p> <p>OPG review/accept SCL.</p>	<p><b>ACCOUNTABLE</b> Prepare, Verify, &amp; Approve System Classification List</p>	System Classification List
4.83	Documents with Defined Revision Cycles of N-GUID-00700-10000 e.g. Safety Report, Fire Safety Shutdown Analysis etc.	N-GUID-00700-10000 N-LIST-01300-10000	<p><b>ACCOUNTABLE</b> To be discussed by OPG Representative on a Case by Case Basis. In cases where there is an assigned OPG Document Owner (e.g. Safety Report), Contractor to liaise with OPG Document Owner.</p>	<p><b>SUPPORT</b> To be discussed on a Case by Case Basis. In cases where there is an assigned OPG Document Owner (e.g. Safety Report), Contractor to Support OPG Representative as required when document is to be revised.</p>	Updated Documents with Defined Revision Cycles.

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
4.84	Instrumentation Calibration Sheets (ICS)	N-PROC-MA-0068	<b>SUPPORT / APPROVE</b> Approve ICS.	<b>ACCOUNTABLE</b> Convert pre-install ICS to permanent ICS as part of AFS. Submit to OPG for approval.	Approved ICS  Updated ICS Program
4.85	Design Plan (Final revision for design completion assurance)	N-PROC-MP-0074 N-TMP-10090 or Approved template per – Contractor approved Quality Assurance Plan	<b>SUPPORT / REVIEW / ACCEPT / AUTHORIZE</b> OPG Representative will coordinate review and providing comments.  OPG to Accept.  OPG Design Authority to Authorize.	<b>ACCOUNTABLE</b> Prepare, review, approve Close out. Design Plan upon completion of Project.  Contractor to submit authorized documents to OPG Information Management Services with proof of OPG acceptance for issuing (See 2.5 for details).	Final Design Plan Issued in Asset Suite.
4.86	Asset Suite Update	N-GUID-00700-10000	<b>SUPPORT</b> As required.	<b>ACCOUNTABLE</b> Status Design ECs in Asset Suite to CLOSED status following issuance of all ADL items and completion of related AFS open items.	Asset Suite Actions

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## 5.0 PROCUREMENT INTERFACE MATRIX

#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverable
<b>PROCUREMENT PLANNING</b>					
5.1	Project Specific Procurement Plan	Refer to Appendix B for Elements to be Considered within a Procurement Plan	<b>SUPPORT / REVIEW / ACCEPT</b> OPG will provide feedback on the Procurement Plan and accept the plan when comments are incorporated. OPG to identify mandatory criterion for which acceptance of deviations will be required. OPG to accept deviations.	<b>ACCOUNTABLE</b> Develop a Procurement Plan for procurement of the Owner or Contractor Specified materials and Services required for implementation of the specified OPG Specification. Provide to OPG for Acceptance Any deviations of mandatory criteria from the Procurement Plan will need to be accepted by OPG	Procurement Plan
<b>ENGINEERING DELIVERABLES</b>					
5.2	Update Master Catalogue / Create CATID	N-PROC-MM-0008 N-GUID-00700-10000 N-GUID-08176.2-10000 Appendix A	Refer to Item 4.38	Refer to Item 4.38	Refer to Item 4.38
5.3	Changes or updates to Master Equipment List (MEL) Records	N-PROC-MP-0077 N-GUID-00700-10000 N-FORM-10492	Refer to Item 4.76	Refer to Item 4.76	Refer to Item 4.76
5.4	Technical Specifications or Tech Spec Data Sheets  Engineering Standards  Design Specifications	N-PROC-MP-0059 N-PROC-MP-0084 N-PROC-MP-0089 N-TMP-10019	Refer to Item 4.35	Refer to Item 4.35	Refer to Item 4.35
5.5	Approved Equipment Bill of Materials	N-PROC-MP-0058 N-FORM-10492 Site Specific Instructions	Refer to Item 4.41	Refer to Item 4.41	Refer to Item 4.41

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverable
5.6	Spare Parts List	N-PROC-MP-0058 N-FORM-10492 Site Specific Instructions	Refer to Item 4.41	Refer to Item 4.41	Refer to Item 4.41
5.7	Procurement Evaluation	Contractor Specific N-PROC-MP-0098 N-GUID-08173-10000	<b>REVIEW / ACCEPT</b> OPG will accept procurement evaluations. Provide Asset Suite approval for Spare Parts.	<b>ACCOUNTABLE</b> Prepare, verify and approve Procurement Evaluations. Provide necessary Asset Suite panels' information and request Asset Suite approval from OPG for Spare Parts.	Procurement Evaluation
5.8	Drawing Bill of Materials	N-PROC-MP-0076	Refer to Item 4.32	Refer to Item 4.32	Refer to Item 4.32
<b>IDENTIFICATION REQUIREMENTS</b>					
5.9	Additional Requirements to Support OPG Business Processes and Requirements		<b>SUPPORT / REVIEW / ACCEPT</b> For elements that are in addition to the standard CSA N286 QA Standard, OPG to specify the specific content and format requirements for information and documentation required to support operation of the plant. OPG to accept requirements to populate into Asset Suite  OPG to input into Asset Suite as required.	<b>ACCOUNTABLE</b> Contractor to include the OPG specific requirements as part of the overall project requirements in addition to the requirements called out in the CSA N286 procurement QA Standard.	Material Information to Support OPG Databases Asset Suite Action
<b>PURCHASING ACTIVITIES</b>					
5.10	OPG Approved Suppliers List (ASL)	N-PROC-MM-0010, N-FORM-10170 Appendix D	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to provide a list of Suppliers qualified on OPG's ASL.  OPG to accept requests for	<b>ACCOUNTABLE</b> Where applicable, the Contractor shall select Suppliers on the OPG ASL only if the Contractor determines that the information provided is sufficient and meets the requirements of applicable	Completed N-FORM-10170



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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverable
			potential new suppliers.	<p>standards and the Contractor's own quality program.</p> <p>The Contractor shall ensure that Suppliers are used for the specific purpose(s) for which they have been approved on OPG's ASL for specific approved manufacturing plant locations and services.</p> <p>Where a supplier is not in OPG ASL or the scope of qualification for a Supplier needs to be changed, the Contractor shall inform OPG of potential new Suppliers and obtain approval to use the new supplier</p> <p>The Contractor shall evaluate, audit (as appropriate) and approve the new Supplier per the Contractors QA Program.</p> <p>Initiate addition to OPG ASL by providing OPG with audit report and checklist and N-FORM-10170, ASL Action Request.</p>	
5.11	Use Commercial Grade Dedication (if required)	N-FORM-10966, Commercial Grade Dedication Plan	<b>REVIEW / ACCEPT</b> OPG to accept the use of CGD strategy.	<b>ACCOUNTABLE</b> Inform OPG of the use of CGD strategy.	CGD Strategy
5.12	Concessions and Exceptions Process (only for owner specified material)	N-FORM-10393 N-PROC-MM-0021	<b>REVIEW / ACCEPT</b> Accept Concession Application	<b>ACCOUNTABLE</b> Submit to OPG Concession Application for Acceptancel, by OPG if disposition is for use as is or repair..	Concession Application Disposition
5.13	Non Conformances (only for owner specified material)	N-PROC-MM-0021 N-INS-01913.11-10003	<b>REVIEW / ACCEPT</b> Accept Non conformance disposition.	<b>ACCOUNTABLE</b> Identifying, Segregation, quarantine and disposition of non conforming items/	Non Conformance Disposition.

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				<p>services for which the disposition is for 'use as is' or 'repair'.</p> <p>Prepare review and approve disposition of non conformance and submit to OPG for acceptance.</p>	
5.14	Reporting of Non-Conformance Post Execution	Appendix C	<b>REVIEW / ACCEPT</b> Accept reporting of non conformance.	<b>ACCOUNTABLE</b> Notify OPG in writing when a known or suspected defect or non-conformance is discovered that affects, or may affect, a product that has already been delivered to OPG as per Appendix C.	Notification of Non Conformance on Company Letterhead
5.15	Source Surveillance and Factory Testing	Contractor Specific CSA N285 CSA N286	<b>SUPPORT</b> OPG to review and add witness points as required.  Refer to item 4.37 Contractor /Vendor Technical Documents	<b>ACCOUNTABLE</b> Perform supplier source surveillance and monitor factory testing as per quality requirements.  Refer to item 4.37 for OPG to accept Contractor/Vendor Technical Documents	Refer to item 4.37
<b>RECEIVING AND INSPECTION</b>					
5.16	Materials Management (Storage, Logistics, Security Screening, Warehousing etc.)	N-PROC-MM-0032	<b>SUPPORT / REVIEW / ACCEPT</b>  OPG Representative to accept Contractor's Materials Management Plan.	<b>ACCOUNTABLE</b>  The Contractor is responsible for developing an approved Materials Management Plan for OPG acceptance.	Materials Management Plan
5.17	Transfer of Maintenance Spares to OPG	N-PROC-MM-0021, Receiving QC Inspection N-PROC-MM-0006 Receive Items N-GUID-08173-10002	<b>SUPPORT / REVIEW / ACCEPT</b>  OPG to accept parts into inventory.  Refer to item 4.41.	<b>ACCOUNTABLE</b>  Submit the reference OPG Purchase Order Number and associated documentation for CatId to OPG with the maintenance spares.	Parts accepted into OPG Inventory.

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverable
				Refer to item 4.41.	
<b>DOCUMENTATION CONTROL AND RECORDS MANAGEMENT</b>					
5.18	History Docket	N-PROC-MM-0021, Receiving QC Inspection N-FORM-10396, History Docket/Nuclear Material Documentation Release N-STM-03651.03- 10000, Shelf-Life Requirements N-TS-08173-10001, History Docket/Nuclear Material Documentation Release N-GUID-08173-10002	<b>RECEIVE</b> OPG to receive History Docket as a permanent record.	<b>ACCOUNTABLE</b> Contractor is accountable to prepare and verify the History docket for Owner or Contractor Specified Materials and Goods purchased and received.	History Docket
<b>CONTRACT COMPLETION (CONTRACTS BETWEEN CONTRACTOR AND SUB-SUPPLIERS)</b>					
5.19	Performance OPEX Evaluation / Continuous Improvement	Contractor Specific	<b>REVIEW / ACCEPT</b> OPG to accept Non Conformance OPEX.	<b>ACCOUNTABLE</b> The Contractor will provide OPG with Non Conformance OPEX of suppliers.	Non Conformance OPEX Report of Suppliers

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### 6.0 CONSTRUCTION INTERFACE MATRIX

#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
6.1	Construction Quality Assurance Plan		<b>SUPPORT / REVIEW / ACCEPT</b> OPG provide feedback to Contractor and accept QA Plan.	<b>ACCOUNTABLE</b> The Contractors to prepare and approve QA Plans for Construction activities and execute per its QA program.  Submit approved QA plan to OPG for acceptance and incorporate any feedback.	Quality Assurance Plan
6.2	Safety Program / Project Specific Safety Plan	OHSA OPG Safety Rules, Corporate Safety Rules, Radiation Safety Rules, Environmental Safety Policy and Rules Contractor's Safety Rules	<b>SUPPORT / REVIEW / ACCEPT</b> Provide input.  Where OPG is Owner/Constructor, OPG to review / accept Contractor's Safety Program, Project Specific Safety Plan, Safe Work Practices and Processes.  Where OPG is Owner Only, OPG to review / accept approved Contractor's (Constructor) Safety Program.	<b>ACCOUNTABLE</b> For Owner/Constructor Projects develop and approve Safety Program, project specific safety plans and safe work practices / processes to meet OPG and regulatory requirements.  For Owner Only, develop and approve safety program for the work.	Safety Program & Plans to address Environmental, Radiation, and Safety
6.3	Preparation of Installation Work Packages (ie. ITPs, FME etc.)	N-PROC-MA-0022 N-PROC-MA-0013	<b>SUPPORT</b> As required	<b>ACCOUNTABLE</b> Prepare and approve installation work packages.  Include verification of critical design characteristics.	Comprehensive Work Package

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
				Obtain authorization as required.	
6.4	Construction Labour Management	Labour Agreements	<b>SUPPORT</b> As required	<b>ACCOUNTABLE</b> The Contractors to Manage the construction staff in accordance with the applicable project labour agreements	Mark-up Meeting
6.5	Control of Field Changes	"Engineering" Section 4.68	Refer to items 4.68	Refer to items 4.68	Refer to items 4.68
6.6	Project Construction Schedule	N-PROC-MA-0013 N-PROC-MA-0022 N-PROC-MA-0069	<b>SUPPORT / APPROVE</b> OPG to provide support to integrate station/project and Contractor schedules.  OPG to approve integrated schedule.	<b>ACCOUNTABLE</b> The Contractors to prepare and submit to OPG field execution schedule.  Contractor to execute per approved integrated schedule.	Integrated Schedule
6.7	Work Order Assessing / Planning and Installation Instructions	N-PROC-MA-0022 N-PROC-AS-0069 N-PROC-MA-0013	<b>SUPPORT</b> OPG to review WO for additional requirements and leads insertion of WO into appropriate work week.	<b>ACCOUNTABLE</b> The Contractors to prepare and assess WO's, and provides WO's to OPG for logically tied Scheduling (through OPG work management process)	Assessed Work Order
6.8	Readiness/Challenge Meeting and Work Release	N-PROC-MA-0022 N-PROC-MA-0013	<b>SUPPORT / AUTHORIZE</b> OPG to attend and challenge Contractor readiness.  OPG to authorize contract work release form.	<b>ACCOUNTABLE</b> Contractor to conduct readiness/challenge review meeting with appropriate stakeholders.  Contractor to respond to challenge comments and disposition or incorporate into Work Release.	Readiness/ Challenge Meeting, Contract Work Release FORM
6.9	Permitry Planning	N-PROC-MA-0012	<b>ACCOUNTABLE</b> OPG to prepare and integrate permitry into OPG plan.	<b>ACCOUNTABLE</b> The Contractors to initiate the request of permitry	Request for Permit

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6.10	Permitry Execution	N-PROC-MA-0012 N-PROC-MA-0011	<b>ACCOUNTABLE</b> OPG to apply the permits and provide Maintenance Authority (as required).	<b>ACCOUNTABLE</b> The Contractors to provide Holder of Record to support the permitry application.	Maintenance Authority (as required)  Holder of Record  Applied Permit
6.11	Radiation Protection	N-PROC-RA-0027	<b>ACCOUNTABLE</b> Apply radiation protection and REP.  Provide Radiation Protection Clothing.	<b>ACCOUNTABLE</b> Contractor to comply with appropriate Radiation Exposure Permit (REP) assigned to the execution of work.	Complicity
6.12	Calibration	N-PROC-MA-0070 (Field Cal'n) N-INS-01516-10009 (UTC) N-INS-01516-10003 (Software) N-INS-01983.1-10012 (FE Cal'n)	<b>SUPPORT</b> As required	<b>ACCOUNTABLE</b> Maintain calibration records of all instruments calibrated and specific calibration equipment used to required standards (UTC & Field Calibration Process or accepted equivalents).  Forward calibration records to OPG prior to AFS.	Calibration Records
6.13	Construction Turnover	N-GUID-00120-10008	<b>SUPPORT / APPROVE</b> OPG Representative to ensure records received and accept Contract Final Inspection and Notice of Construction Contract Completion  OPG to approve Contract Final Inspection and Notice of Construction Contract Completion.	<b>ACCOUNTABLE</b> Contractors to submit to OPG records ITPs, as build construction QA records  Contractors to prepare and submit to OPG for approval a Contract Final Inspection and Notice of Construction Contract Completion	Contract Final Inspection  Notice of Construction Contract Completion
6.14	Pre-Commissioning Activities		<b>SUPPORT / REVIEW / ACCEPT</b> Support and Accept pre-	<b>ACCOUNTABLE</b> Provide pre-commission testing &	Completed ITP

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#	Items	Reference Documents	OPG Accountability	Contractor Accountability	Deliverables
			commissioning / Calibration testing results (if required, pre-start safe guard inspection)	complete ITP results	
6.15	Commissioning Activities		Refer to item 4.71	Refer to item 4.71	Refer to item 4.71
6.16	FIC confirmation and incorporation	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT / REVIEW / ACCEPT</b> Review & Accept Design EC Revisions as required.	<b>ACCOUNTABLE</b> Prior to AFS Meeting, review latest Design EC & Change Papers to to confirm all FICs/Minor FICs are incorporated in EC revision.	Approved EC Revision
6.17	Status On-Line Wiring/INTEC as "Currently Built"	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT</b> OPG Drawing Office to status OLW/INTEC to currently built status following Contractor Project Representative request.	<b>ACCOUNTABLE</b> Review OLW/INTEC for accuracy and completeness, request OPG Drafting Office to status OLW to currently built status. Confirm OLW/INTEC status update is successful.  Contractor to complete "OLW/INTEC Stated" milestone in Asset Suite.	Asset Suite EC Milestone  OLW Status to Currently Built Status.
6.18	Installation Completion Assurance (For Nuclear Refurbishment Only)	N-GUID-01920-10000	<b>REVIEW / REVIEW / ACCEPT</b> OPG to review and accept installation completion assurance documents	<b>ACCOUNTABLE</b> Prepare and issue installation completion declaration	Installation Completion Assurance documents

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APPENDIX A: Procurement Asset Suite Template

In addition to the following table, Contractor to also prepare/approve and submit to OPG details of evaluation of Cat Ids. These details may include but not limited to “PE Request Log Disposition” (Asset Suite Panel Q102), “PE Safety Basis Summary” (Asset Suite Panel Q120), “PE Item Equivalency Evaluation and Configuration” (Asset Suite Panel Q150). Copies of templates for these panel will be provided by OPG. Submit Action Request to initiate new Cat Ids (May require Appendix A for more clarity if requested by OPG).

No.	EC Number	Cat ID	QL	Description	PB (Y/N)	EQ (Y/N)	SQ (Y/N)	Nuclear (Y/N)	Conventional (Y/N)	QA Program	Applicable Code	TSSA REGISTRATION (CRN) Y/N	Vendor Documentation Requirements	End Use (Equipment Code)	SR/NSR	Applicable Specification Number	Drawing Number	Item # in Drawing	Flow Diagram	Vendor Manual	Purchase Receipt History Documentation	Manufacturer	Model	Part Number	Suggested ROP/TMAX	Material Safety Data Sheet MSDS	Shelf Life in Months or N/A	In Storage Maint Required (ISM) Y/N	ISM Details (if ISM = Y)	REMARKS
Example	120299	670736	1	VALVE, GATE, 6". 900LB, BUTTWELD, A182, NC1	Y	N	A	Y	N	Z299.3	ASME SEC. III	Y	CMTR, HDOC, SEISMIC REPORT, ITP	6-71340-V853/V854/V855	SR	NK30-SPEC-04940-10854 REV 2	M014-783710-E01		NA44-1G-71340-00041, REV 08	NOT AVAILABLE	P-HDOC-0324302	VELAN	B14-1064C-02P5	NOT AVAILABLE	1/3	NOT AVAILABLE	N/A	Y	Oil Change - 3 Months	
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PB Pressure Boundary  
EQ Environmental Qualification  
SQ Seismic Qualification  
Code B51, B31.1, ASME - NB, NC, ND, etc.  
ASL OPG Approved Supplier List  
End Use E-Tag or Location in plant  
ROP/TMAX Reorder Point/Target Maximum  
Trace Type H=Heat Number, S=Serial Number, L=Lot or Batch number  
N/A Not Applicable

Vendor Documentation

C OF C Certificate of Compliance  
CMTR Certified Material Test Report  
HDOC History Documentation  
C OF A Certificate of Analysis

Legend

Required Information

Provide information if available

Exceptions:

1. Only certain fields are required initially to create Cat Ids  
2. All fields are required at the time of setting Cat Id to ready

Applicable Code

ASME SECTION III (EXAMPLE) NC1  
ASME SECTION VIII  
B51

QA Program

CSA Z299.1  
CSA Z299.2  
CSA Z299.3  
CSA Z299.4  
ISO 9001



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### APPENDIX B: Procurement Plan Template

The Procurement Plan shall be prepared and include the Owner or Contractor Specified Materials and Services procurement activities. The Procurement Plan shall be based upon the Contractor's qualified procurement program.

The plan may include, but not limited to, the following elements:

1. Executive Summary
2. Background Information
3. General Description of Product/Services
4. Technical and Regulatory Requirements
5. Historical and Future OPG Usage
6. Vendor/Marketplace Capabilities & Supply Restrictions
7. Existing OPG/Vendor Relationships
8. Bidder Prequalification
9. Competitive Tendering
10. Evaluation/Negotiation & Contract Award
11. Subcontract Management
12. Scheduling
13. Staffing and Succession Plans
14. Source Surveillance
15. Concessions and Exceptions
16. Sourcing Strategy
17. Success Criteria
18. Risks and Mitigations
19. Commercial/Contractual Requirements
20. Contract Administration Considerations
21. Quality Assurance
22. Quality Control
23. Expediting
24. Transportation/logistics,
25. Site Receipt of Goods, Warehousing
26. Claims Resolution
27. Invoice Approval
28. Contract Closeout
29. Post Contract Considerations
30. References

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### APPENDIX C: Non-Conformance Post-Installation Reporting

The Contractor shall submit a notification on company letterhead endorsed by Senior Quality Management addressing the following as a minimum:

- (a) A clear description of the defect or non-conformance.
- (b) An assessment on the impact of the defect or non-conformance to the product form, fit or function. Also address the potential impact on safety if known.
- (c) Identify OPG CatID numbers(s) that are affected including OPG PO and line item numbers, ship date, quantity, manufacturer product identification / traceability (i.e. serial number, lot number, batch number, manufacturing date, etc.).
- (d) Immediate short term actions to be taken to remedy the situation at OPG (address the availability of replacement item(s) and delivery time lines).
- (e) Long term corrective action plan to address the root cause for the defect or non-conformance, including completion / implementation commitments.

Contractor to submit notification by email to: [scqs.suppliers@opg.com](mailto:scqs.suppliers@opg.com)

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### APPENDIX D: OPG Approved Supplier List

(a) **Use of OPG's ASL.**

Subject to the other requirements of the Agreement, the Contractor will be able to utilize vendors on OPG's Approved Supplier List (ASL). All vendors which are active on OPG's ASL are maintained up to date and their qualification is current. OPG's ASL is maintained using OPG's QA Program.

OPG will provide to the Contractor a list of vendors qualified on OPG's ASL. The list will contain the following information: the Asset Suite Vendor Code, Vendor name, supplier web page – when available, Quality level (QL1 or QL3), qualification result (SAT or UNSAT), detailed scope of qualification, including scope restrictions, if the vendor has Corrective Actions issued or restrictions and warnings (only Yes or No – no additional details), qualification effective date and expiry date, scope of supply – manufacturer, services, distributor, etc, Pressure Boundary (PB), non PB flag, and quality standard used. The Contractor may use the list for the sole purpose of work to be performed for OPG.

Vendors on OPG's ASL may be used by the Contractor only if the Contractor determines that the information provided is sufficient and meets the requirements of the applicable standards and the Contractor's own quality program. The Contractor is responsible to use the vendors on OPG's ASL only for the specific purpose(s) for which they have been approved on OPG's ASL. The Contractor is solely responsible for taking all necessary actions to ensure that its sub-suppliers have the technical and quality assurance capability for the scope of work they are utilized for, and the ability to provide the required product or service. This includes obtaining assurance that the sub-suppliers have an appropriate and effective quality program implemented in accordance with the Contractor's own quality program and applicable standards requirements.

The use of vendors on OPG's ASL does not preclude or limit in any way the Contractor's responsibility for and obligation to provide OPG with quality parts and services meeting all requirements under the Agreement.

(b) **Use of suppliers not on OPG ASL**

If the Contractor's requirement is not satisfied by vendors on the OPG's ASL, or the scope of qualification for a vendor on OPG's ASL needs to be changed, the Contractor shall inform OPG and obtain OPG's acceptance to use a new supplier when required as identified below:

(i) **OPG acceptance is required for the use of sub-suppliers only when:**

The Contractor acts a procurement organization as per CSA N286-05 for the purchase of items and services:

- For QL1 and QL3 items only when a quality program is specified
- For QL1 and QL3 items, when the specified quality program is for CSA Z299.3 or higher (e.g. CSA Z299.1/.2/.3, NCA 3800 Material Organizations)
- When a primary CSA N286-05 engineering, procurement or construction is subcontracted in its entirety

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(ii) **OPG acceptance is not required for sub-suppliers:**

- When the Contractor purchase materials/ components following a CSA Z299 program as part of their manufacturing process (i.e. the Contractor is the manufacturer or the manufacturer of record)
- When there is no quality program specified
- When the specified quality program is CSA Z299.4 or ISO 9001
- Service suppliers (other than those primary N286-05 engineering, procurement, or construction service suppliers identified above in (i))
- Software suppliers

The Contractor shall evaluate, audit as appropriate, and approve the new supplier, according to the Contractor's own quality program. When OPG acceptance to use a supplier is required and obtained, the Contractor shall provide the audit report, checklist, corrective action requests and certificates to OPG. When OPG acceptance is not required, the Contractor shall maintain the audit report and checklists according to their own quality program requirements and provide it to OPG upon request.

(c) **Administrative Instructions for requesting OPGN acceptance to use suppliers not on OPGN ASL**

When EPC suppliers performing Nuclear Power Plan Procurement want to use a supplier not on OPG's ASL, the N286-05 qualified EPC Contractor/Subcontractor shall send requests for acceptance to [scqs.suppliers@opg.com](mailto:scqs.suppliers@opg.com).

The emailed request shall include:

- 1) Purpose of the request: e.g. "This is to request OPG acceptance of our use of a supplier not on OPG's ASL per N-DAI-0010-10000 requirements."
- 2) Attach N-FORM-10170 – ASL action request, (the form shall be appropriately filled out). The form shall include a brief business justification as to why OPG should accept. Note: justification section on the N-FORM-10170 shall address OPG business considerations such as the following:
  - a. Cost considerations, specifically:
    - i. Minimize the addition of new suppliers required to be maintained on OPG's ASL for replacement/maintenance activities going forward.
    - ii. Maintain and continue existin OPGN business leverage with strategic partners on OPG's ASL.
    - iii. Other business benefits/reasons why OPG should accept when it conflicts with OPG's business considerations.
  - b. Quality considerations:

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- i. Preference is to suppliers with a history of acceptable CSA Z299 Quality Assurance program implementation and experience/knowledge of CSA Z299 requirements.
    - c. Sustainable Businesses considerations – Per N286-05 Clause B.2 – Supplier has to have a reliable and maintainable business (provide replacement parts or support warranty issues).
  - 3) Copies of Audit Report & Checklists (if already performed), or identification that an audit will be performed and the report and checklist will be submitted for OPG acceptance at a later date, prior to purchase orders being issued.



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Title:

**DARLINGTON REFURBISHMENT CONTRACT MANAGEMENT PLAN**

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**Darlington Refurbishment Contract  
Management Plan**

**NK38-NR-PLAN-09701-10001-0013-R001**  
2015-09-04

Order Number: N/A  
Other Reference Number: N/A

**Internal Use Only**

Prepared By: K. Reid  
Manager, Strategic Contract  
Management (Acting)  
Contract Management

Approved By: D.J. Semple  
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Plan

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### Revision Summary

Revision Number	Date	Comments
R000	2014-01-31	<p>This document supersedes NK38-PLAN-09701-10067 Sheet 0017. The changes between NK38-PLAN-09701-10067 Sheet 0017 and this document are as follows:</p> <ul style="list-style-type: none"><li>• The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001,</li><li>• The security classification has been removed so that the document can be submitted to the CNSC, and</li><li>• References have been updated.</li></ul>
R001	2015-09-04	General update. Added Appendix A.



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### Records Table

The following Records may be generated by use of this document and shall be registered in the appropriate document management system in accordance with the following table:

Record Created	Associated Form or Template Number	QA Record? Y/N	Filing Information/Retention (AIMS Type/Sub-Type)
None	None	N	N/A

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## 1.0 PURPOSE

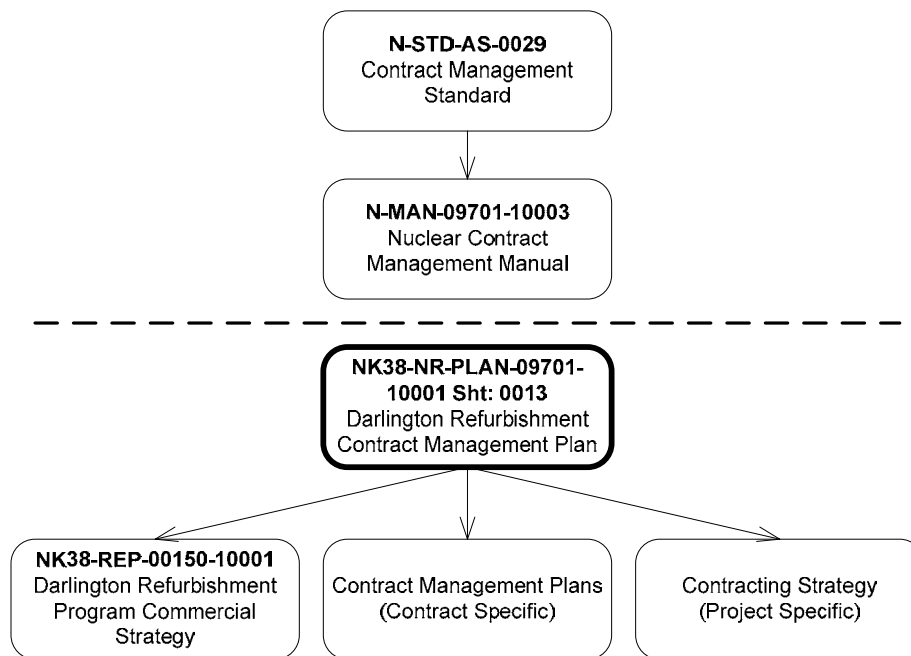
The purpose of this Program Management Plan (PgMP) is to define how the major *Contracts* within Darlington Refurbishment (DR) will be defined, managed, and controlled.

Contract management is the process that enables all parties to a *Contract* to meet their obligations in order to deliver the objectives required from the *Contract*. It involves building a good working relationship between OPG and the Supplier(s), and continues throughout the life of a *Contract*. Active contract management shall ensure OPG and Supplier compliance to contractual obligations through project monitoring, early identification of potential issues and prudent management of issues as they arise. Contract management includes oversight of Suppliers to ensure they are meeting safety, quality and performance requirements.

This PgMP aligns with the requirements laid out in NK38-NR-PLAN-09701-10001 Sht: 0001, Darlington Refurbishment Program Structure.

## 2.0 PROGRAM REQUIREMENTS

This Contract Management PgMP aligns with Nuclear, Corporate, and other business unit governance, governance support and non-governance documentation. Figure 1 shows the framework of documents that impact this PgMP.



**Figure 1: Contract Management Documentation Framework**

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Activities within the Contract Management organization are broken into two groups – overall program requirements and contract specific requirements.

## 2.1 Overall Program Requirements

The purpose of the Darlington Refurbishment Program Commercial Strategy (NK38-REP-00150-10001) is to set out the overall commercial framework with guiding principles for establishing and maintaining commercial relationships with third parties to support the DR program objectives.

Project Director, Contract Management reviewed the *DR Commercial Strategy*.

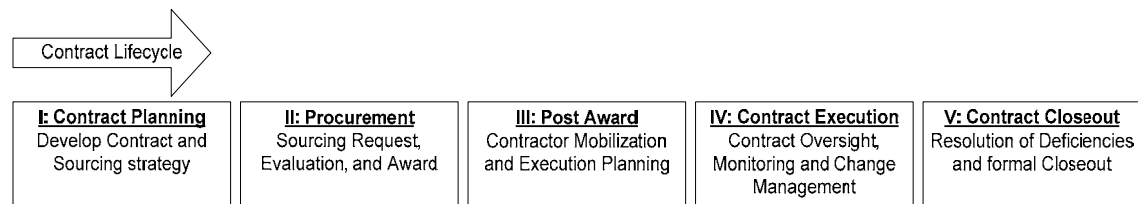
Vice President, Nuclear Projects Oversight approved the *DR Commercial Strategy*.

Senior Vice President, Nuclear Refurbishment approved the *DR Commercial Strategy*.

The *DR Commercial Strategy* should be reviewed and updated annually.

## 2.2 Contract Specific Requirements

The contracting process for a specific *Contract* is implemented in five stages in accordance with N-STD-AS-0029, Contract Management Standard, and as illustrated in Figure 2. Appendix A describes the agreed roles and accountabilities Contract Management and Supply Chain organizations throughout the contract lifecycle.



**Figure 2: Contracting Process Stages**

### 2.2.1 Stage 1: Contract Planning

The contract planning stage of the contract management life cycle includes preparation of the *Contracting Strategy*.

Manager, Strategic Contract Management will prepare a *Contracting Strategy* for each major work package in accordance with the *DR Commercial Strategy*. The *Contracting Strategy* will be prepared taking into consideration input from the Project Manager, Supply Chain and other relevant stakeholders.

Project Manager will recommend the *Contracting Strategy*.

Project Director, Contract Management will concur with the *Contracting Strategy*.

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Vice President, Nuclear Projects Oversight will approve the *Contracting Strategy*.

Senior Vice President, Nuclear Refurbishment will approve the *Contracting Strategy*.

### 2.2.2 Stage 2: Procurement

The procurement stage of the contract management life cycle includes sourcing and awarding of *Contracts* in accordance with the *Contracting Strategy*.

Manager, Strategic Contract Management and / or *Contract Manager* will provide input and concur with procurement documentation prepared by Supply Chain such as the Expression of Interest and Request for Proposals.

Manager, Strategic Contract Management and / or *Contract Manager* will participate in the Supplier selection process including:

- Establishing evaluation and selection criteria
- Development of negotiation strategy and plans
- Bid evaluations
- *Contract* negotiations
- *Contract* award

### 2.2.3 Stage 3: Post Award

The post award stage of the contract management life cycle covers Supplier mobilization and execution planning.

*Contract Manager* should develop a *Contract Management Plan (CMP)* for each *Contract* supporting a major work package in accordance with N-MAN-09701-10003, Nuclear Contract Management Manual.

Project Manager will concur with the *CMP*.

Project Director, Contract Management will approve the *CMP*.

The *CMP* will be reviewed on a periodic basis as activities under the contract proceed and when *Contract* changes or amendments are executed, but not less than annually.

The *Contract Manager* is be responsible for supporting the Project Manager with interpretation and clarification of *Contract* terms and conditions and ensuring that all obligations under the *Contract* are being met by both parties.

*Contract Manager* should provide input into the project management plans, procurement oversight plan, and should participate in the Supplier kick-off meeting.

### 2.2.4 Stage 4: Contract Execution

The contract execution stage consists of a range of activities that can be grouped into the following three key areas:

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1. Service Delivery Management
2. Relationship Management
3. *Contract* Administration

All three areas must be integrated and managed successfully for OPG to achieve the intended value of the *Contract*. This means optimising the efficiency, effectiveness and economy of the service or relationship described by the *Contract*, balancing costs against risks and actively managing the relationship.

The Project Team will execute the contract management activities as outlined in the *CMP*, with support from the *Contract Manager* as applicable. Activities that the *Contract Manager* will be involved in include:

- Management of *Contract* documentation
- Management of OPG complaints/disputes with Supplier
- Management of Supplier complaints/disputes with OPG
- Provides evidence to Supply Chain and Law in support of formal claims process
- Management of Supplier warranty and/or rework requirements
- Management of *Contract* Project Change Directives (PCDs)
- Assist with drafting and implementation of *Contract* Amendments (as required)
- *Contract* performance monitoring and reporting (e.g., Supplier scorecards)
- Management of insurance requirements
- Review of subcontractor *Contracts*
- Assessment of Supplier Workplace Safety and Insurance Board certificates
- Oversight of Supplier recovery plans as required
- Execution of engineering, procurement, and / or construction terms and conditions
- Commercial contract input on Supplier invoices (as requested)
- Analysis of Supplier financial information
- Supplier correspondence register
- Program and project status reports
- Supplier risk management

*Contract Manager* shall participate in meetings related to the *Contract*, including:

- Project meetings
- Joint steering committee meetings
- Executive committee meetings
- Challenge meetings

*Note: Contract Management will organize and chair the Contract Steering Committee Meetings.*

### 2.2.5 Stage 5: Contract Close Out

The contract close out stage covers ensuring all products and services have been delivered and accepted, fulfillment of contractual requirements, and resolution of deficiencies and claims.

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*Contract Manager* will recommend to the Project Manager that the *Contract* is ready for close-out. Prior to recommending *Contract* close out, the *Contract Manager* should:

- Ensure all disputes and / or claims have been resolved
- Confirm that all contractually required documentation has been received from the Supplier
- Confirm that all products and services provided under the *Contract* have been accepted by the Project Team
- Ensure that all outstanding project security documents (i.e. letters of credit) have been returned
- Confirm that all contractually required payments have been processed

*Contract Manager* will participate in any lessons learned sessions that take place prior to or after a *Contract* has been closed.

### 2.3 Performance Indicators

Contract Management organization will execute the major contract audit program.

Contract Management organization will perform an annual self-assessment of its adherence with this PgMP.

Contract Management organization will perform *Contract* compliance reviews as required. The purpose of the reviews will be to assess execution of a *Contract* compared to the CMP and the *Contract* terms and conditions.

Contract Management organization will perform a review of Station Condition Records related to *Contract* issues, compliance, and misinterpretations.

### 3.0 ROLES AND ACCOUNTABILITIES

The Contract Management organization shall ensure that contract management is implemented within the Darlington Refurbishment program as set out in N-STD-AS-0029, Contract Management Standard, and N-MAN-09701-10003.

Project Director, Contract Management, will ensure that a *Contract Manager* is assigned to support each major work package for the duration of a *Contract*.

Project Director, Contract Management is the document owner and is responsible for the definition and implementation of this document.

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## 4.0 DEFINITIONS AND ACRONYMS

### 4.1 Definitions

**Commercial Principles:** As defined in N-MAN-09701-10003, the commercial principles for contract management are Accountability, Value for Money, Fairness and Transparency, and Risk Transfer/Sharing.

**Contracting Strategy:** An internal, OPG confidential document that takes into consideration factors such as the nature and scope of the work, the Supplier marketplace, potential longer term or broader commercial arrangements and results in a recommendation of the procurement approach, contract structure, pricing mechanism and the style and type of management to be adopted for the subsequent *Contract*. The depth of analysis and documentation required for each *Contracting Strategy* is based on a graded, risk-based approach, supported by adequate inputs and analysis taking into consideration the *Commercial Principles*.

**Contract:** An agreement between two or more parties based on an agreed allocation of rights, obligations, responsibilities, and risks. *Contracts* are based on the concept of 'offer and acceptance' which may be enforced by a court.

**Contract Management Plan (CMP):** An internal, OPG confidential document which outlines OPG's approach to managing key contractual terms and risks for a specific *Contract*. It identifies systems and processes to ensure that the Supplier complies with the terms and conditions during the performance of the *Contract*. The *CMP* is developed utilizing a risk-based approach. The *CMP* is a living document that will continue to be updated throughout the life of the *Contract*.

**Contract Manager:** A member of the Contract Management organization that it engaged exclusively with the management of the *Contract* (in support of the Project Manager) and involved in the planning and implementation of the *Contract*. Responsibilities of the Contract Manager are documented in N-MAN-09701-10003.

**Darlington Refurbishment Commercial Strategy (NK38-REP-00150-10001):** An internal, OPG document that sets out the overall commercial framework with guiding principles for establishing and maintaining commercial relationships with third parties to support the DR program objectives from schedule, quality, and cost perspectives.

### 4.2 Acronyms

<b>CMP</b>	Contract Management Plan
<b>DR</b>	Darlington Refurbishment
<b>PCD</b>	Project Change Directive
<b>PgMP</b>	Program Management Plan

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## **5.0 REFERENCES**

- [1] NK38-NR-PLAN-09701-10001 Sht: 0001, Darlington Refurbishment Program Structure
- [2] NK38-REP-00150-10001, Darlington Refurbishment Program Commercial Strategy
- [3] N-MAN-09701-10003, Nuclear Contract Management Manual
- [4] N-STD-AS-0029, Contract Management Standard



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## Appendix A: Roles and Accountabilities for Contract Management, Project Management and Supply Chain

The following roles and accountabilities were agreed between the VP Nuclear Projects Oversight and the VP Supply Services OPG Projects on August 6, 2015.

**Principles:** Contract Management and Supply Chain organizations will work together, sharing project, supplier, and contract related information and providing assistance to each other as required.

Stage of Work		Contract Management (CM) <sup>1</sup> & Project Management (PM)	Supply Chain (SC)
Preparation/Planning	1	PM identifies need (services and materials) and CM develops Contracting Strategy. If need is for materials only, SC to support.	Provide input to Contracting Strategy
	2		Determine mitigating strategies for long lead and at risk materials
	3	PM prepares Scope of Work. CM reviews Scope of Work (and assists with developing Scope of Work for MSAs)	Review and provide input to Scope of Work
	4	Review and provide input to the Procurement Strategy	Develop Procurement Strategy
	5		Review vendor procurement plans. Perform oversight of EPC contractor procurement activities.
	6	Provide input to procurement documents	Prepare and issue procurement documents
	7	Provide input to proposal evaluation criteria	Document criteria and weightings for proposal evaluation
	8	Participate in SC led bid evaluation. Escalate if cannot agree on vendor selection.	Evaluate Bids with CM and PM Escalate if cannot agree on vendor selection.
	9	Chair Contract Steering Committee Meetings	Provide input to Steering Committee presentations and

<sup>1</sup> CM is involved in all strategic contracts or contracts that exceed \$40 MM. Otherwise the CM accountabilities are managed by the PM

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Stage of Work		Contract Management (CM) <sup>1</sup> & Project Management (PM)	Supply Chain (SC)
<b>Management of Procurement Process</b>			Speak to all contracts not yet awarded.
	10	Provide input to Negotiation Strategy and Plan.  Escalate if there is not agreement on the plan or allocation of responsibility.	Develop and seek approval of Negotiation Strategy and Plan (With input of Contract Steering Committee for major contracts). Escalate if there is not agreement with the plan or allocation of responsibility.
	11	Participate in contract negotiations as required.  Escalate if there is not agreement on the allocation of responsibility for negotiations or if internal parties cannot agree with negotiated contract.	Manage the contract negotiations process. Solicit input from key Project Stakeholders on all final negotiated agreements. Escalate if there is not agreement on the allocation of responsibility for negotiations.
	12		Ensure compliance with OPG procurement governance.
	13		Obtain approvals and award contracts and issue purchase orders.
	14		Turnover contract to PM and CM. Educate PM and CM on contract terms, conditions, etc. Check-in at regular frequency to ensure PM/CM complying with terms and conditions of the contract.
	15	Develop and execute Contract Management Plans.	Manage and approve the release of/access to contract information.
	16	Ongoing education of PM organization on contract terms and conditions.	
	17	Ongoing interpretation of contract terms & conditions (with support of SC and Law as applicable).	
	18	Ongoing contract performance monitoring and reporting.	
	19	Provide commercial contract	

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Stage of Work		Contract Management (CM) <sup>1</sup> & Project Management (PM)	Supply Chain (SC)
		input on invoices, as requested.	
Ongoing Contract Management	20	<p>PM to determine and authorize Project Change Directives ("PCD").</p> <p>CM to manage the PCD process on behalf of the PM.</p> <p>PCD's are limited to original scope, schedule, and cost changes.</p> <p>Minor, non intent, or contract clarification changes that may be required, within bounds of original approvals, shall be collectively referred to as a "Minor PCD". It is expected that approximately 90% of PCD's will be Minor PCD's.</p> <p>It is expected that PCD's will be required to revise various contract schedules, such as payment milestones, economic cost adjustment indices, minor scope change or addition, etc. CM will confer with Law and SC, as well as P&amp;C and Finance as required, to determine whether a PCD or contract amendment is appropriate.</p> <p>Escalate if there is not agreement re: the categorization of PCD, or if there is not agreement re: a PCD negotiation strategy.</p> <p>All PCD's will be incorporated</p>	<p>SC primary involvement in PCD's is to process any contract amendment that may result. SC to manage negotiations and perform all contract amendments, including any contract changes that modify the risk profile, or the original terms and conditions of the agreement.</p> <p>Escalate if there is not agreement on the amendment negotiation strategy.</p>

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Stage of Work		Contract Management (CM) <sup>1</sup> & Project Management (PM)	Supply Chain (SC)
		into a contract amendment on at least an annual basis.  CM to identify and track all PCD's in a consistent manner for all major contracts	SC to be copied on, or have access to, all PCD tracking information.
	21	Assists Supply Chain with the drafting and implementation of contract amendments as required.	SC drafts amendments, revises purchase orders, and seeks approvals.
Claims and Contract Close-Out	22	PM/CM informs SC of potential warranty claims associated with the work.	SC determines if warranty applies. Enforces warranty and other terms and conditions.
	23	Manage vendor complaints/ disputes related to scope, schedule and cost, or anything that is not significant in nature.  Inform SC of significant complaints /disputes at an early stage. <sup>2</sup>	Manage all formal vendor claims. Ensure PM/CM aligned with settlement terms and conditions.
	24	Work with PM to provide evidence to support formal claims.	Manage and negotiate disputes that have escalated to formal claims.
	25	PM to identify when work is complete and when milestones have been met. PM/CM to notify Supply Chain of completion of contract deliverables and of final payment.	Close-out purchase orders.
	26	Implement a major contract audit program. Inform SC of audits and audits results. Work collaboratively with SC to resolve findings.	Support enforcement of resolution of audit results. Assess impact against other contracts for precedents, etc.
	27	Support OEB reporting	

Notes:

This allocation of responsibility currently applies to the DNR program and does not apply to

<sup>2</sup> It is anticipated that approximately 90% of disputes can be resolved between PM/CM and Supplier before a formal claims process is initiated. SC and Legal will manage formal claims disposition.

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contracts that are managed by Projects and Modifications.

Agreed by:	<div>Original signed by</div> <div>_____</div> <div>Phil Reinert, VP Supply Services OPG Projects</div> <div>Date:</div>
Agreed by:	<div>Original signed by</div> <div>_____</div> <div>Meg Timberg, VP Nuclear Projects Oversight</div> <div>Date:</div>



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**Defuelling Project Management Plan**

**NK38-PLAN-09701-10134-R001**

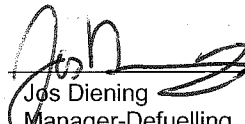
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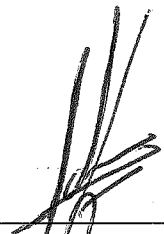
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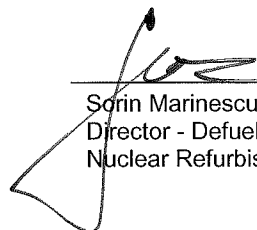
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## 1.0 INTRODUCTION

Darlington Nuclear Generating Station (DNGS) requires a major refurbishment in order to extend the service life of all four production units. The refurbishment is currently planned to begin in 2016. The first unit will be shutdown and restarted with no overlap while the remaining units will have a partially overlapping sequence with the third unit shutdown commencing after removal of all reactor components in the second shutdown unit. The first major step in the Refurbishment Program is to remove the irradiated fuel from the reactor core (i.e. 480 channels everyone containing 13 fuel bundles for a total of 6240 irradiated fuel bundles) in order to allow the downstream activities, including RFR, to be executed.

## 1.1 Project Scope

The main scope of the Project is to design, manufacture and test Defuelling tools with support from an External Contractor as well as defuel the entire reactor core using OPG resources. The Defuelling activity will be repeated for all four units at DNGS, is on the Critical path, and needs to be completed in the shortest practical timeframe.

The following Defuelling tools/software are being required:

- Universal Carriers (UC)
- Flow Restrictive Outlet Bundles (FROB)
- Dummy Fuel Bundles (DFB)
- Fuel Push Tool (FPT)
- New Fuel Transfer Mechanism (NFTM) modification
- Software changes (SW)
- Grappling Equipment

## 1.2 Technical background

A number of defuelling options were considered for the units in NK38-REP-35000-10004 "Darlington NGS Defuelling Study" [1] and the option selected is flow defuelling using 2 Fuelling Machines (FMs) with 2 channels being defuelled simultaneously where possible.

Flow Defuel uses the flow of the Primary Heat Transfer (PHT) system to push the fuel into the downstream fuelling machine. FROBS will be inserted into the empty channels to mimic the flow resistance of a fuel string and maintain overall core hydraulic conditions constant. There will be some channels close to the periphery where PHT flow alone is not able to defuel a channel so dummy fuel bundles will be used to displace the irradiated fuel into a fuelling machine.



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### 1.3 Project Management approach

The Defuelling project is divided into three phases:

- The Definition Phase includes tasks required to complete detail design, supply of prototype components and testing of these components. The definition Phase will be completed in August 2015 with DCAVR (Design Completion Assurance Verification) process.
- The Execution Phase includes tasks required to commission the components at the DNGS as well as defuel entire reactor core on Unit 2 and will be repeated three times for the rest of the reactor units. It will start in July 2015 after the DCAVR process is completed and will end in 2021 after Unit 4 is defueled.
- The Project Closeout Phase will be done at the end of the Execution Phase for Unit 4 in 2021.

The initial revision of the Project Management Plan covers the planned effort for the Definition Phase i.e. June 2013 and up to August 2015 (Design Completion Assurance Verification Requirements process – DCAVR). The second revisions will focus on the early portion of the Execution phase i.e. commissioning (June 2015 - April 2016).

The project management approach for the Defuelling project is as follows:

- The EP (Engineering, Procurement) part will be executed by an External Contractor: General Electric Hitachi Nuclear Energy Canada (GEH-C) was chosen as the Defuelling Contractor.
- The C (Construction) part will be executed by OPG with technical support from the Contractor since only authorized OPG staff (Fuel Handling panel and field operators) can operate/maintain the Fuel Handling system.

OPG will be accountable for performing oversight for the EP Contractor and integrating all work packages throughout the project lifecycle.

### 1.4 Project roles and accountabilities

The key roles on the Defuelling project are:

- Project Sponsor: Vice President, Nuclear Refurbishment Execution
- Contract Owner: Defuelling Project Manager and authorized delegates
- Engineering Lead
- Project Controls Lead
- Contract Manager

For other roles see Appendix A "OPG Defuelling Project Organization".



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### **1.5 Limits of Authority**

The authority to execute the Defuelling Project resides with project Sponsor – Vice president of Refurbishment Execution. As sponsor he delegates execution authority to the Defuelling Project Manager. This authority includes the following:

- Determine the structure, size and makeup of the organization required for project execution.
- OAR (Organizational Authority Register) authority for Defuelling project costs.

### **1.6 Project organization**

The Defuelling project staffing structure has been organized to facilitate project execution. The organization has been setup to align with the execution model and contract. For more details about the project organization see section 9.0 "Project Human Resource Management".

## **2.0 GOVERNANCE STRUCTURE AND INTERFACES**

### **2.1 Defuelling Management Plan**

Defuelling Management Plan is consistent with NR Program Management Plan NK38-NR-PLAN-09701-10001 sheet 1 "Darlington Refurbishment Program Structure" [2] and the Project Management Body of Knowledge (PMBOK), fourth Edition [R3]. The content of this PMP is divided into nine knowledge areas as shown below:

- Section 4.0 Project Integration Management
- Section 5.0 Project Scope Management
- Section 6.0 Project Time Management
- Section 7.0 Project Cost Management
- Section 8.0 Project Quality Management
- Section 9.0 Project Human Resources Management
- Section 10.0 Project Communications Management
- Section 11.0 Project Risk Management
- Section 12.0 Project Procurement Management

There is a separate section dedicated to Safety as a cornerstone of the Project.



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### 3.0 SAFETY

Safety is the core value of the Nuclear Refurbishment and Defuelling Project.

#### 3.1 Safety Management

The Defuelling Project will comply with the requirements in the Health and Safety Management Plan NK38-NR-PLAN-09701-10001, sheet 5 [4].

Specifically the Project will discuss safety issues at the weekly Defuelling Project meetings and safety statistics for both OPG and the Contractor (when applicable) on a weekly basis.

A Project specific Safety Management Plan will be issued prior to the Execution phase of this project (August 2015).

Goals and Objectives:

- No Defuelling Project related injury, illness, or damage to property or the environment is acceptable.
- OPG and Contractor (when applicable) will work collaboratively to prevent all such injury, illness and damage.
- OPG and Contractor (when applicable) will accept nothing short of zero incidents as the only justifiable goal for Nuclear Refurbishment work.
- OPG and Contractor (when applicable) will carry out Defuelling activities in a responsible manner that minimizes risk to employees, and the public.

#### 3.2 Environment Management

The Defuelling Project will comply with requirements of Program Environmental Management NK38-NR-PLAN-09701-10001, sheet 4 [5].

#### 3.3 Execution/Implementation Management

The Defuelling Project will comply with requirements of Darlington Refurbishment Construction Program Management Plan NK38-NR-PLAN-09701-10001, sheet 12 [6]. OPG will have different roles during the Definition and Execution project phases as follows:

- Definition phase: Owner role
- Execution phase: Constructor role



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## **4.0 PROJECT INTEGRATION MANAGEMENT**

### **4.1 Integrated Governance**

This section refers to the integration of OPG and Contractor's governance is outlined in details as part of the approved Contract/Owner Interface Requirements document (COIR) for Defuelling project (D-DAI-35000-10003) [7] and the associated list of approved deviations as documented in NK38-CORR-35000-0481077 [8].

### **4.2 Project Management**

The technical side the project is supported by the NK38-SOW-35000-10002 "Scope of Work – Reactor Defuelling" [9] and a suite of other technical documents while the commercial side is covered by NK38-REP-09701-10020 "Contracting Strategy for Fuel Handling Defuelling" [R10] as well as the Defuelling Contract.

### **4.3 Project Oversight**

Defuelling project oversight covers all activities required to be performed by OPG in order to properly oversee the Contractor's activities as well as its own activities over the life of the project. All oversight activities will follow "Nuclear Refurbishment Project Oversight" N-MAN-09701-10002 [11] and will be planned and documented on Risk, Management and Oversight Tool (RMO). When oversight activities are performed, the findings will be documented in the Oversight Log which is a separate tab on RMO Database.

#### **4.3.1 Project team oversight**

Defuelling project team oversight plans to use the following guiding principles:

- Trust but verify.
- Use a risk based approach – level of intrusiveness. The more risk the more oversight required.
- Alarm before fail.
- Focus on identifying and correcting organizational weaknesses in the EP Contractor's management system rather than focusing on individual performance.
- Use Pareto principle to focus oversight on the right 20% of the products and services to uncover 80% of the problems.
- Escalate issues quickly when problem persist.

#### **4.3.2 Functional team oversight**

The Nuclear Refurbishment (NR) program will provide an important formal aspect of project oversight over the Defuelling Project team that will be executed through the NR Functional Support groups. This formal functional team oversight will be delivered via the self assessment process that will ensure that performance of work meets the requirements and



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opportunities to improve the functional management systems per N-PROC-RA-0097 "Self-Assessment and Benchmarking" [12] are taken.

#### 4.4 Engineering Design Management

The Defuelling Project Engineering Plan has been developed by the Contractor to describe how work will be organized and where applicable processes and procedures will be located for these activities. This plan is based on the requirements from the Defuelling COIR [7] and may be revised periodically to align with the Contract schedule.

The breakdown of individual work packages was determined by the Contractor in consultation with OPG and is captured in the Contractor's Engineering Plan and Schedule. Planning for activities within the individual work packages will be conducted as specified below:

##### 4.4.1.1 Engineering Modifications

The Contractor developed Detailed Design Plans for each individual work package to address the associated engineering activities beginning with conceptual engineering and finishing with the release of the construction packages. Those work packages following OPG's ECC process N-PROC-MP-0090 "Modification Process" [13] will require the Design Authority to authorize the Contractor's detailed design plans via a separate coversheet during the "Modification Planning" and "Closeout" phases.

##### 4.4.2 Scoping

During the scoping phase of the project, OPG developed and approved a set of Modification Design Requirements (MDR) and Component Design Requirements under 3 separate Master ECs. The following documents will form the bounding Design Basis Requirements and thus, as a set, shall be considered a set of Modification Design Requirements for the project:

Master EC #	Title	Documents
<b>118844</b>	0-35000-MASTR: Darlington Reactor Defuelling Introduction Of Flow Restricting Outlet Bundles And Dummy Bundles	NK38-MDR-35000-10001 TD 38-35667-022-002 TD 38-35667-022-003 TD 38-35667-022-004 NK38-REP-35000-10008
<b>119682</b>	0-35211-MASTR: Introduction Of Universal Carriers In Lieu Of Existing Fuel And Defuel Carriers In Support Of Darlington Reactor Defuelling	NK38-MDR-35211-10001 TD 38-35211-022-102
<b>119684</b>	0-35260-MASTR: FM Flow Injection Modification	NK38-MDR-35260-10001

**Table 1 - Defuelling Modification Design Requirements set**





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#### 4.4.3 Requirements Traceability Matrix

A Requirements Traceability Matrix (RTM) will be prepared and updated by the Contractor through the design process for modifications and tooling as per NK38-GUID-01900-10001 "Darlington Refurbishment Design Completion Assurance" [14]. The RTM will ensure the design satisfies the critical design requirements which will be submitted as part of the Design Completion Assurance Package (DCAVR). The RTM will identify:

- Basis of the requirement(s) (e.g. MDR Equivalent Design Requirements)
- Specify requirement(s) (e.g. Derived Requirements)
- Method used to prove the requirement (e.g. Calculations & Analysis)
- Evidence of meeting the requirements (e.g. Design EC Package)

#### 4.5 Project Gate Progression

A gate progression strategy for Defuelling Project must take into account the needs and timing associated with the Project Contract Agreement as well as the progression of the project N-MAN-00120-10001 Sheet: GRB "Nuclear Projects – Gated Process [15]. Additionally, it is important to forecast the required finances as accurately as possible. In order to minimize the risk of inaccurate financial planning, the Defuelling project will follow the phased approach to the gate review process that employs 5 principle gated reviews and is based on the maturity of scope development and OPG/Contractor integration.

The following is a high level summary of the phased approach that will be structured through the Contractor versus the gated project phases. It will also highlight the work to be completed in each contractual phase and what gates would apply to those phases. Each Gate will include accurate financial forecasts until the next gate. Overall project estimates will be refined further at each gate review.

Defuelling Project Gate			
P6 Activity	Gate	Information	Date
MS010	Gate 1	<ul style="list-style-type: none"> <li>• Core Scope DSRs related to Defuelling and FH Refurbishment contracts</li> <li>• Approval given for planned Cash Flow until June 2013</li> <li>• Contingency covered at the Program level</li> </ul>	Complete 10-Nov-2011
MS020	Gate 2	Definition Phase <ul style="list-style-type: none"> <li>• Project Management Plan</li> <li>• Class 3 and 5 Estimates</li> <li>• Alternate options, CDR</li> <li>• Contracting Strategy</li> <li>• Scope Definition</li> </ul> Gate 2 Readiness Submission is 10-June-2013	Complete 17-Jun-2013



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MS025	Gate 3	Execution Phase	1-June-2015
MS035	Gate 4	Unit Specific and Integrated Closeouts	01-Jan-2021
MS040	Gate 5	Final Project Closeout	01-Jan-2025

**Table 2 - Defuelling Project Gates**

#### 4.5.1 Approval Process

Approval of this gate progression strategy is obtained through the Gate Review Board as identified in N-MAN-00120-10001 Sheet: GRB "Nuclear Projects – Gated Process and NK38-NR-PLAN-09701-10001 sheet 0010 "Darlington Refurbishment Management System Oversight Program Management Plan" [16].

### 5.0 PROJECT SCOPE MANAGEMENT

Project Scope Management ensures that the Defuelling project includes all the work required, and only the work required, to complete the project successfully. It is primarily concerned with defining and controlling what is or is not included in the project. Defuelling project scope is represented by the DSR item below:

DSR	Description	Status
SI0200-1	Perform Flow defuelling of Darlington reactors using Flow Defuelling method.	Approved

**Table 3 - Defuelling DSR**

#### 5.1 OPG Scope Management

##### 5.1.1 Scope Definition

The scope of work for the Defuelling project is defined in the Scope of Work document, 'NK38-SOW-35000-10002' [9] and is managed in accordance with program document NK38-NR-PLAN-09701-10001 sheet 02 "Darlington Refurbishment Planning And Controls Program Management Plan" [17].

Scope definition for Defuelling project was conducted by the project organization. A set of three Master EC packages were developed which includes 3 MDRs and 4 Component Design requirements.

##### 5.1.1.1 Scope Requirements Basis

Defuelling project consists of a combination of two-bundle flow-defuelling of the high flow channels followed by push defuelling of the remaining channels. For more details see NK38-PLAN-35000-10003, Refurbishment Defuelling Reliability Readiness Development [34].



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#### **5.1.1.2 Requirements Management Plan**

Requirements will be managed in accordance with NK38-INS-09701-10001, Darlington Nuclear Refurbishment Program - Scope Control [18].

#### **5.1.1.3 Accepted Deliverables**

Contract deliverables will be accepted based on technical requirements from the Defuelling COIR [7] and applicable sections of the Contract.

#### **5.1.2 Work Breakdown Structure**

The purpose of the Work Breakdown Structure (WBS) is to identify the deliverables with top-down approach that serve as the basis for project scope verification during Project planning phase. The WBS is the foundation of the overall schedule for all phases through to closeout. The control accounts setup at WBS level includes work packages for cost estimation, collecting, and monitoring costs using Proliance Earned Value Management System (EVMS). Defuelling project WBS has been developed in accordance with Darlington Nuclear Refurbishment Program Project Work Breakdown Structure documented in NK38-NR-PLAN-09701-10001 sheet 02 "Darlington Refurbishment Planning And Controls Program Management Plan" [17].

##### **5.1.2.1 WBS Elements**

The purpose of the Work Breakdown Structure (WBS) is to identify the deliverables with a top-down approach that serve as the basis for project scope verification during Project planning phase. The WBS is the foundation of the overall schedule for all phases through to closeout. The control accounts setup at WBS level includes work packages for cost estimation, collecting, and monitoring costs using Proliance Earned Value Management System (EVMS). The Defuelling project WBS has been developed in accordance with Darlington Nuclear Refurbishment Program Project Work Breakdown Structure and documented in NK38-NR-PLAN-09701-10001, Sht: 02 – Darlington Refurbishment Planning and Controls Program Management Plan [17] Using the WBS, performance and cost will be tracked for each of the work packages throughout the project evolution.



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### 5.1.3 Scope Control

The scope of work for the Defuelling Project will be as defined by the contract between OPG and Contractor. No changes to this scope of work will be accepted by either OPG or the Contractor, unless defined Change Directive process is followed. Any written or verbal instructions to the contrary will not take effect, and will not be accepted by either party.

### 5.1.4 Scope Management Integration

Scope Management Integration shall be performed throughout the project duration, identifying areas of best practice that the Project Team should comply with. Change Control will monitor and control the deviations from the approved design requirements during the life of the project. Change control will become active after work is assigned to Engineering and a design re-baseline has been approved. Potential scope changes shall follow NK38-NR-PLAN-09701-10001, Sht: 02 – Darlington Refurbishment Planning and Controls Program Management Plan [17] No work will be performed on a potential change unless authorized by OPG via the Change Directive Process. In any case, to mitigate schedule risk, OPG may direct Contractor to proceed with the change directive in advance of the formal amendment to the contract. In such cases, the Project Manager (PM) will present the request with the commercial and technical risk to the Senior Management team and request authorization to proceed.

### 5.1.5 Optional scope

There is optional scope outlined in NK38-SOW-35000-10002 – Scope of Work Reactor Defueling [9] that may be added later in 2015 to the external contract.

## 6.0 PROJECT TIME MANAGEMENT

The OPG Refurbishment Defuelling projects governance will be structured for Project Time Management once the Engineering mobilization starts during post contract award phase. This process will include the processes required to manage timely completion of the project. The Time Management plan for Defuelling project will be managed and will be followed in accordance with NK38-NR-PLAN-09701-10001, Sht: 02 – Darlington Refurbishment Planning and Controls Program Management Plan [17]

### 6.1 OPG Time Management

The Defuelling project has developed Level 1 and 2 schedules for the entire duration. The activities have been defined, sequenced and the activity resources and durations were estimated. OPG will track monitor and control Contractor schedule via Level 2 schedule (in work package level). See table below for a summary of key milestones:

Activity ID	Activity Name	Start	Finish
Defuelling Project <b>OPG</b> Milestones			
73156M1000	Defuelling Nuclear Safety Analysis Started	01-Jun-11 A	

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Activity ID	Activity Name	Start	Finish
73156M0010	Gate G1 Approval (Defueling)		10-Nov-11 A
73156M1030	Flow Defuel EDM Meeting		25-Jun-12 A
73156M1110	Defuelling Contract Strategy Finalised/Procurement Process Initiated		16-Oct-12 A
73156M1010	Defuelling Nuclear Safety Assessment Complete		16-Oct-12 A
73156M1020	Defuelling Scope Definition Complete		22-Apr-13
73156M1040	Flow Defuelling Strategy Challenge Meeting		17-Dec-12 A
73156M0015	Gate G2 Readiness Submission (Defueling)		15-May-13 A
73156M0020	Gate G2 Approval (Defueling)		17-Jun-13 A
73156M1070	Defuelling Contract Awarded		17-May-13 A
73156M1120	Defuelling CNSC Preliminary Notification		16-Apr-14 A
73156M1060	SARF Rehabilitation and PTF Testing Complete		15-Sept-15
73156M0030	Gate G3 Readiness Submission (Defueling)		01-June-15
73156M0025	Gate G3 Approval (Defueling)		15-June-15
73156M0035	Gate G4 Approval (Defueling)		15-Jan-21
73156M0040	Gate G5 Approval (Defueling)		15-Jan-25
Defuelling Contract <b>GEH-C</b> Milestones			
Contract Major Milestones			
73161M1050	Detailed Design Complete for DFB,FROB's,FPT (Key Milestone 1)		16-Jul-14 A
73161M1040	Detailed Design Complete for UC, SW-REQ's, NFTM (Key Milestone 1)		23-Jul-14 A
73161M1080	Prototype Testing Complete GEH-C: UC,SW,NFTM		27-Mar-15
73161M1090	Prototype Testing Complete GEH-C: DFB,FROB,FPT		10-Apr-15
73161M1110	DCAVR Completed and Approved DFB,FROB,FPT (Key Milestone 2)		10-Apr-15 A
73161M1100	DCAVR Completed and Approved UC,SW,NFTM (Key Milestone 2)		02-Jul-15
73161M1130	Commissioning Complete for DFB,FROB,FPT		30-Sep-15
73161M1120	Commissioning Complete for UC, SW, NFTM		29-Jan-16
73161M1170	Each Type of Equipment Delivered DFB,FROB, FPT		01-Apr-16

**Table 4 - Defuelling Project Milestones**

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## 6.2 Contractor Time Management

The Contractor have developed a Level 2/3 schedule that meets project requirements and establish activities to meet project deliverables as defined by WBS. The following guidelines were used when creating the Post contract Contractor's project schedule:

- Level 2/3
- Show integration with OPG's responsibilities and activities
- Show all required deliverables and all required stages of deliverables
- Show all critical path activities and any activities having 10 days float.
- Logic link all tasks and milestones/submittals associated with the Defuelling Project.
- Minimize use of lags and constraints
- Show all required approvals, including OPG approvals.

## 7.0 PROJECT COST MANAGEMENT

The Defuelling project is governed by NK38-NR-PLAN-09701-10001, Sht: 02 – Darlington Refurbishment Planning and Controls Program Management Plan [17]. Project funding is allocated from the Program via the Gated process and the Gate Review Board in accordance with N-MAN-00120-10001, sheet GRB [15].

Funding required in the current release period is categorized and tracked as follows in Nuclear Refurbishment Project Cost Management system (Proliance):

- *Original Budget* is the approved funding established by the release or Gated Process. Original budgets cannot be altered for the period in which they apply.
- *Control Budget* consists of Original budget plus the sum of all approved Directed Changes (i.e. baseline changes).
- *Approved Funding* consists of Control Budget plus all approved funding requests not impacting the baseline.
- *Projected Budget* represents the accountable manager's forecast of cost at completion of the current release and includes all pending (i.e. unapproved) funding change requests plus the impact of undocumented funding impacts based on managerial judgement.

At this time the Defuelling Project has a Class 3 estimate and a Cost Breakdown Structure (CBS), as part of the Project Gate submission documentation.

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## 8.0 PROJECT QUALITY MANAGEMENT

### 8.1 OPG Quality Management

The Quality Management of the project will be in compliance to:

- N-CHAR-AS-0002 – Nuclear Management System [19],
- N-PROG-AS-0001 – Managed Systems [20],
- N-PROG-AS-0007 – Project Management [21],

Along with the following Standards and Guideline documents:

- N-STD-AS-0028 – Project Management Standard [22]
- N-STD-AS-0029 – Contract Management Standard 23]
- N-STD-AS-0030 – Project Oversight Standard [24]

### 8.2 **NK38-NR-PLAN-09701-10001 sheet 10, Darlington Refurbishment Management System Oversight Program Management Plan Operating Experience**

Operating Experience (OPEX) from other stations has been reviewed; in the nuclear industry there have been several reactor Defuelling to date: Pickering A, Point Lepreau and Wolsung are from the Candu 6 design type NPP's and Bruce A is from the Candu 9 design type NPP's, a similar design to Darlington.

From technical point of view the OPEX from Candu 6 stations although relevant in many areas, is not really helpful in certain key design aspects due to large differences between the Defuelling methods: Candu 6 and Pickering A use a "mechanical push" type method by using "ram extensions" inserted by the upstream Fuelling Machine (FM) to push fuel bundles in the downstream FM.

The Bruce A Defuelling process used flow to carry away the fuel bundles, in the downstream FM similar to Darlington method. The OPEX from Bruce proved that the current Flow Defuelling method is viable however the Bruce A reactor feeder design uses equal flow configuration for all reactor channels. The Darlington core design uses flow restrictors in the core outer channels which decreases the flow and makes Flow Defuelling more difficult to be executed.

From Project management point of view both Candu 6 and Candu 9 project OPEX is helpful in sense that for both reactor refurbishments, the Defuelling project was the first major step and it was on the critical path so it received similar attention from the main stakeholders.

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### 8.3 Quality Assurance

The Defuelling project and its EP Contractor are required to meet the following requirements:

- Applicable elements for engineering, procurement and construction services of CSA N286-05, Managed System Requirements for NPP as amended, restated or replaced.
- CSA Quality Standards Z 299.2 series of standards or such equivalent quality standard agreed to by OPG that may replace said standard.
- Applicable elements for Design Software (use, modification or development) of CSA N286.7, Quality Assurance of Analytical, Scientific and Design Computer Programs for Nuclear plants.
- Electric Power Research Institute (EPRI) guidelines with respect to the prevention and detection of Counterfeit, Fraudulent and Suspect Items (CFSI).
- Ensuring Subcontractor evaluation and selection is performed in compliance with the requirements of the applicable elements of CSA N286-05 and CSA Z 299 series of quality standards or such equivalent standard agreed by OPG.

OPG has reviewed and accepted the Contractor's Project Quality Assurance Plan.

The Contractor's QA program will be audited at intervals as required, but as a minimum every three years to ensure that the Contractor continues to implement the Quality Program as required by OPG.

During the different phases of Project work, the Project team jointly with the Functional team (i.e. the NR Engineering organization supporting the Defuelling project) will work to ensure the quality of design, quality of materials and services provided are meeting OPG standards, Purchase Order requirements, and compliance to codes and standards as applicable. The oversight activities will be based on the documented oversight plans with the oversight being based on risk, criticality and OPEX.

Assessments, witnessing activities, document reviews etc. will be performed as required ensuring that necessary quality standards are maintained. In the instance of a Quality system failure or a breakthrough event occurring for which the Contractor is accountable; such adverse conditions will be documented per the Contractor's QA Program and per N-PROC-RA-0022 "Processing Station Condition Records" [25]. The Contractor will be asked to initiate a Corrective Action as per their program for any identified quality issues. When there is a systemic failure of their implemented Quality System, a formal Non-Conformance and Corrective Action Request process will be initiated by OPG Supply Chain Quality Services as per N-PROC-MM-0010 "Establishing and Maintaining Ontario Power Generation Approved Suppliers List" [26] and N-GUID-01935-10004 "Desktop Guide for Supplier Non Conformance Correction Requests (NCAR)" [27].



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To ensure compliance to OPG requirements, the Contractor interface will be controlled by the Contractor Owner Interface Requirement (COIR) document forming part of the agreement and deviations, additions, exceptions, revisions thereto will be accepted by both OPG and the Contractor.

#### **8.4 Quality Control**

The combination of OPG's Program, Defuelling Project and EP Contractor's Plans will be used to ensure quality on the project. As the great majority of the work is executed under the Contractor's Quality Assurance program, OPG will perform oversight and witness key aspects of the work program. For example, witness points will be added to Manufacturing Inspection & Test Plans for Defuelling hardware components.

### **9.0 PROJECT HUMAN RESOURCES MANAGEMENT**

#### **9.1 OPG Human Resource Management**

##### **9.1.1 Team Resourcing**

OPG has retained the role of Project Manager and will be accountable for performing oversight for EP Contractor and integrating all work packages throughout the project lifecycle. The EP Contractor will be accountable to deliver the contracted work as per the individual EP Agreement. The OPG Defuelling Project Organization is shown in Appendix A with key roles and their respective accountabilities described in Appendix A "Project Organization".

Nuclear Refurbishment has elected to employ a Matrix organizational model to execute the Refurbishment Program. It is Defuelling project's plan to staff the project team with OPG staff, and supplemented by Managed task activities to meet the project schedule and needs. OPG staff will either be embedded in the team or will perform functions matrixed from the NR functional support organizations. Where NR functional support staff is currently unable to fulfill a specific need, due to unavailability or missing skill sets, the project will work with the accountable Functional Manager (responsible to acquire the required resources) to either utilize Managed task contracts to maximize outside experience or attempt to find staff within other OPG business units.

### **10.0 PROJECT COMMUNICATION MANAGEMENT**

Refurbishment Program Communications Management Plan is NK38-NR-PLAN-09701-10001sht 14 [35].

#### **10.1 Contractor Communication Management**

External Contractor (EP part of the project): communication is managed in accordance with the Contract and will be related to the engineering, manufacturing, and commissioning activities for the Defuelling tools.

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Key principles in effective communications are to:

- Adhere to OPG ECC process to communicate with modification stakeholders.
- Engage all relevant stakeholders at the right time.
- Be clear and concise and maintain 3 way communication strategy.
- Maintain integrity in the content of written and verbal communications.

All proprietary information and confidentiality requirements required by OPG will be closely adhered to.

## 10.2 Darlington Station Communication Management

OPG Darlington station (C part of the project): communication is managed in accordance with OPG governance and will be related to the training activities for the FH operators as well as Defuelling execution activities.

## 10.3 Information Control

The main stakeholder communication methods are:

- Telephone and Email communications,
- Submittals and Requests for Information (RFI),
- Meetings, and
- Publications and Reports.

Emails: Regularly used to document interface with stakeholders, the project team and with the Contractor. A Defuelling Project Mailbox may be set up in order to streamline the electronic communication hub. If such Project email is set up, it will be accessible by all members of the OPG Defuelling Team to capture emails deemed important for all project members to be aware of..

Meetings: Conducted face-to-face with available teleconference and/or videoconference as required. The stakeholder meetings involving the Defuelling project and its stakeholders are listed in the Table 5.

Publications and Reports: Defuelling Project publications and reports are described in the applicable sections of this PMP. Publications of Defuelling Project information are also communicated to internal stakeholders via OPG newsletters (e.g. The Pulse) and Intranet websites (e.g. Fuel Handling Project intranet website).

Submittals and RFI's: Submittals and RFIs are important communication methods. Submittals will be defined as per the Contract Agreement. The internal process for handling submittals and RFIs is described in Nuclear Projects Records and Document

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Management manual N-MAN-00120-10001-RDM [36] and Nuclear Projects Supplier Document Hub manual N-MAN-00120-10001-RDM-02 [37].

Defuelling Project Stakeholder Meetings		
Meeting	Title	Description Frequency
Executive Oversight Committee	Project Performance Update. Issue resolution. Chief Executive Update	Quarterly
OPG/Contractor Steering Committee	Project Performance Update. Issue resolution.	Monthly
Defuelling/ Contractor Project Manager's Meeting	Project Performance Update. Issue resolution	Bi-Weekly
Defuelling/Contractor Team Leads Meeting	Project Performance Update. Issue resolution.	Bi-Weekly
Scope Review Board	This includes the related Technical Screening Committee and Funding Screening Committee meetings. Scope addition, removal, modification processing.	Quarterly
MRM Meeting	Review and processing of station condition records associated with Defuelling	Bi-Weekly
Monthly Integrated Project/ Functional Communication Meeting	Discussion of Project Quad-Charts	Monthly
Darlington Refurbishment (DN) Monthly Program Status Meeting	Project Performance Update. Issue resolution.	Monthly
DN Refurbishment/ NWMD Coordination Meeting	Alignment meeting	Bi-Weekly
Operations and Maintenance Scope Status Meeting	Project Performance Update. Issue resolution.	Weekly
Operations and Maintenance & NR Execution PM Meeting	Alignment meeting	Bi-Weekly
Defuelling/MCED Interface Meeting	Alignment meeting	Monthly
DN Refurbishment/CNSC Meeting	Alignment meeting	As Required
DN Refurbishment Execution PM Meeting	Discuss current events and issues on projects	Weekly
Nuclear Refurbishment All Staff Face-to-Face Meeting	Project update	As Required
Nuclear Refurbishment Program Huddles	Various topics	As Required (weekly)
DN Refurbishment Execution Three-Stratum Meeting	Project Performance Update. Issue resolution.	Monthly

**Table 5 - Defuelling Project Stakeholder Meetings**

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Records: Communication Technology and Information distribution tools that will be used by the project include:

- Supplier Document Hub (SDH): External environment used for exchange, management of Submittals, Request for Information (RFI) as per the Defuelling Contract Agreement.
- SharePoint 2007: Internal document storage, exchange environment used for storage of project documents, deliverables, schedules, cost information, as well as confidential & commercially sensitive information relevant to the Defuelling contract.
- NR Refurbishment Documents Management (RDM) are owners of both the SDH, SharePoint, and are responsible for process definition and support, technical support for SDH as it relates to Submittals, RFIs as outlined in the Defuelling Contract Agreement. A generic email is available to contract NR Refurbishment Documents Manage group through (DNGD: Refurb Doc Mgmt)
- Project Records will be maintained in SharePoint and Project Emails. As applicable, project records will be indexed and stored in Asset Suite.

#### 10.4 Stakeholder Inputs

Stakeholder inputs are gathered through the various meetings conducted by and with the Defuelling project staff. Actions, issues and risks are then tracked in the appropriate system as described in the Risk Management Plan portion of this PMP.

The major stakeholders for the Defuelling Project are listed in Table 6 'Defuelling Stakeholder Register'. When situation arise that specific stakeholder input is required but not available, additional resources will be obtained either internally or externally to ensure that any stakeholder input gaps are managed.

An example would be when a specific expertise is required to review an engineering package and an external contractor is utilized for expert review.

Defuelling Stakeholder Register			
Identification	Main Expectations	Potential Influence & Phase of Most Influence	Stakeholder Classification
Darlington Nuclear Generating Station (DNGS)	Return of units 1-4 as per Refurbishment Program Charter	Owners of Plant Systems; Execution Phase	Internal
Contractor	Coordination with OPG as per Defuelling Contract Agreement	Throughout the Entire Project	External
Unions	Upholding of Collective Bargaining Agreements	Execution Phase	External

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Canadian Nuclear Safety Commission	Compliance with Regulations	Throughout the Entire Project	External
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**Table 6 - Defuelling Stakeholder Register**

#### 10.4.1 Performance Reporting

Project reporting will be done in accordance with the NR Program as per the Defuelling Project Controls Plan.

### 11.0 PROJECT RISK MANAGEMENT

Risk Management for the Defuelling Project takes authority from the Nuclear Project Risk Management Process N-MAN-00120-10001-RISK [28] and N-MAN-00120-10001-RISK-04, Nuclear Refurbishment Risk Management [29]. In addition, the Defuelling Project will provide oversight on the responsibilities that the EP Contractor is obligated to perform.

The Defuelling Project risks are identified, assessed and maintained in the RMO database and an OPG person from the Project is the assigned SPOC for maintaining and updating the Project risks in RADAR Database.

#### 11.1 Risk Identification and Analysis

All known risks that could impact the Defuelling project will be tracked in the RMO. Information gathering for input to the Defuelling risk register will be taken from issues arising from Defuelling Team meetings, OPEX, Contractor risk register.

The significance of each risk is the product of its impact and probability. These factors are assessed by the Defuelling project team, the appropriate stakeholders for each risk and when needed with help from expert advice according to criteria identified in the Table 6 below.

After assessing the risk factors a number from 1 to 5 is awarded to every factor, then risk is calculated by multiplying the Probability factor with the highest of Financial and Schedule impact factors. Then the number obtained is characterized based on Table 7

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“Heat Map” below.

Nuclear Projects Risk Assessments Scale						
Risk Attribute	Definition	1 (Minimal)	2 (Minor)	3 (Notable)	4 (Substantial)	5 (Major)
Probability	The probability that a risk will occur	<20%	20%-40%	40%-60%	60%-80%	>80%
Schedule Impact	The impact that a risk would have on the project critical path	No Delay	< 1 Week	1-2 Weeks	2-6 Weeks	>6 weeks
Financial Impact						
Re-turbishment	Program (Functions)	<\$50M	\$50M-\$100M	\$100M-\$200M	\$200M-\$400M	>\$400M
	Projects (Bundles)	<\$1M	\$1M-\$10M	\$10M-\$50M	\$50M-\$200M	>\$200M
AISC Projects	<\$1M	<\$50K	\$50K-\$100K	\$100K-\$300K	\$300K-\$500K	>\$500K
	\$1M - \$5M	<\$200K	\$200K-\$500K	\$500K-\$1M	\$1M-\$2M	>\$2M
	\$5M - \$10M	<\$400K	\$400K-\$1M	\$1M-\$2M	\$2M-\$4M	>\$4M
	\$10M - \$20M	<\$700K	\$700K-\$2M	\$2M-\$4M	\$4M-\$8M	>\$8M
	>\$20M	<\$2M	\$2M-\$5M	\$5M-\$10M	\$10M-\$20M	>\$20M

Table 7 Project Execution Risk Assessment Criteria/Scale

First the risk Probability is assessed and a number from 1 to 5 is awarded, then similar the Financial and Schedule impact numbers are awarded. Risk is calculated by multiplying the Probability factor with the highest of Financial OR Schedule impact factors. Then the number obtained is characterized based on Table 7 “Heat Map” below:

Risk = Probability x Impact

From the Table above, it can be observed that the FH Powertrack project contains three risk categories:

- Low Risk: scores between 1 – 3
- Medium Risk: scores between 4 – 12
- High Risk: scores between 15-25

Appendix C summarizes the risks from Defuelling project: there are 13 Medium category risks.

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#### 11.1.1 Project Assumptions and Decisions

Significant assumptions and decisions will follow the process for assumption Identification, ownership, analysis and recording as outlined in N-MAN-00120-10001-RISK-07 "Nuclear Refurbishment Assumptions and Decisions Management" [30]. Current significant Project assumptions are documented in Appendix D: Project Assumptions and Decisions.

#### 11.2 Risk Response Planning

Defuelling Project is implementing the following operational mitigation plan for project risks:

1. All risks will be mitigated, accepted or monitored.
2. All risks that are not being monitored will have mitigation actions.

#### 11.3 Risk Monitoring and closure

Risks are reviewed often for reassessing and updating. Risk closure will follow NK38-MAN-00120-1001, sheet: Risk-03"Task Instruction –Closing Risks" [31] and it is performed by the Project Manager or his empowered delegate. Closure notes (e.g. Closed due to risk overlap / duplication with Risk ID ###) are mandatory. Risk trending, variance analysis and performance metrics are performed at the program level.

#### 11.4 Project Issues

Project issues are recorded in the RMO database. An owner is assigned to each issue. The issues are being reviewed weekly in the project meeting. Each owner will use their judgement as to when to identify the issue as a risk and follow the risk process for monitoring and control. As an example, if there is an organizational issue that can be resolved by simply meeting, the issue will be documented until the meeting has occurred and rectified the issue. If the meeting is held and alignment is still not met, it may then be considered as a risk if there is downstream negative impact to the project outcome.

#### 12.0 PROJECT PROCUREMENT MANAGEMENT

The Procurement Management Plan will define how procurement will be managed by both OPG and the Contractor for the Defuelling Project. The Procurement Management Plan is to be referenced for all specifics on procurement management for all phases and aspects of the project.

The Procurement Management Plan applies to procurement activities performed by the Contractor for the scope of work. This includes the procurement of all OPG specific materials, components, goods and services required to complete the scope of work defined during the Defuelling Project. Refurbishment Supply Chain (RSC) department (part of OPG Nuclear Refurbishment) will support the project team with all

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procurement related activities in relation to overall cost, schedule and quality of the project. It is the intent of the Darlington refurbishment program to have the EPC Contractors to procure as much of the refurbishment materials as possible under their own qualified QA program with RSC providing oversight on EPC Contractor procurement activities.

## 12.1 OPG Procurement Management

For all procurement activities, the process is defined in OPG-PROC-0058 Procurement Activities [32]. The procurement terms and conditions will be defined in the Defuelling Agreement and Contractor/Owner Interface Requirements (COIR) which will be issued after contract award. Project specific governance may be created on as required basis.

The following table lists the current project materials milestones for each unit to be refurbished at DNGS.

Unit	Breaker open date	Components for Defuelling project	Material required on site
1 <sup>st</sup> Unit (Unit 2); Unit 0	15-Oct-2016	FROBs	01-Apr-2016
		DFBs	01-Apr-2016
		FPT	01-Apr-2016
		NFTM Loading Ram	21-May-2015
		UCs	21-May-2015

**Table 6 - Defuelling Project Materials Milestones**

## 12.2 Long lead materials

Based on NK38-PLAN-31100-10002 "Fuel Handling at risk & long lead materials procurement plan" [33] there are no known materials that have the potential to become LLM's.

If at risk or LLM's for the Defuelling project are identified in the future, the procurement of such materials will be done by EPC Contractor. In situations where the EP contract award is delayed, OPG may choose to purchase the LLM's and free issue to EP Contractor once contract is awarded.

## 13.0 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

AFS	Available For Service
AIDA	Assumptions Issues Decisions and Actions



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CBS	Cost Breakdown Structure
CCB	Change Control Board
CCF	Change Control Form
CFSI	Counterfeit, Fraudulent and Suspect Items
CNSC	Canadian Nuclear Safety Commission
COIR	Contractor Owner Interface Agreement
COMS	Constructability Operability Maintainability and Safety
CSA	Canadian Standard Association
DCAVR	Design Completion Assurance Verification Requirements
DF	Defuelling
DFB	Dummy Fuel Bundles
DNGS	Darlington Nuclear Generating Station
DSR	Darlington Scope Request
EC	Engineering Change
ECC	Engineering Change Control
EDM	Executive Decision Meeting
EP	Engineering Procurement
EPC	Engineering Procurement Construction
EPRI	Electric Power Research Institute
EV	Earned Value
EVMS	Earned Value Management System
FH	Fuel Handling
FM	Fuelling Machine
FPT	Fuel Push Tool

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FROB	Flow Restrictive Outlet Bundles
GEH	General Electric Hitachi
GRB	Gate Review Board
IT	Information Technology
LLM	Long Lead Materials
MDR	Modification Design Requirements
NCAR	Non Conformance Correction Requests
NFTM	New Fuel Transfer Mechanism
NPP	Nuclear Power Plant
NR	Nuclear Refurbishment
NWMD	Nuclear Waste Management Division
OAR	Organizational Authority Register
OPEX	Operating Experience
OPG	Ontario Power Generation
OSM	Owner Supplied Material
PM	Project Manager
PMBOK	Project Management Body Of Knowledge
PMP	Project Management Plan
PTF	Pressure Test Facility
QA	Quality Assurance
RADAR	Risk Assessment Database And Register
RDM	Refurbishment Documents Management
RFI	Request for Information
RFR	Re-tube and Feeder Replacement

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RPET	Refurbishment Program Executive Team
RSC	Refurbishment Supply Chain
RTM	Requirements Traceability Matrix
SARF	Service Area Rehearsal Facility
SCR	Station Condition Record
SDH	Supplier Document Hub
SME	Subject Matter Expert
SPOC	Single Point Of Contact
TBD	To Be Determined
TOR	Terms of Reference
TSSA	Technical Standard and Safety Authority
UC	Universal Carriers
WBS	Work Breakdown Structure

## 14.0 REFERENCES

- [1] NK38-REP-35000-10004 - Darlington NGS Defuelling Study
- [2] NK38-NR-PLAN-09701-10001, sheet 1 – Darlington Refurbishment Program Structure
- [3] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Fourth Edition
- [4] NK38-NR-PLAN-09701-10001 sheet 5, Health and Safety Management Plan
- [5] NK38-NR-PLAN-09701-10001, sheet 5, Program Environmental Management

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[6] NK38-NR-PLAN-09701-10001, sheet 12, Darlington Refurbishment Program Assurance Program Management Plan

[7] D-DAI-35000-10003 - Nuclear Refurbishment Defuelling Project - Contractor/Owner Interface Requirements

[8] in NK38-CORR-35000-0481077- Contract/Owner Interface Requirements

[9] NK38-SOW-35000-10002 - Scope of Work Reactor Defuelling

[10] NK38-REP-09701-10020 "Contracting Strategy for Fuel Handling Defuelling"

[11] N-MAN-09701-10002 Refurbishment Project Oversight"

[12] N-PROC-RA-0097 - Self-Assessment and Benchmarking

[13] N-PROC-MP-0090 – Modification Process

[14] NK38-GUID-01900-10001 – Darlington Refurbishment Design Completion Assurance

[15] N-MAN-00120-10002 sheet: GRB "N-MAN-09701-10002.

[16] NK38-NR-PLAN-09701-10001 sheet 10, Darlington Refurbishment Management System Oversight Program Management Plan

[17] NK38-NR-PLAN-09701-10001 sheet 02, Darlington Refurbishment Planning And Controls Program Management Plan

[18] NK38-INS-09701-10001, Darlington Nuclear Refurbishment Program - Scope Control.

[19] N-CHAR-AS-0002 – Nuclear Management System

[20] N-PROG-AS-0001 – Managed Systems

[21] N-PROG-AS-0007 – Project Management

[22] N-STD-AS-0028 – Project Management Standard

[23] N-STD-AS-0029 – Contract Management Standard

[24] N-STD-AS-0030 – Project Oversight Standard

[25] N-PROC-RA-0022 – Processing Station Condition Records

[26] N-PROC-MM-0010 – Establishing and Maintaining Ontario Power Generation Approved Suppliers List

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[27] N-GUID-01935-10004 – Desktop Guide for Supplier Non Conformance Correction Requests (NCAR)

[28] N-MAN-00120-10001-RISK – Nuclear Project Risk Management Process

[29] N-MAN-00120-10001-RISK04 – Nuclear Project Risk Management

[30] N-MAN-00120-10001-RISK-07 – Nuclear Refurbishment Assumptions and Decisions Management

[31] NK38-MAN-00120-1001 Sheet: Risk-03 -Task Instruction –Closing Risks

[32] OPG-PROC-0058 –Procurement Activities

[33] NK38-PLAN-31100-10002 - Fuel Handling at risk & long lead materials procurement plan

[34] NK38-PLAN-35000-10003 - Refurbishment Defuelling Reliability Readiness Development

[35] NK38-NR-PLAN-09701-10001 Refurbishment Program Communications Management Plan

[36] N-MAN-00120-10001-RDM - Nuclear Projects Records and Document Management manual

[37] N-MAN-00120-10001-RDM-02 - Nuclear Projects Supplier Document Hub manual

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## Appendix A: OPG Defueling Project Organization

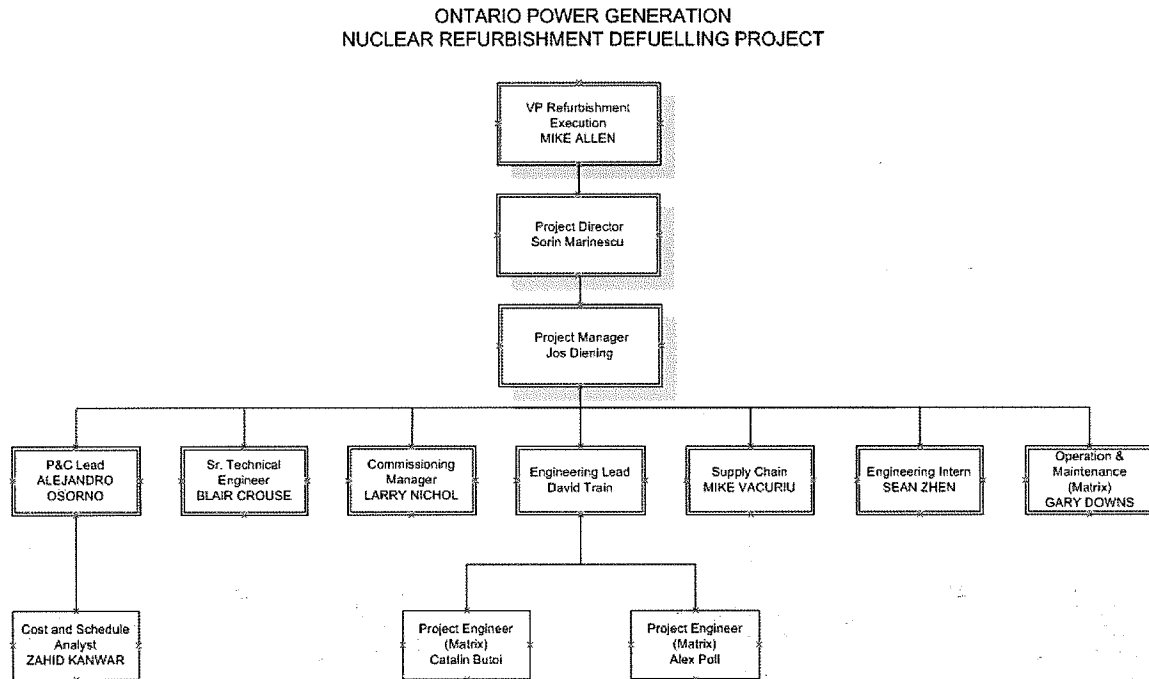


Figure 1 Defuelling ORG Chart

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## Appendix B: Project Organization

Project Sponsor: Vice President, Nuclear Refurbishment Execution

### Accountabilities:

- Ensure Defuelling Project is fully staffed,
- Ensure adherence to Nuclear Refurbishment Program,
- Administer monthly Steering Committee meetings. Address any concerns escalated in a timely fashion, and
- Administer quarterly Executive Oversight Meetings. Address any concerns escalated in a timely fashion.

Project Manager, Defuelling

### Accountabilities:

- Environment, Health & Safety,
- Scope,
- Schedule,
- Cost,
- Risk,
- Quality,
- Staffing & Resources,
- NR Program Governance adherence,
- Reporting & Communications,
- Oversight, and
- Contract Adherence.

Engineering Lead

### Accountabilities:

- The Engineering lead is responsible to meet the overall project engineering objectives. He/she will ensure that matrix engineers are deployed to perform oversight, document reviews and other engineering tasks as required supporting the project.
- The Engineering lead will be matrixed to the Defuelling project, will take day to day direction from the Project Manager and will be responsible for:
  - Ensuring that the ECC process required is defined, understood, reflected in the schedule and implemented per process.
  - Provide resources and context to perform adequate document review within the contractual time frame allotted
  - Provide resources and context to perform required deliverables per process
  - Ensuring resources and context to perform adequate oversight of the Contractor to ensure project objectives for cost, scope, schedule, and quality are met.

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- Attend COMS reviews and ensure OPEX is embedded in the Engineering deliverables
- Ensure scope is defined, understood and managed per the applicable scope management governance
- Ensure all risks associated with Modifications are identified in RADAR per appropriate governance; mitigating actions are prepared per Defuelling PMP, tracked monthly and updated as required.
- Identify, coordinate and solicit all stakeholders' inputs to engineering deliverables reviews.

### Project Controls Lead

#### Accountabilities:

- Ensure project conforms to NR Program Governance, supported by routine quality checks and self assessments.
- Liaising between functions and project including centers of excellence,
- Gated Process including budget loads and baselines,
- Reporting including Earned Value,
- Analysis and Forecasting,
- Business Planning,
- Project Tools including IT tools, processes and instructions, and
- EP Contractor integration within OPG system.



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### Appendix C: Project Risks

ID	Title	Description	Current Score
13471	SDS PIDS hardware commodity contract failed to be renewed or renewal terms unfavourable	The project plans to purchase the PIDS hardware under a current commodity contract which expires October 2015. If the commodity contract fails to be renewed or the renewal terms are vastly different, the cost for the PIDS hardware could be significantly higher.	2
13467	Different SDS setpoints for a pre-equilibrium reactor core may be required	Nuclear Safety had originally identified a requirement for two sets of trip setpoints - one set for a pre-equilibrium reactor core and a different set for a post-equilibrium reactor core. Recently, NS assessed that this was unlikely to be required and the requirement was removed from the Project scope. The Project is now carrying the uncertainty in this regard as a risk.	5
13464	SDS equipment failed during installation	There is a risk that the hardware components are damaged or fail during the installation and commissioning phase.	8
13463	SDS interface compatibility issues discovered during installation	The project plans to thoroughly test the system under simulated conditions. Nevertheless, some field conditions cannot be simulated (for example, driving actual field solenoid valves). Therefore, there is a risk that interface compatibility issues are discovered during installation.	8
13399	Vault Cooler exceptions to Cat ID tech specs	Any significant exceptions to cat ID tech specs and drawings would result in cost impact to the project	4
13397	Vault Cooler equipments quality issues	Quality issues with Vault Cooler Fan Motors and/or Coils result in rework due to ball screws OPEX, this could impact project execution cost and schedule.	1
13396	Vault Cooler agreement to utilize revised strategy for future installation	Agreement to utilize revised strategy for future Vault Cooler installation due to decision on re-wind/Refurbish Fan Motors, this could cause Schedule delay and cost reduction.	1
13394	Vault Cooler Scope Change	Change in project scope (such as to utilize a split coil design), would need to be processed as a project scope change, which would also require a project change directive. This could impact on both cost and schedule.	6

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ID	Title	Description	Current Score
12423	Vendor Claims	There is risk of the vendor making claims for additional cost and schedule, as a result of OPG not meeting its obligations ( for instance: Contractor's Access to Site for)	1
12422	Risk of Vendor Default/Business Continuity	Risk of Vendor default or otherwise becoming unable to maintain business and contractual obligations.	1
12329	SDS Computer Project inconsistent revisions of SDS hardware components	This risk concerns the possibility of inconsistency in the revisions of SDS2 hardware components. As computer technology changes rapidly, the risk is that the project may be unable to obtain production hardware components and spares of the same revisions as used in the hardware qualification activities of the project.	4
12328	SDS Computer Project grounding problem	Grounding has been an issue in past computer system installations, there is a risk that grounding issues may arise with the installation of the new equipment. This risk concerns signal grounding problems that would not be detected during bench testing and could arise at site due to site wiring issues.	8
12327	SDS Computer Project failure to meet hardware design requirements	The project is undertaking substantial testing and qualification (including age conditioning qualification) activities. The risk is that findings during these activities may necessitate a redesign and/or result in significant delays.	8



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ID	Title	Description	Current Score
12324	SDS Computer Project difficulty in securing hardware system integrator	The risk is that the specialty hardware vendor selected for unexpectedly becomes nonviable or chooses not to take on the hardware system integration responsibility.	8
12323	SDS Computer Project late hardware deliveries impacting installation	As the work involves custom designed specialty hardware this risk concerns the inability of the equipment vendor to deliver the custom hardware due to competing priorities or fabrication issues in time for the installation window.	8
12258	Installation Delays Due to Unidentified Structural Members in Front of Vault Cooler Coils	Removal or relocation of structural members due the lack of documentation in drawings, may necessitate a modification, significantly impacting the cost and schedule of the project.	8
12255	Procurement Delay Due to Component Obsolescence	Inability to procure like-for-like replacements of fan motors (due to an obsolescence of parts) may necessitate the requirement of a modification, significantly impacting the cost & schedule of the project.	8
12254	Installation Delays due to Assessment Issues	Due to lack of documentation for field configuration of VC motors/fans, installation work may be delayed.	6
12253	Installation Delays due to Lack of Integration/Priority with RFR Activities	Other projects being executed by the JV may have an overriding priority over the vault cooler replacement project due to their size and/or complexity of scope. This may result in the JV reducing focus on the execution of the scope, thereby shifting the execution windows and impacting the schedule and cost of the project.	10
11982	Delay in Contracting process impacting project schedule	This risk concerns the timely issuance of contracts. As the project heavily depends on purchased services and equipment, the risk is that contract delays will seriously impact the project schedule. The risk is particularly significant because of the specialized nature of safety critical computing and the limited availability of suppliers in this area.	12

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### Appendix D: Project Assumptions and Decisions

ID	Title	Description	Risks
684	Powertrack Execution can be supported by sufficient Station resources	Additional site infrastructure (breathing air system) will be completed in time to allow the execution of Powertrack refurbishment to begin on time.	
683	Powertrack Estimate accuracy	Estimate/proposal from vendor is within accuracy range for Gate 3/RQE requirements.	
682	Powertrack dose management	Dose can be managed to minimize impact on contractor resources.	13383
681	Powertrack ES MSA staffing agreement	On ES MSA staffing agreement, contractor standby time has not been included in the Powertrack estimate as project contingency (should be carried at program level).	13381
680	Powertrack Installation Methodology	Installation methodology ?Operating units zones can recover following installation windows, with 2 operating trolleys ?Planned fuelling recovery windows allow operating unit recovery	13376
679	Powertrack Execution Schedule	Execution Schedule can be integrated into IPG Schedule, and includes return to service process following each installation window.	
678	Powertrack Modification	There is no modification scope for Powertrack project.	13372
651	Reactor Area Bridge & Carriage Material Procurement, Material Pricing	The assumption is that Reactor Area Bridge & Carriage refurbishment material costs will not escalate significantly from Gate 3 until procurement phase.	
650	Reactor Area Bridge & Carriage Material Procurement, Cat ID Validation and Availability	The assumption is that the material required for Reactor Area Bridge & Carriage Refurbishment will be available and can be procured as required for the Refurbishment outage.	
648	Powertrack Long Lead Material Procurement	The assumption is that Long Lead Material (LLM) is defined as any material with 24 months delivery lead time. On this basis, Powertrack Refurbishment has no LLM.	
596	Powertrack Implementation Costs	The assumption is that the Powertrack implementation costs, based on vendor proposal, are accurate.	
595	Powertrack Integration into IPG Schedule	The assumption is that the Powertrack installation can be integrated into the IPG schedule	11980

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379	4D Planning Assumptions	<p>1.- New Power Track EPC estimate is \$89,000k vs. \$38,466 k considered in 4c, variance of \$50,534 k 2.- OBU's Transferred from FH 4c to DF 4d: (\$5,775.18 k) 3.- Reactor Area Bridge submitted as \$13,968 k in 4d vs \$21,495 in 4c: Variance is (\$7,527 k) 4.- New execution strategy added extra OBUs not included in 4c: variance of \$87,04 k 5.- Additional Labour/Core Matrix resources not included in 4c: Variance \$1,917 k 6.- CSA cost, (\$ 1,230k), was removed to avoid double-counting, they should be considered under Work Control's 4D Budget 7.- Interest considered in 4d is \$30,118k vs \$3,029.45 k considered in 4c, variance of \$27,088.55 k 8.- IFB Inspection facility cost has been removed after Options Review Board suggestion, (\$12,000 k) 9.- RAB Installation cost to be performed by JV, (\$ 6,748k), has been removed because it is considered on RFR's 4d 10.- After 4D-RPET final reductions we are committing to reduce (\$ 9 M) from FH R 4D: This will be done by removing \$7.6 M from Station Reliability and reducing \$ 1.4M from Execution throughout better efficiencies during execution. 11.- We will additionally try to reduce (\$2M) through achieving better efficiencies during Execution.</p>
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## Nuclear Program

### TITLE

### ENGINEERING CHANGE CONTROL

### AUTHORIZATION

DOCUMENT OWNER:	S.R. Lawrence Manager, Engineering Mechanics
APPROVAL FOR ISSUE:	R. Manley Director, Nuclear Regulatory Affairs
AUTHORIZATION AUTHORITY:	W.M. Elliott Senior Vice President Nuclear Engineering and Chief Nuclear Engineer

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Document is Related to Pressure Boundary	<input checked="" type="checkbox"/>	Document Requires CNSC Notification	<input checked="" type="checkbox"/>
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### PURPOSE AND SCOPE

- The Engineering Change Control (ECC) Program ensures all *modifications* to Ontario Power Generation Nuclear (OPGN) systems, structures, and components (SSCs), including software and *engineered tooling*, are planned, designed, installed, commissioned, placed into service, or removed from service within the *Safe Operating Envelope (SOE)* or *Safety and Design Envelope (SDE)*, *design basis*, and licensing conditions. This program complies with Canadian Standards Association (CSA) N286 **[B-1]** and CSA N285 **[B-2]** code editions as referenced in the facility operating licenses.
- This program ensures all problems or betterment ideas requiring a *modification* are reviewed prior to approval to ensure they improve or maintain operability, maintainability, radiological and conventional safety, regulatory or license compliance, and production at an acceptable cost to

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- (c) This program ensures approved *modifications* are:
- (1) Assessed to clearly identify the problem statement to be solved.
  - (2) Analyzed to determine the requirements and the risk level associated with the *modification*.
  - (3) Evaluated, based on the risk level, to determine the scope of work activities, stakeholders, resources, documentation updates required to reflect the *modification* and materials required to complete the *modification*.
  - (4) Designed in accordance with relevant codes and standards.
  - (5) Analyzed to be safe for all foreseeable modes of operation.
  - (6) Adequately reviewed by stakeholders and approved by the *Design Authority (DA)*.
  - (7) Installed in accordance with the approved design and installation requirements.
  - (8) Commissioned and tested in accordance with acceptance criteria as specified in commissioning specifications.
  - (9) Made available for long term operation and maintenance in full compliance with Nuclear standards.
  - (10) Closed out ensuring configuration is maintained.
- (d) This Program applies to Nuclear and contract staff participating in initiation, design, installation, and commissioning of *physical changes* and controlled document changes associated with SSCs, software, and *engineered tooling*. This includes contractors and design agencies performing engineering activities on behalf of OPGN unless these organizations are performing these activities in accordance with a Quality Program approved by OPGN.
- (e) This program does not apply to facilities, systems, equipment, and buildings, governed by OPG-PROG-0032, Facilities and Projects Management System, under authority of the Vice President, Real Estate and Services.
- (f) SSCs which have been *abandoned* as a result of a previous *modification* are exempt from the application of this process. The process for subsequent removal or harvesting of *abandoned* equipment items are governed by work management and facility specific procedures.

#### DATES (YYYY-MM-DD)

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### 1.0 DIRECTION

- (a) The ECC program ensures *modifications* fulfill at least one of the following objectives:
- (1) Improve safety.
  - (2) Meet a regulatory commitment.
  - (3) Correct a design flaw.
  - (4) Replace obsolete equipment.
  - (5) Address a betterment idea.
  - (6) Have a considerable economic or performance benefit.
- (b) The program and supporting procedures ensure proper reviews and approvals are achieved before *modifications* are implemented.
- (c) Affected stakeholders shall review changes for the following:
- Scope and process impact.
  - Nuclear safety, employee safety, and equipment safety.
  - Constructability, operability, and maintainability.
  - Human Factors (HF), and ergonomics
  - Environmental impact (in accordance with OPG-POL-0021, Environmental Policy (Board of Directors Policy) and N-PROG-OP-0006, Environmental Management).
  - Security and potential property damage.
  - Computer software impact.
  - Environmental Qualification (EQ) in accordance with N-PROG-RA-0006, Environmental Qualification.
  - Seismic Qualification, in accordance with N-PROG-MP-0009, Design Management.
  - *Engineered tooling.*
- (d) N-PROG-AS-0007, Project Management, deals with resourcing, scheduling, and ensuring *modifications* add value consistent with Nuclear financial objectives.

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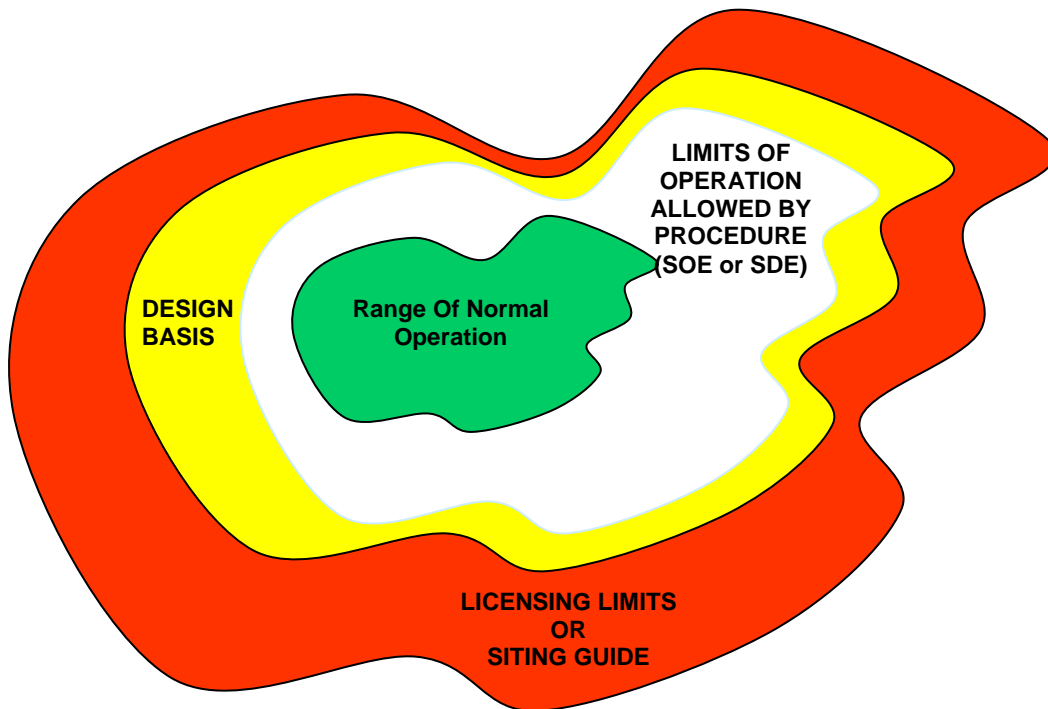
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### 1.1 Overview

- 1.1.1 A nuclear system shall be controlled at all times to ensure operation in a state that is analyzed to be safe and operated conservatively within the *design basis*, which is defined conservatively within the licensing limits. ECC should strive to protect operating, design and safety margins (refer to Figure 1, Relationship of Licensing Basis, Design Basis, and Operating Configuration).



Interfacing Program	Area of Control
N-PROG-OP-0001, Nuclear Operations	Operating Configuration
N-PROG-RA-0002, Conduct of Regulatory Affairs	<i>Licensing Basis</i>
N-PROG-MP-0005, Configuration Management	All
N-PROG-MP-0009, Design Management	<i>Design Basis</i>
N-PROG-MP-0014, Reactor Safety Program	<i>Design Basis</i>

**Figure 1: Relationship of Licensing Basis, Design Basis, and Operating Configuration**

- 1.1.2 Performance Engineering reviews and concurs with changes to Operating and Maintenance procedures, which affect *safety-related* portions of the system, to ensure the *SOE* or *SDE* is maintained. Performance Engineering concurs with these procedures only if:
- (a) All modes of operation have been analyzed as being safe.
  - (b) Any new failure mode has been previously considered in the design or accident analysis.
  - (c) There is no increase in the likelihood of a *design basis* event.

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- (d) There is no reduction of safety margins beyond those described in the Safety Report and supporting documents.
  - (e) Sufficient operating and design margins are maintained
- 1.1.3 *Modifications* and revised licensing limits may drive changes to the *design basis* and Operating configuration.
- 1.1.4 The *modification* process provides:
- A systematic risk based approach to identifying a design issue.
  - Developing and approving the scope of the *modification*.
  - Preparing *preliminary designs*.
  - Preparing detailed designs and approving them for installation.
  - Preparing installation and commissioning documentation.
  - Executing installation and commissioning activities.
  - Turnover of systems to operations.
  - Close out of the *modifications*.
- 1.1.5 *Design changes* are controlled and uniquely tracked in ASSET SUITE to provide traceability of the *modification* to changes in the design documentation, to work packages in the field, to procurement of materials, and other documentation as necessary.
- 1.1.6 The *modification* process ensures that:
- (a) Configuration is controlled and maintained by updating design, operating, maintenance, and training documentation impacted by *design changes*.
  - (b) *Design changes* comply with applicable licenses, codes, standards, and regulations.
  - (c) Progression of *design changes* is tracked and monitored.
  - (d) Scheduling of work and purchasing of materials are considered. In particular availability of components and materials, component and material options and suitability of suppliers are considered and long lead items are identified.
- 1.1.7 Requirements are documented and archived on scoping documents and checklists provided by the ECC Program and identified by unique tracking numbers.
- 1.1.8 OPGN's Pressure Boundary (PB) processes are described in N-PROG-MP-0004, Pressure Boundary. **[B-2]**
- 1.1.9 The *modification* process allows personnel to apply effort consistent with Nuclear and employee safety significance and economic impact. The controlling documents are shown in Figure 2, Engineering Change Control Documents. Figure 3, Engineering Change Request and Modification Procedure Paths, shows the available change paths.

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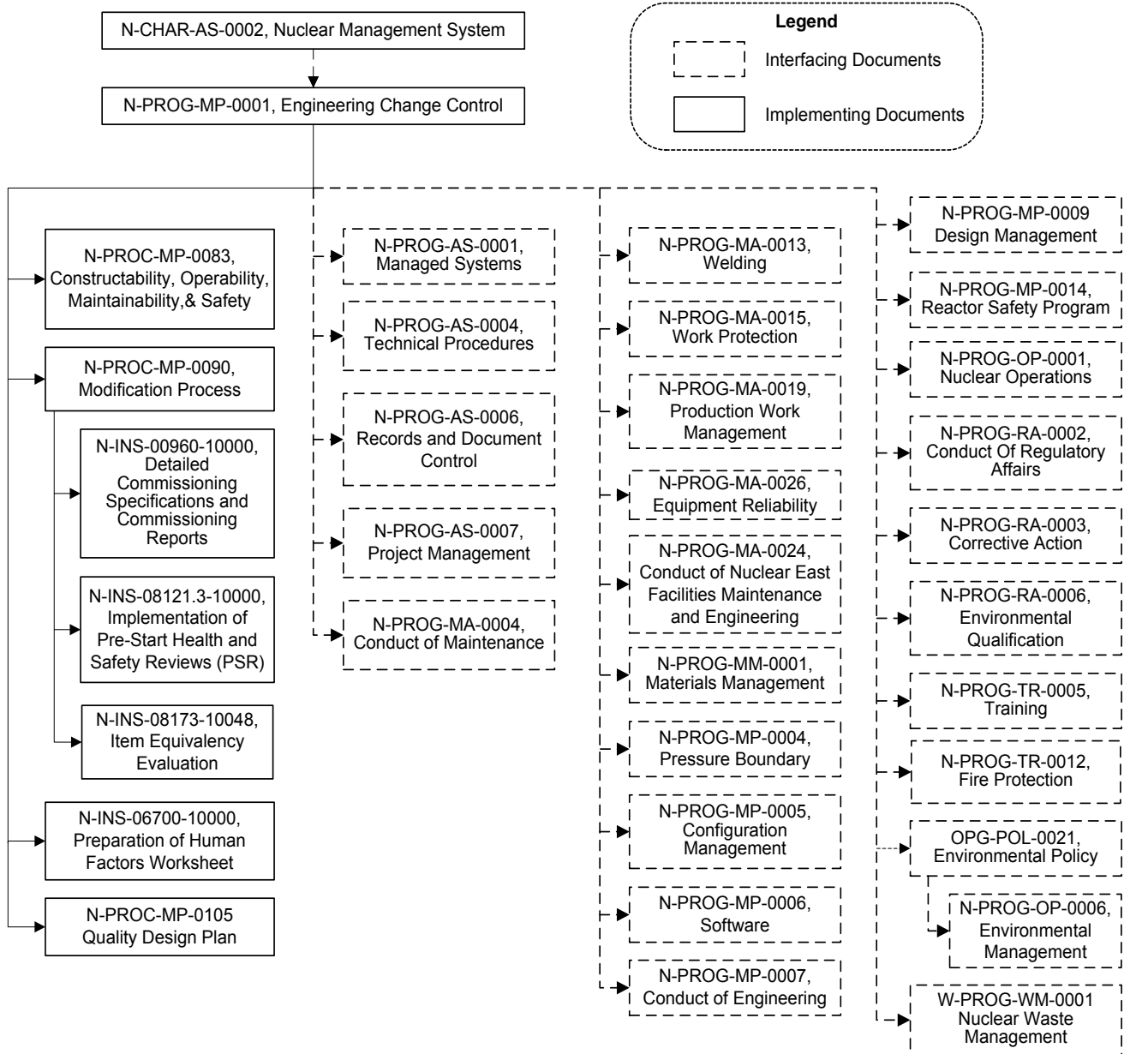


Figure 2: Engineering Change Control Documents

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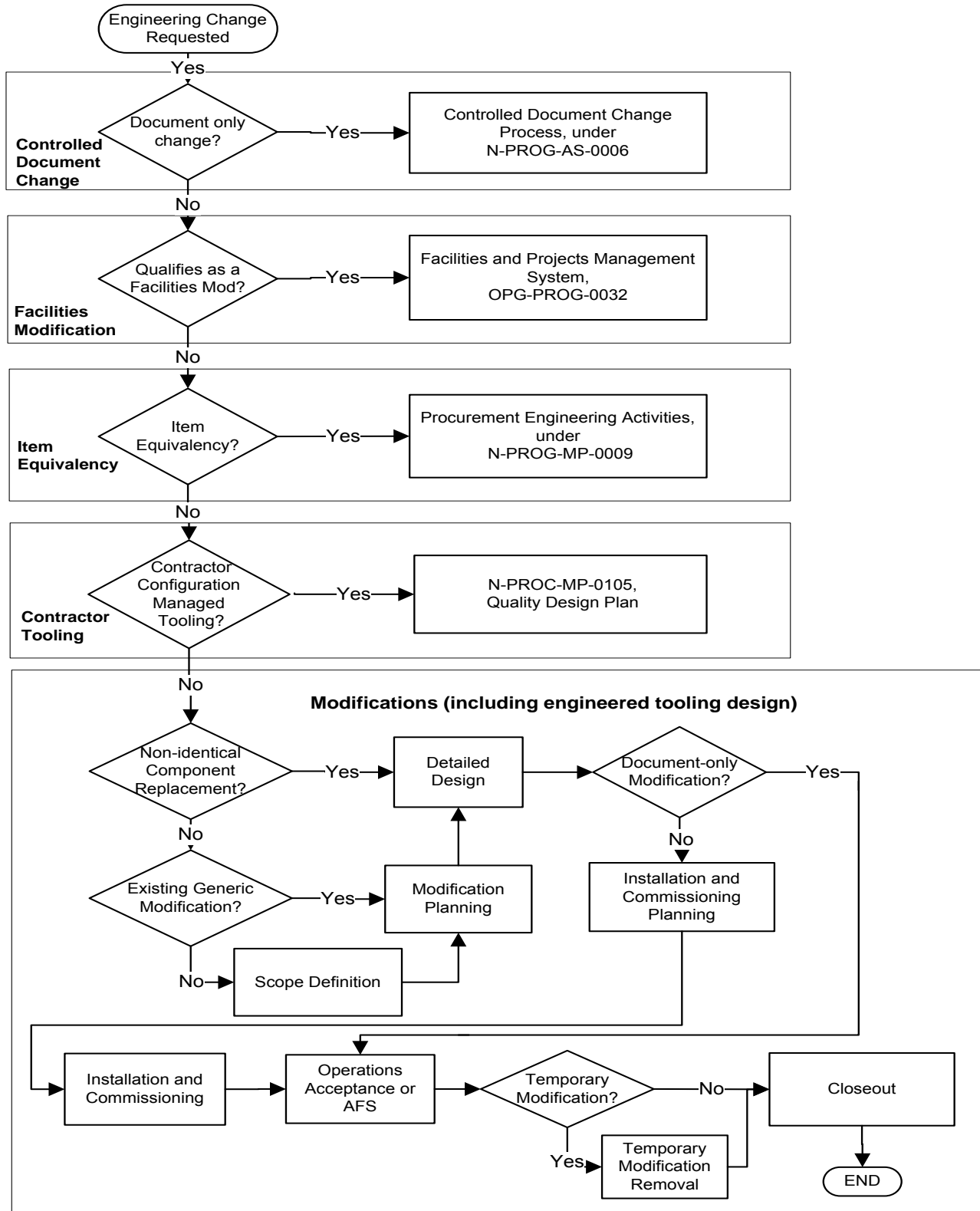


Figure 3: Engineering Change Request and Modification Procedure Paths

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## 1.2 Engineering Change Request Process

- 1.2.1 Anyone may submit a problem or betterment idea. The Corporate policy is to encourage proposed solutions that may improve safety, operation, maintainability, or cost.
- 1.2.2 The electronic *Engineering Change Request (ECR)* process described in N-PROC-MP-0090, Modification Process, describes the process steps necessary to initiate, assign, review, and disposition *ECRs* into one of the following types of changes:
- Soft solution (not a change to the *Design Basis*) (see Section 1.3)
  - Controlled Document Change (Document-only change that does not change the *design basis*, and therefore is not a *modification*) (see Section 1.4)
  - *Facilities Commercial Modification (FMOD)* (see Section 1.5)
  - *Item Equivalency Evaluation (IEE)* (see Section 1.6)
  - *Non-Identical Component Replacement (NICR)* (see Section 1.9.4)
  - *Modification* (includes *temporary modifications*, *engineered tooling* designs) (see Section 1.9)
    - (a) A reviewer knowledgeable in the field impacted by the *ECR* should be assigned to review the requests' requirements for clarity and recommend the appropriate change type.
    - (b) *ECRs* are routed for disposition based on their change type and in accordance with the procedure applicable to the change type.
    - (c) *ECRs* requiring *permanent modifications* (excluding *NICRs*) should be presented to a screening committee for review and approval.
    - (d) *NICRs* and *temporary modifications* are reviewed and approved by the line organizations accountable for maintaining the *design basis* of the impacted SSCs.
    - (e) Where it is unclear which process should be followed, the applicable *DA* should determine what process should be used to administer a change, such as whether use of a *temporary modification*, or some other controlled process such as temporary change request or technical procedure (in accordance with N-PROG-OP-0001) as appropriate.

## 1.3 Soft Solution

A soft solution is any solution that does not require a *physical change* to an SSC or a change to the *design basis*. *ECR* screening is designed to consider soft solutions first to minimize changes and ensure lower cost solutions are explored. Examples of soft solutions are provided in Appendix A, Engineering Change Control Examples. *ECRs* dispositioned as soft solutions are closed to the applicable process governing the implementation of the soft solution.

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**Note:** Any soft solution considered to require a significant change should be controlled in accordance with N-STD-AS-0024, Change Management.

#### 1.4 Controlled Document Change Process

1.4.1 Controlled document changes are reviewed to ensure that the change does not impact the *design basis* or require a change to an SSC to maintain alignment between the documented and physical configuration. This review is required for engineering documents, normally those documents described in N-LIST-01300-10000, Bounded Document Set under N-PROG-MP-0005, Configuration Management. Examples of Bounded Document Set documents include:

- *Design requirements.*
- Design verification documents.
- *Design outputs.*
- Safety Report and its supporting documents.
- Other supporting documents identified in the Reactor Operating License.

1.4.2 Changes to engineering documentation that do **not** reflect a change to the *design basis* or a *physical change* to SSCs are **not modifications** (that is, if the *design basis* does **not** change, the change is **not** considered to be a *document-only modification*). Such changes include but are not limited to:

- Correction of errors.
- Addition or revision of information for clarity.
- Addition of new information or documents.
- Propagation of information already included on one or more *design basis* documents to another *design basis* document (for example, a previously-documented *modification* accidentally missed updating a document).

1.4.3 Document-only changes that do not affect the *design basis* are processed in accordance with the governing processes applicable to the document type, and, as applicable, N-PROC-AS-0003, Controlled Document Management.

**Note:** Document changes should be processed using the N-PROC-MP-0090 if a change is required to an engineering document due to an as-found *modification* to an SSC or if a *modification* is required to an SSC to maintain alignment of the paper and physical configuration. Following N-PROC-MP-0090 ensures that the documented and installed configurations meet all requirements even if the result of this process may only require that documentation be updated.

1.4.4 Document changes in support of the *modification* process are listed on the *Affected Document List* of the specific ASSET SUITE Engineering Change (EC) and processed in accordance with the procedure governing the specific document type.

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#### 1.5 Facilities Commercial Modification Process

- 1.5.1 OPG-PROG-0032 gives authority to the *Facilities Commercial Modification (FMOD)* process which applies to SSCs under the management of Projects and Modifications. Such facilities are identified in N-LIST-00700-10000, Pickering and Darlington Property Management Facilities Responsibility Matrix.
- 1.5.2 Where Facilities SSCs have an interface to nuclear systems, any *modification* to the interface or nuclear SSCs are governed by N-PROC-MP-0090.
- 1.5.3 Where there is no clear separation of the systems governed by the *FMOD* process and the *modification* process, the *DA* has the accountability to specify which process should be followed.

#### 1.6 Item Equivalency Process

- 1.6.1 Procurement engineering activities, under N-PROG-MP-0009, invoke the *IEE* process, to make replacements at the structure, component, or parts level, when the item being replaced is no longer available.
  - 1.6.2 Engineering should perform an engineering evaluation, in accordance with N-INS-08173-10048, Item Equivalency Evaluation, to determine if a prospective replacement meets all of the original *design requirements*. Appendix A may be referenced for examples.
  - 1.6.3 An equivalent item shall meet the form, fit, and function of the item to be replaced.
    - (a) **Form** - Physical characteristics (including material composition), design ratings, *safety-related* classifications, code applicability, and Quality Assurance (QA) requirements.
    - (b) **Fit** - Mounting, attachment, mass, and the space which the item occupies or is required to support operation.
    - (c) **Function** - Performance characteristics, range of operation, and how these parameters match up against the *design requirements* of the original item for its intended use.
  - 1.6.4 The *IEE* process ensures that product procurement descriptions should be prepared consistent with component design specifications.
  - 1.6.5 The content of component design specifications shall only be modified in accordance with N-PROC-MP-0090, ensuring all system design and nuclear safety requirements are met.
- #### 1.7 Engineered Tooling
- 1.7.1 *Engineered tooling* produced by OPGN or external contractors is governed by this program.
  - 1.7.2 OPGN designed *engineered tooling* follows N-PROC-MP-0090 to govern tool creation and *modification*.



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- 1.7.3 *Engineered tooling* shall meet nuclear standards for design of:
- Material Handling and Lifting Tools.
  - Hoisting and Rigging devices.
  - PB Tools. **[B-2]**
  - Software, including Software Engineering Tools (changes should be in accordance with N-PROG-MP-0006, Software).
  - Inspection and Maintenance Tools.
- 1.7.4 Where engineered tools require either temporary or *permanent modification* to SSCs, the *modification* process under N-PROC-MP-0090 shall be used to manage the change to the SSC. If use of the tooling creates the risk of leaving foreign material behind in major equipment assets, special attention should be applied during design and in the field to prevent damage.
- 1.7.5 If an external contractors *engineered tooling* is custom designed, manufactured and maintained by the contractor, N-PROC-MP-0105, Quality Design Plan shall be used to control the use of the tool at OPGN.
- 1.7.6 The *DA* with accountability for the interfacing SSC shall be notified of any new or redesigned engineered tools, including those controlled by contractors, prior to their use at the facility.
- 1.7.7 *DA* authorization for use of such tools shall be obtained if the tooling has any potential impact on PB, Nuclear Safety or Foreign Material Exclusion (FME).
- 1.8 Legacy Engineering Change Control Processes**
- 1.8.1 In the past, Engineering Change Control processes other than N-PROC-MP-0090 were in use by various OPGN organizations.
- 1.8.2 All of these processes are obsolete and all *modifications* in OPGN should be performed in accordance with N-PROC-MP-0090 (see Section 1.9).
- 1.8.3 Any OPGN *modification* initiated under a process other than N-PROC-MP-0090 should only progress after transition to the N-PROC-MP-0090 risk-based *modification* process.
- Note:** N-GUID-00700-10000, Guide to Modification Process provides the mechanism and guidelines for transitioning legacy type *modifications* to risk based *modifications*.

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### 1.9 Risk Based Modification Process

- (a) SSCs impacting the *design basis* are modified following a risk based process outlined in N-PROC-MP-0090. This procedure describes activities required to identify the scope of the work, develop the discrete work assignments required to complete the design, and assigns the organizational responsibilities for preparing the design and design documentation. Types of change processes described in this procedure are:

- *Permanent modifications* (refer to Section 1.9.1).
- *Temporary modifications* (refer to Section 1.9.2).
- *Generic modifications (GMODs)* (refer to Section 1.9.3).
- *NICR* (an extended item equivalency) (refer to Section 1.9.4).

**Note:** *Permanent modifications* follow the standard process, which is altered or expanded upon for *temporary modifications*, *GMODs*, and *NICRs* as indicated in their Sections.

- (b) For *modifications* associated with Darlington Refurbishment, users should **also** refer to NK38-NR-PLAN-09701-10001 Sheet 0003, Darlington Refurbishment Return To Service Program Management Plan, which provides references to guides and instructions that add to or enhance the standard engineering change control process governance. No document referenced by NK38-NR-PLAN-09701-10001 Sheet 0003 should contravene or supersede any engineering change control process governance requirements (as found in N-PROC-MP-0090 and its referenced governance), but may add additional requirements, details, enhancements, or specification of options. Any conflicts between documents referenced by NK38-NR-PLAN-09701-10001 Sheet 0003 and the engineering change control process governance shall be resolved in favour of the engineering change control process governance.
- (c) *Document-only modifications* are included in the process, in order to control scope (including evaluation of whether a *physical change* may be required). *Document-only modifications* will not require some aspects of the process, for example, installation and commissioning planning, installation, and commissioning.

#### 1.9.1 Permanent Modifications

##### 1.9.1.1 General

The process uses a graded level of rigour based on a thorough risk assessment, adjusting the number and type of approvals, verification and review, post *modification* commissioning, and pre-operation training to suit the *modification*.

- (a) Risk is defined in terms of, at minimum:

- Employee safety risk.
- Environmental risk.
- Nuclear safety risk.
- Equipment risk.
- Production risk.
- Safeguards and security risk.

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- (b) *Modification* Team Leader (MTL) is assigned responsibility for managing the *modification* from scoping through to closeout. Overall accountability for ensuring the work is completed and resources are made available through to the closeout of the *modification* rests with the MTL.
- (c) Design Team Leader (DTL) is assigned to oversee the development of the engineering design and works with the MTL to determine the resources and stakeholders required to complete the design and sequencing and scheduling of work.
- (d) Field Team Leader (FTL) is assigned to oversee the installation and commissioning of the *modification*.
- (e) Stakeholders such as System Engineering, Design Engineering, Operations, Maintenance, Training, and others are identified to participate throughout the *modification* process to ensure all aspects of the *modification* are addressed in the design and implementation process.
- (f) Where Design Agencies perform any roles in the *modification* process, their responsibilities, and OPGN's responsibilities, should be defined in accordance with design agency control processes defined in N-PROG-MP-0009.
- (g) Projects are controlled in accordance with N-PROG-AS-0007. Project Management is the process of planning, organizing, and managing resources to bring about the successful completion of specific project goals and objectives.

#### 1.9.1.2 Scope Definition

- (a) During the scoping phase:
  - (1) The problem statement providing the requirements for the *modification* should be developed.
  - (2) SSCs should be walked down to determine the current configuration of the system to be modified.
  - (3) Operating experience should be reviewed to mitigate potential errors, in accordance with N-PROG-RA-0003, Corrective Action.
  - (4) Design alternatives shall be assessed and criteria for selection of the recommended alternative determined, taking into consideration:
    - *Design requirements.*
    - Results of *conceptual studies* (including conceptual safety analysis if required).
    - Experience with previous similar designs.
    - Cost and schedule risks.
    - Risk of using new or unproven designs.

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- (5) Regulatory, licensing, and permit requirements shall be established and plans should be prepared to address the purchase of equipment and staff assignment for design. **[B-1] [B-2]**
  - (6) Stakeholders should be determined to ensure input from all impacted disciplines is considered.
  - (7) The risk of the *modification* shall be evaluated to determine the appropriate level of design rigor to be applied to the *modification*. Risk is evaluated on various criteria, including nuclear safety (reference N-PROG-MP-0014, Reactor Safety Program).
  - (8) A turnover plan shall be established based on the type of *modification* and risk, and additional management oversight requirements should be determined.
- (b) MTL should initiate and oversee the scope definition, risk evaluation, and preliminary engineering phase of the *modification*.
- (c) The scope, requirements, and structure of a *modification* package should be described.
- (1) This contract between management and the MTL should not be changed without management approval.
  - (2) The description should be finalized at completion of scope definition.
- (d) Stakeholder review should ensure that *modifications* are evaluated for important issues such as:
- Welding, in accordance with N-PROG-MA-0013, Welding.
  - Fire Protection, in accordance with N-PROG-RA-0012, Fire Protection.
  - Seismic Qualification, in accordance with N-PROG-MP-0009.
  - Harsh Environment EQ impact and accident analysis assumptions.
  - Training Impacts, in accordance with N-PROG-TR-0005, Training.
  - Pre-Start Health and Safety Reviews, completed in accordance with N-INS-08121.3-10000, Implementation of Pre-Start Health and Safety Reviews (PSR).
  - Selection and qualification of computer design tools in accordance with N-PROG-MP-0006.
  - Design and qualification of Real-Time Process Control software in accordance with N-PROG-MP-0006.

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- Identification and categorization of Critical Equipment in accordance with N-PROG-MA-0026, Equipment Reliability.
  - *Modification*, use, creation or impact on existing *engineered tooling*.
  - Initial *Constructability, Operability, Maintainability, and Safety (COMS)* review in accordance with N-PROC-MP-0083, Constructability, Operability, Maintainability, and Safety (COMS).
  - Impact on corporate or station Beyond *Design Basis* Accident (BDBA) response.
- (e) *Modification design requirements* should be prepared, documenting the requirements of the new SSCs or *engineered tooling* as well as those systems impacted by a *modification*, using the inputs from the stakeholder reviews.
- (f) DA and Director, Operations and Maintenance shall grant approval.
- (g) Additional Reactor Safety and regulatory approvals may be required.

#### 1.9.1.3 Modification Planning

If required, Design Plans, *Design Requirements*, and COMS screening should be completed during the *modification* planning phase.

#### 1.9.1.4 Detailed Design

DTL should oversee the detailed design phase and MTL should ensure that detailed design work and deliverables fall within project scope. During design preparation, use diverse information sources, such as design information, probabilistic safety assessment, operating experience, vendor information, analytical techniques and engineering principles, to understand technical issues and provide the best possible input for making operational decisions.

- (a) An ASSET SUITE *Design Engineering Change (Design EC)* details all design deliverables in ASSET SUITE and is the mechanism used to issue the detailed design for installation. *Design ECs* may be created for each engineering discipline required for the *modification*, and for each affected operating unit. *Modifications* that require changes to the *design basis* of computer software may also have specific *Design ECs* describing the software changes, and design should be in accordance with N-PROG-MP-0006.
- (b) Project ECs provide a mechanism to track and complete project, engineering, operations, training and other details common to the *modification*. These Project ECs are completed at the end of a *modification* after all *Design ECs* have been installed and turned over to operations in accordance with Section 1.9.1.8.
- (c) Affected Documents Lists included on *Design ECs* or Project ECs identify Engineering, Operations, Maintenance, and Training controlled documents to be updated if affected by the *modification*. The minimum set of documents to be considered is listed in N-LIST-01300-10000.

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- (d) *Engineering change papers* should be:
- (1) Created for *physical changes* to configuration in accordance with N-PROC-MP-0090.
  - (2) Posted electronically in ASSET SUITE for tracking of proposed changes.
  - (3) Used to identify and approve *design changes*, and for installation and commissioning purposes.
  - (4) Retained as *modification* records and should not be incorporated into or issued as controlled documents or records prior to the installed *Design EC* being turned over to operations in accordance with Section 1.9.1.8.
  - (5) An accurate representation of the actual configuration, in addition to the installed configuration represented by the current revision of approved engineering controlled documents, at turn over to operations.
  - (6) Issued or incorporated into the engineering controlled documents or records against which they are posted within six months of turn over to operations.
- (e) Requirements for *COMS* should be rigorously addressed and factored into the detailed design deliverables at this time.
- (f) *Modifications* where full commissioning is not practical should invoke an enhanced *COMS* process, requiring enhanced oversight and a documented assessment of the critical failure modes and characteristics of the design as a basis for *modification* completion assurance, to address the risk.
- (g) HF processes should ensure performance of operators and maintainers is systematically considered in any EC. Questions during scoping should identify whether HF issues are present, and if so, direct the design team to consult with HF stakeholders and N-INS-06700-10000, Preparation of Human Factors Worksheet, to identify the nature of the HF work required and the need for involvement of HF Specialist assistance.
- (h) *Design EC* Affected Equipment List should be used to identify equipment changes. Master Equipment List updates, material specification, spare parts requirements, and procurement activities should be initiated during this phase.
- (i) Designer's Section Manager should:
- (1) Approve the *Design EC* including application of all applicable code and technical requirements.
  - (2) Ensure clear and adequate procurement, technical, and QA requirements are defined, such as the need for Inspection and Test Plans and regulatory witness hold points.
- (j) If required, the *DA* and Director, Operations and Maintenance should grant approval prior to installation.

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### 1.9.1.5 Installation and Commissioning Planning

For *modifications* associated with Darlington Refurbishment, refer to Paragraph 1.9 (b) as well as to the following text. For all other *modifications* refer to the following text.

FTL should oversee the installation and commissioning planning phase, with MTL responsible for overall scope.

- (a) Prior to the beginning of Installation and Commissioning, FTL should oversee the specification of an overall Commissioning Plan and development of Installation Instructions and Commissioning Instructions.
  - (1) Installation and Commissioning activities should be planned and scheduled in accordance with the applicable work management programs (e.g., N-PROG-MA-0019, Production Work Management, and N-PROG-MA-0015, Work Protection, or W-PROG-WM-0001, Nuclear Waste Management Program).
  - (2) Installation instructions for project-funded *modifications* should be prepared as described in N-STD-AS-0031, Field Engineering Standard.
  - (3) Installation instructions for base-funded *modifications* should be prepared in accordance with N-PROG-MA-0019.
  - (4) The overall commissioning plan should be documented in the Detailed Commissioning Specifications prepared for large projects using N-INS-00960-10000, Detailed Commissioning Specifications and Commissioning Reports.
  - (5) For small projects, detailed commissioning plans and specifications may be prepared in accordance with N-INS-00960-10000 or the commissioning requirements may be documented in the *Design EC* in ASSET SUITE.
  - (6) Detailed Commissioning Specifications should prescribe the sequence of tests to be executed and include the test objective, required performance values, test prerequisites, and acceptance criteria, for each Commissioning Requirement.
  - (7) Detailed Commissioning Specifications shall be reviewed by design engineering for conformance with the design intent, and may be reviewed by appropriate performance engineers.
- (b) Commissioning Instructions should be prepared in accordance with N-PROG-MA-0019.
- (c) MTL should ensure that installation and commissioning work and deliverables fall within the project scope.
- (d) Contract provisions and interfaces should be administered in accordance with N-PROG-MM-0001, Materials Management, N-PROG-AS-0007, and N-PROG-MP-0007, Conduct of Engineering.

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- (e) MTL should ensure that the *DA* authorizes the use of configuration controlled *engineered tooling* for new or re-designed tooling where the following conditions exist:
  - (1) Tooling impacts on or becomes part of the PB system.
  - (2) Tooling has an impact on Nuclear Safety.
  - (3) Tooling may be intrusive to systems or may have FME impact.
- (f) MTL ensures disclosure to the *DA* of all *modifications* to an engineered tool, since last use, before use on SSC(s).

#### 1.9.1.6 Installation

For *modifications* associated with Darlington Refurbishment, refer to Paragraph 1.9 (b) as well as to the following text. For all other *modifications* refer to the following text.

FTL should oversee the installation phase, with MTL responsible for overall scope.

- (a) Installation shall be executed in accordance with specifications meeting the requirements of CSA N286.
- (b) Installation activities, including associated prerequisite, inspection, testing, and verification details, are governed by installation work plans created in accordance with N-STD-AS-0031 and N-PROG-MA-0004, Conduct of Maintenance.
  - (1) *Field initiated changes (FICs)* should be permitted provided they fall within the scope of the approved design.
  - (2) *FICs* which do not impact the scope of the design are considered non-intent and are managed as a non-intent revision to the *Design ECs*.
  - (3) If the design scope changes, intent revisions to one or more *Design ECs* are required and the scope description document is revised if impacted.
- (c) Any installation work affecting PB shall be performed in accordance with N-PROG-MP-0004, including any concessions requiring regulatory approval. The FTL shall ensure PB QA requirements specified by design are met, such as Inspection and Test Plan execution and regulatory witness hold points. **[B-1]**

#### 1.9.1.7 Commissioning

For *modifications* associated with Darlington Refurbishment, refer to Paragraph 1.9 (b) as well as to the following text. For all other *modifications* refer to the following text.

FTL should oversee the commissioning phase, with MTL responsible for overall scope.

- (a) Commissioning shall be executed in accordance with specifications meeting the requirements of CSA N286.
- (b) Commissioning plans and Commissioning Reports should be developed in accordance with N-INS-00960-10000.



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- (c) Prior to beginning commissioning, FTL shall ensure the following installation activities have been completed for the system being turned over for commissioning:
  - (1) Outstanding items from installation are tracked as installation open items and changes to the design have been documented as field changes.
  - (2) Revisions to the design and the impact of these changes evaluated and incorporated into the Commissioning Specification.
- (d) During the commissioning phase, critical design parameters should be tested under all appropriate operating modes and conditions.
  - (1) Results should be reviewed for acceptability.
  - (2) Multi-discipline engineering reviews of the commissioning results may be required depending on the complexity of the project.
  - (3) Final commissioning results shall be accepted by design engineering to ensure the results conform to the requirements of the design, and may also be accepted by appropriate performance engineers.

### 1.9.1.8 Available For Service or Operations Acceptance

For *modifications* associated with Darlington Refurbishment, refer to Paragraph 1.9 (b) as well as to the following text. For all other *modifications* refer to the following text.

- (a) Prior to Available For Service (AFS) or Operations Acceptance declaration of *modifications* being turned over to operations, all design, purchasing, construction, installation, and commissioning activities shall have been assessed for completeness.
  - (1) Critical characteristics of each of these activities should have been identified and demonstrated to be satisfied.
  - (2) Outstanding or incomplete items should not compromise the safe operation, maintenance, or intended use of the *modification*.
- (b) Boundaries between SSCs being turned over shall be clearly identified in the field and on documentation.
- (c) MTL should be responsible for preparing and arranging for formal AFS turnover meetings.
  - (1) Representation from operations, maintenance, and performance engineering should each review and concur with the AFS package.
  - (2) DA and Manager of Operations, or delegates should approve the AFS package.
- (d) System status should be updated in accordance with N-PROG-OP-0001.

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- (e) Walk-downs shall be completed as necessary to ensure that systems being turned over are complete as documented in the AFS or Operations Acceptance documentation.
  - (1) Incomplete items and exceptions shall be documented and actions assigned to complete.
  - (2) Systems with incomplete items or exceptions may be fully or partially turned over provided these items do not compromise the safe operation or purpose of the turned over portions of the *modification*.
  - (3) Remaining work for partially turned over systems should be completed in accordance with the *modification* process.
- (f) Operations representative shall formally accept all *modifications* in an AFS or Operations Acceptance package prior to placement into service, except for *NICRs*, where acceptance is captured in the work management processes.
- (g) For *modifications* where full commissioning is not practicable, an enhanced AFS process, requiring confirmation that *modification* critical attributes have been documented and verified by qualified staff, shall be invoked to control the risk.

### 1.9.1.9 Closeout

- (a) MTL should oversee closeout activities in accordance with N-PROC-MP-0090 such as EC and work plan closeout, and update of controlled documents within 6 months of AFS/Operations Acceptance or *NICR* installation.
- (b) Records should be produced and stored as described in N-PROC-MP-0090. Management of Nuclear records and managed in accordance with N-PROC-AS-0006, Records and Document Control.

### 1.9.2 Temporary Modifications

- 1.9.2.1 The *temporary modification* route in N-PROC-MP-0090 shall include removal of the *modification*.
- 1.9.2.2 *Temporary modifications* should be minor in scope, of short duration, few in number, and used only when there is an urgent need to maintain system or component operability or availability, or when needed to support implementation of permanent changes.
- 1.9.2.3 *Temporary modifications* do not require presentation to the Screening Committee.
- 1.9.2.4 The following restrictions apply to *Temporary Modifications*:
  - (a) Installation shall be for only a limited and pre-established period of time, or during a specific system operating condition.

**Note:** Institute of Nuclear Power Operations (INPO) best practice is to remove *temporary modifications* within 6 months of installation or at the next outage if an outage is required for removal.

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- (b) *Temporary modifications* to PB SSCs shall be removed within one year, or one outage cycle where removal is not possible during system operation **unless**:
    - (1) This is a recurring *temporary modification* which has had previous classification approval, overpressure protection report update, and registration update in accordance with N-PROG-MP-0009 (e.g., this PB *modification* is a previously registered alternate configuration).
    - (2) This is a non-recurring *temporary modification* and classification approval, overpressure protection report update, and registration update are completed **or** have been reconciled as not needing registration, in accordance with N-PROG-MP-0009.
  - (c) *Temporary modifications* to non-PB SSCs shall be restored to their original configuration, or the *temporary modification* shall have been processed as a *permanent modification*, as soon as practicable, but no later than the end of the next planned maintenance outage following installation **unless**:
    - (1) The unit is laid up; if so, prior to re-start the *temporary modification* should be removed or made permanent.
    - (2) Written approval of the Chief Nuclear Engineer has been obtained to extend *temporary modifications*.
  - (d) SSCs impacted by a *temporary modification* shall be restored to their original configuration at the end of the established period or system operating condition.
- 1.9.2.5 Shift Manager may initiate installation of an emergency *temporary modification* in accordance with N-PROG-OP-0001. The emergency *temporary modification* is replaced with a fully approved *modification* in accordance with N-PROC-MP-0090, or the system is returned to its approved original design configuration in a time frame consistent with application of steps in the *modification* process.
- 1.9.2.6 *Temporary modifications* that are installed to maintain operability, availability, and reliability prior to resolution of legacy *modification* changes for the affected SSCs shall require DA approval prior to installation.
- 1.9.2.7 Operators should be aware of *temporary modifications* in the system configuration at all times in accordance with N-PROG-OP-0001.
- 1.9.2.8 Engineering, through the *modification* process, shall ensure that *temporary modifications* conform to the design and *licensing basis* and safety and reliability requirements.
- 1.9.2.9 Recurring temporary changes should be implemented using Facility operations and maintenance procedures having received review and approval by Engineering rather than through the repeated use of the *temporary modification* process. Engineering review and approval of these procedures shall ensure consistency and compliance with design and *licensing basis*.

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#### 1.9.3 Generic Modifications

If the same *modification* may be repeated under similar risk conditions, a *GMOD* may be initiated. A *GMOD* may be a *permanent modification* or a *temporary modification*, and is initiated following the same processes, but may be re-used when required for future installation at other locations.

#### 1.9.4 Non-Identical Component Replacement

*NICR* is a process which is effectively an extended Item Equivalency Process used for component substitutions where the original equipment is no longer available and the *IEE* process has failed to find a replacement. The *NICR* route in the *modification* process may be used for replacement of equipment and components which fail the *IEE* process as long as the replacement items meet strict criteria ensuring that there is no impact on the *design basis*. The *NICR* process does not apply to the design of new systems or redesign of existing systems.

- 1.9.4.1 The *NICR* process is considered to be a low risk component substitution that does not require presentation to the Screening Committee. For *NICRs*, a streamlined version of the full *modification* process eliminates the need for completion of scope definition, risk analysis, and preliminary engineering.
- 1.9.4.2 Specific criteria shall be met to ensure that a *NICR* change does not impact the *design basis* of the system including seismic or EQ. If all *NICR* criteria cannot be met the full risk based *modification* process shall be followed.

#### 1.10 Constructability, Operability, Maintainability, and Safety

*COMS* ensures, during all life-cycle phases of a *modification*, that the following issues are adequately identified and incorporated into the *design requirements* of nuclear design projects.

##### Constructability

- Operability
- Ergonomics
- Maintainability
- Conventional Safety
- Radiological Safety

The purpose of N-PROC-MP-0083 is to guide an ECC *modification* team on how to demonstrate due diligence in determining *COMS* issues by:

- (a) Identifying, and assessing user-centred issues impacting *COMS*.
- (b) Analyzing risks these issues present to human safety, and dispositioning and documenting issues.

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## 1.11 Performance Indicators and Review

### 1.11.1 Performance Indicators

The performance indicators in Figure 4, ECC Performance Indicators, provide a set of “Mandatory” and “Suggested” metrics available to monitor the health of the engineering *modification* process.

- “Mandatory” metrics that shall be collected are S99 report data required quarterly by the Canadian Nuclear Safety Commission (CNSC).
- Other “Suggested” metrics may be prepared periodically at each facility to measure quantity, quality, schedule adherence, and cost performance.
- Self Assessments should be used to assess program metrics and overall program quality.

Priority	Performance Indicators
Mandatory (required quarterly by the CNSC)	<ul style="list-style-type: none"> <li># incomplete permanent equipment changes (S99)</li> <li># temporary MODs outstanding (S99)</li> <li># temporary MODs &gt; 6 months old (S99)</li> </ul>
Suggested (non-mandatory)	<ul style="list-style-type: none"> <li># documents with outstanding changes, including Document Change Requests (DCRs)</li> <li># approved modification ECRs outstanding</li> <li># NICR material substitution requests</li> <li># Design change requests</li> <li># ECs designed but not installed</li> <li># ECs installed</li> <li># ECs open &gt; 6 months past turnover</li> <li># temporary MODs &gt; 12 months old</li> <li># temporary MODs &gt; 18 months old</li> <li>Other</li> </ul>

**Figure 4: ECC Performance Indicators**

### 1.11.2 Audits

The following Performance Monitoring and Review processes support this program:

- Line management self-assessment.
- Internal and External reviews, assessments, and audits (e.g., Nuclear Oversight, WANO).
- Management review of performance indicators, results of monitoring, and review of processes, and development of corrective action plans when actual performance is below expectations.

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#### 1.12 Personnel and Training Qualifications

All staff involved in ECC require a general knowledge of ECC concepts, principles, and process. Personnel performing ECC roles should be trained on the working level activities in accordance with N-PROG-TR-0005, Training, and the qualification guide applicable to their role.

## 2.0 ROLES AND ACCOUNTABILITIES

### 2.1 Chief Nuclear Engineer

Approves *temporary modification* extensions.

### 2.2 Manager, Engineering Mechanics

Assumes Program Owner roles and accountabilities for this program, in accordance with N-PROG-AS-0001, Managed Systems.

### 2.3 Design Authority

2.3.1 Accountable for specifying which process change control process should be followed.

2.3.2 Approves scope of all permanent and temporary changes.

2.3.3 Approves AFS Declarations.

### 2.4 Director, Operations and Maintenance

2.4.1 Approves scope and installation of all permanent and temporary changes.

2.4.2 This role is associated with a Stratum V or higher individual or delegate responsible for directing the operations and maintenance of the facility such as defined in the applicable role documents, N-MAN-08131-10000 sheets CNSC-003, S5-0092, S5-0094, and S5-0111. This role may be delegated in accordance with facility practices, and may have differing job titles.

### 2.5 Manager, Operations Production

2.5.1 Approves Available for Service Declarations and Operations Acceptance Declarations.

2.5.2 This role is associated with a Stratum IV or higher individual responsible for the operation of the applicable facility and associated support systems to meet the facilities business objectives for delivery of energy and/or services. This role may be delegated in accordance with facility practices, and may have differing job titles.

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## 3.0 DEFINITIONS AND ACRONYMS

### 3.1 Definitions

The following words are defined in N-LIST-01300-10008, Lexicon of Engineering Governance Terms. All of these defined terms are shown in italic font in this document's text, to alert users that the term has been defined.

*Abandoned*  
*Affected Document List*  
*Conceptual Study*  
*Constructability, Operability, Maintainability, and Safety (COMS)*  
*Design Authority (DA)*  
*Design Basis*  
*Design Change*  
*Design Engineering Change (Design EC)*  
*Design Output*  
*Design Requirement*  
*Document-Only Modification*  
*Engineered Tooling*  
*Engineering Change Paper*  
*Engineering Change Request (ECR)*  
*Facilities Commercial Modification (FMOD)*  
*Field Initiated Change (FIC)*  
*Generic Modification (GMOD)*  
*Item Equivalency Evaluation (IEE)*  
*Licensing Basis*  
*Modification*  
*Non-identical Component Replacement (NICR)*  
*Permanent Modification*  
*Physical Change*  
*Preliminary Design*  
*Safe Operating Envelope (SOE)*  
*Safety and Design Envelope (SDE)*  
*Safety-Related*  
*Temporary Modification*

### 3.2 Abbreviations and Acronyms

<b>AFS</b>	Available for Service
<b>BDBA</b>	Beyond Design Basis Accident
<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>COMS</b>	Constructability, Operability, Maintainability and Safety
<b>CSA</b>	Canadian Standards Association
<b>DA</b>	Design Authority
<b>DCR</b>	Document Change Request
<b>DTL</b>	Design Team Leader
<b>EC</b>	Engineering Change
<b>ECC</b>	Engineering Change Control
<b>ECR</b>	Engineering Change Request

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<b>EQ</b>	Environmental Qualification
<b>FIC</b>	Field Initiated Changes
<b>FME</b>	Foreign Material Exclusion
<b>FMOD</b>	Facilities Commercial Modification
<b>FTL</b>	Field Team Leader
<b>GMOD</b>	Generic Modification
<b>HF</b>	Human Factors
<b>HVAC</b>	Heating, Ventilation, Air Conditioning
<b>IEE</b>	Item Equivalency Evaluation
<b>INPO</b>	Institute of Nuclear Power Operations
<b>MTL</b>	Modification Team Leader
<b>NICR</b>	Non- identical Component Replacement
<b>OPGN</b>	Ontario Power Generation - Nuclear or Ontario Power Generation
<b>PB</b>	Pressure Boundary
<b>QA</b>	Quality Assurance
<b>SDE</b>	Safety and Design Envelope
<b>SOE</b>	Safe Operating Envelope
<b>SSC</b>	Systems, Structures, and Components
<b>WANO</b>	World Association of Nuclear Operators

## 4.0 BASES AND REFERENCES

### 4.1 Bases

- [B-1] CSA N286, Management System Requirements for Nuclear Power Plants
- [B-2] CSA-N285.0, General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants

### 4.2 References

#### 4.2.1 Performance References

- N-GUID-00700-10000, Guide to Modification Process
- N-INS-00960-10000, Detailed Commissioning Specifications and Commissioning Reports
- N-INS-06700-10000, Preparation of Human Factors Worksheet
- N-INS-08121.3-10000, Implementation of Pre-Start Health and Safety Reviews (PSR)
- N-INS-08173-10048, Item Equivalency Evaluation
- NK38-NR-PLAN-09701-10001 Sheet 0003, Darlington Refurbishment Return To Service Program Management Plan
- N-LIST-00700-10000, Pickering and Darlington Property Management Facilities Responsibility Matrix
- N-LIST-01300-10000, Bounded Document Set



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N-LIST-01300-10008, Lexicon of Engineering Governance Terms

N-MAN-08131-10000 CNSC-003, Director, Operations And Maintenance

N-MAN-08131-10000 S5-0092, Director, Used Fuel Operations

N-MAN-08131-10000 S5-0094, Director - Low And Intermediate Level Waste Operations

N-MAN-08131-10000 S5-0111, Director, Operations And Reactor Maintenance

N-PROC-AS-0003, Controlled Document Management

N-PROC-MP-0083, Constructability, Operability, Maintainability, and Safety (COMS)

N-PROC-MP-0090, Modification Process

N-PROC-MP-0105, Quality Design Plan

N-PROG-AS-0001, Managed Systems

N-PROG-AS-0004, Technical Procedures

N-PROG-AS-0006, Records and Document Control

N-PROG-AS-0007, Project Management

N-PROG-MA-0004, Conduct of Maintenance

N-PROG-MA-0013, Welding

N-PROG-MA-0015, Work Protection

N-PROG-MA-0019, Production Work Management

N-PROG-MA-0026, Equipment Reliability

N-PROG-MM-0001, Materials Management

N-PROG-MP-0004, Pressure Boundary

N-PROG-MP-0005, Configuration Management

N-PROG-MP-0006, Software

N-PROG-MP-0007, Conduct of Engineering

N-PROG-MP-0009, Design Management

N-PROG-MP-0014, Reactor Safety Program

N-PROG-OP-0001, Nuclear Operations

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N-PROG-OP-0006, Environmental Management

N-PROG-RA-0002, Conduct of Regulatory Affairs

N-PROG-RA-0003, Corrective Action

N-PROG-RA-0006, Environmental Qualification

N-PROG-RA-0012, Fire Protection

N-PROG-TR-0005, Training

N-STD-AS-0024, Change Management

N-STD-AS-0031, Field Engineering Standard

OPG-POL-0021, Environmental Policy

OPG-PROG-0032, Facilities and Projects Management System

W-PROG-WM-0001, Nuclear Waste Management

#### 4.2.2 Developmental References

CSA-N286.2, Design Quality Assurance for Nuclear Power Plants

CSA-N286.5, Operations Quality Assurance for Nuclear Power Plants, Section 6.5

N-CHAR-AS-0002, Nuclear Management System

N-REP-08130.013-0107, Performance Objectives and Criteria for Operating Nuclear Power Plant

EPRI NP-5640, Nuclear Plant Modification and Design Control: Guidelines for Generic Problem Prevention, March 1988

EPRI NP-6406, Guidelines for the Technical Evaluation of Replacement Items in Nuclear Power Plants (NCIG-11)

EPRI TR-103586, Guidelines for Optimizing the Engineering Change Process for Nuclear Power Plants, March 1994

Industry-Wide Benchmarking Project Engineering Best Practice Report, (Nuclear Energy Institute (NEI)) May 1996

INPO AP-905, Configuration Change Process Description, November 1996

INPO AP-906, Design Change Process Description, May 1996

N-STD-AS-0002, Procedural Use and Adherence

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OPG-PROC-0019, Records and Document Management

Practical Loss Control Leadership (International Loss Control Institute [ILCI]), 1996

### 5.0 REVISION SUMMARY

This is an **intent** revision.

- Purpose and Scope (a) - Deleted reference to N-LIST-08130-10023 and deleted code version number and replaced with reference to facility licenses (DCR 128981).
- Purpose and Scope (e) – Replaced N-PROG-MA-0024 with OPG-PROG-0032 (DCR 129494).
- Figure 2 - Added implementing instruction N-INS-08173-10048 and deleted interfacing program N-PROG-MP-0011.
- Figure 3 - Replaced reference to N-PROG-MP-0011 with N-PROG-MP-0009. Replaced N-PROG-MA-0024 with OPG-PROG-0032 (DCR 129494).
- 1.5.1 - Replaced N-PROG-MA-0024 with OPG-PROG-0032 (DCR 129494).
- 1.6.1 - Replaced reference to N-PROG-MP-0011 with N-PROG-MP-0009.
- 1.6.2 - Added reference to implementing instruction N-INS-08173-10048. Changed “Procurement Engineering” to “Engineering” (DCR 128115).
- 1.9.1.1(e) - Changed reference to stakeholder “Procurement Engineering” to “Design Engineering” (DCR 128115).
- 1.9.1.6(a) - Replace reference to specific code version and Annex C with “CSA N286” (DCR 128981).
- 1.9.1.7(a) - Deleted reference to specific code version and Annex D with “CSA N286” (DCR 128981).
- 2.6, 2.7, 2.8 - Deleted accountabilities which are not specific to this program. These accountabilities are addressed in interfacing processes.
- 4.1 - Deleted version numbers from bases references (DCR 128981).
- 4.2.1 - Deleted reference to N-PROG-MP-0011. Added N-INS-08173-10048. Replaced N-PROG-MA-0024 with OPG-PROG-0032 (DCR 129494)
- 4.2.2 - Deleted N-LIST-08130-10023 (DCR 128981).

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### Appendix A: Engineering Change Control Examples

#### A.1.0 SOFT SOLUTIONS

Examples of soft solutions are as follows:

- (a) Improvements to procedures, training.
- (b) Improvements in work and task planning.
- (c) Improvements to operating and maintenance practices.

#### A.2.0 ENGINEERING CONTROLLED DOCUMENT CHANGES

##### A.2.1 Examples of non-technical changes are as follows:

- (a) Making a document consistent with other like documents.
- (b) Clarifying illegible documents, correcting typographical errors.

##### A.2.2 Examples of technical changes are as follows:

- (a) Evaluating a new hazard that does not result in a hardware change.
- (b) Revising analysis in the safety report that does not result in a hardware change.
- (c) Updating operating procedures where *design requirements* information is changed or correcting a discrepancy between actual physical configuration and documentation.
- (d) Providing clarifying detail to an engineering document that is consistent with the original intent.

#### A.3.0 ITEM EQUIVALENCIES

Examples of item equivalencies are:

- (a) Replacing a valve with one manufactured by a different company with slightly better flow characteristics, but that is otherwise the same in terms of performance parameters.
- (b) Replacing one lubricant with another that is functionally equivalent.
- (c) Changing instrument manufacturers where changes to the instrument's function do not affect the intended design function(s).

#### A.4.0 TEMPORARY MODIFICATIONS

Examples of changes that may be temporary are as follows:

- (a) Electrical jumpers.
- (b) Pulled circuit boards.

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## ENGINEERING CHANGE CONTROL

### Appendix A (Continued)

- (c) Mechanical bypasses.
- (d) Temporary set-point changes outside of system design range as specified in *design basis* documents.
- (e) Disabled relief or safety valves.
- (f) Installed or removed filters or strainers.
- (g) Plugged or covered floor drains.
- (h) Installed or removed pipe supports.

#### A.5.0 NON-IDENTICAL COMPONENT REPLACEMENT (NICR)

Examples of *NICRs* are:

- (a) Valves or circuit breakers that differ in fit but perform to the same design intent as the current component.

#### A.6.0 PERMANENT MODIFICATIONS

##### A.6.1 Examples of *modifications* that alter the *design basis* (*design requirements* or *design assurance documents*) are:

- (a) A change to a setpoint that is outside of the system design range as specified in *design basis* documents.
- (b) Adding a drain or vent test connection for a new function.
- (c) Auxiliary feedwater systems bypass installation.

##### A.6.2 Examples of *modifications* that do not alter the *design basis* (*design requirements* or *design assurance documents*) are:

- (a) Replacing flange fittings with compression type fittings on a pump unit. Analysis is necessary to assure that the new configuration does not invalidate existing calculations or qualifications associated with the pump.
- (b) Replacing a skid-mounted heating, ventilation, or air-conditioning (HVAC) compressor unit with one from a different vendor. A mounting analysis is necessary to assure that the new compressor, with a different weight, does not invalidate existing calculations or qualifications associated with the skid package. All other functional parameters are the same or better than the original.
- (c) A setpoint change, which changes operating range, but is not outside of the system design range as specified in *design basis* documents.



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# Nuclear Standard

<b>TITLE</b>
<b>FIELD ENGINEERING STANDARD</b>

<b>AUTHORIZATION</b>
<p>SINGLE POINT OF CONTACT: G. Howard Director, Field Engineering &amp; CMO</p> <p>DOCUMENT OWNER: Art Rob VP, Projects and Modifications</p>

<b>DOCUMENT RELATIONSHIP</b>
Applicability: All of Nuclear
Receives Authority from: N-PROG-AS-0007, Project Management

Document is Related to Pressure Boundary <input type="checkbox"/>	Document Requires CNSC Notification <input type="checkbox"/>
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<b>PURPOSE</b>
This standard provides the criteria, expected behaviours and output requirements for persons performing field engineering activities including technical support, quality planning and <i>quality control</i> in compliance with Canadian Standards Association CSA N286, Management System Requirements for Nuclear Facilities.

<b>DATES (YYYY-MM-DD)</b>
PDF Creation Date: 2015-12-17
Compliance Date: Immediate

<b>EXCEPTIONS</b>
None

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Title:
<b>FIELD ENGINEERING STANDARD</b>

### 1.0 DIRECTION

This standard provides the criteria, expected behaviours and output requirements for quality services provided by persons performing field engineering activities for projects executed under the Ontario Power Generation – Nuclear (OPG-N) management system.

For clarity this standard is not applicable to work performed under third party Quality Assurance Plans or management systems. The requirements for Field Engineering quality surveillance and oversight of third party quality assurance providers are covered in N-STD-AS-0030 Project Oversight Standard.

### 1.1 Key Field Engineering Elements

#### 1.1.1 Training, Qualification and Experience

- (a) Personnel who execute activities under this standard are required to have skills and qualifications commensurate with their work assignment.
- (b) Operating Experience should be adequately shared among persons performing field engineering activities during work planning and construction/installation execution.

#### 1.1.2 Interfaces and Coordination

Persons performing field engineering activities shall interface and coordinate with the site project manager, contractors and any other applicable organizations to ensure work is planned and executed to meet all stated project requirements including quality while maintaining design, safety and performance objectives.

The site project manager shall ensure that persons performing field engineering activities understand the project requirements and expectations.

#### 1.1.3 Work Planning

Persons performing field engineering activities shall plan the quality service activities to ensure the following objectives are met for the project being executed:

- (a) All activities are planned, verified and controlled based on design requirements, and in particular those related to *Quality Assurance* and *Quality Control* activities.
- (b) Work is assessed and the associated inspection and testing activities are planned, reviewed, approved and released based on the approved scope of work for the project.

#### 1.1.4 Field Engineering Work Execution

Persons performing field engineering activities shall perform technical support and quality service activities to ensure the following objectives:

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- (a) Inspection, examination and test activities are performed and documented in accordance with approved plans, and design and commissioning requirements.
- (b) Measuring and test equipment required during execution is calibrated and controlled.
- (c) Changes are controlled and the results communicated and documented.
- (d) Non-conformances are identified, dispositioned and documented.
- (e) All records management requirements are satisfied, especially those relating to *Quality Assurance* and *Quality Control* records.

### 1.1.5 Non-conformance and Corrective Action

When conditions are encountered resulting in non-conformance with design, commissioning or procedural requirements, field engineering personnel shall ensure:

- (a) *Non-conformances* are dispositioned prior to execution and safe stated, as needed.
- (b) *Non-conformances* are documented / reported.
- (c) Corrective action is implemented to correct the adverse condition as needed and measures or controls are instituted where appropriate, to prevent the recurrence or reduce the risk of recurrence of a similar adverse condition.
- (d) Communicate non-conformance and corrective action results and lessons learned to the appropriate stakeholders.

### 1.1.6 Change Control

Persons performing field engineering activities shall ensure that changes to the following are controlled and documented where applicable to field engineering work:

- approved designs;
- specific procedures or instructions for construction;
- field execution Work Plans; and
- *Quality Assurance* or *Quality Control* documents

## 2.0 ROLES AND ACCOUNTABILITIES

### Field Engineering Manager

Work with a Matrix or Functional Organizational structure within departments and division, and provide daily work direction to a matrix team as required.



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### FIELD ENGINEERING STANDARD

Accountable for the execution of field related oversight of all projects executed by the Projects and Modifications business unit throughout the project life cycle in accordance with applicable laws, codes and oversight standards and guides, specifically during (but not limited to):

- Project Initiation and Definition – support conceptual design development and front end planning,
- Engineering – support Preliminary and Detail Engineering,
- Procurement – support development of Technical Specifications, Request for Proposal (RFP), Request for Quote (RFQ), Material Handling,
- Execution – review and oversight of: CWP's, installation and test processes, workplace health and safety, non conformances, construction/installation quality.

## 3.0 DEFINITIONS AND ACRONYMS

### 3.1 Definitions

**Non-conformance** is a deficiency in characteristic, documentation or procedure which renders the quality of an item or service unacceptable, indeterminate or not according to specified requirements.

**Quality Assurance** is a planned and systematic pattern of means and actions that is designed to provide confidence that items or services meet specified requirements and perform satisfactorily in service.

**Quality Control** is a set of processes in place to ensure that specified requirements are met through inspections, examinations or verifications.

### 3.2 Abbreviations and Acronyms

None

## 4.0 BASES, RECORDS AND REFERENCES

### 4.1 Bases

None

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### 4.2 Records

- 4.2.1** Any controlled documents which may be produced as a result of this document should be managed in accordance with OPG-PROC-0178, Controlled Document Management.
- 4.2.2** Any records which may be produced as a result of this document should be managed in accordance with OPG-PROC-0019 Records and Document Management, and N-MAN-00120-10001-RDM Nuclear Projects Records and Document Management.

### 4.3 References

#### 4.3.1 Performance References

Canadian Standards Association, CSA N286-05, Management System Requirements for Nuclear Power Plants and CSA N286-12, Management System Requirements for Nuclear Facilities

N-PROG-AS-0007, Project Management

N-MAN-01983-10000, Field Engineering Quality Control Manual

N-GUID-01983-10003, Field Engineering Quality Control Civil

N-GUID-01983-10004, Field Engineering Quality Control Mechanical

N-GUID-01983-10005, Field Engineering Quality Control Electrical And Control

N-GUID-01983-10001, Excavation Concrete Drilling And Anchoring Processes

N-GUID-01983-10002, Guide To Field Engineering Design Interface And Support

#### 4.3.2 Developmental References

N-INS-08120-10011, Workplan Preparation and Development Process

N-MAN-01983-10000, Field Engineering Quality Control Manual

N-PROC-RA-0022, Processing Station Condition Records

N-PROG-AS-0001, Managed Systems

N-PROG-MP-0001, Engineering Change Control

N-PROG-MP-0004, Pressure Boundary

N-PROG-RA-0003, Corrective Action

N-PROG-RA-0010, Independent Assessment

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## FIELD ENGINEERING STANDARD

### 5.0 REVISION SUMMARY

This is an **intent** revision.

- Purpose statement updated
- Section 1.0 Direction – first paragraph updated
- Section 1.1.2 Interfaces and Coordination – first paragraph updated
- Section 1.1.3 Work Planning – subsection (a) modified
- Section 1.1.4 subsection title revised to remove Quality
- Section 1.1.4 Field Engineering Work Execution (d) and (e) revised
- Section 1.1.5 Non-conformance and Corrective Action – revision to entire section
- Section 1.1.6 Change Control - revision to entire section

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Title:

**Guide for the Contractor / Owner Interface Requirements (COIR) Document**


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**Guide for the  
Contractor / Owner Interface  
Requirements (COIR) Document  
N-GUID-00120-10009-R000  
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**Guideline**

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**Revision Summary**

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R000	2013-08-01	Initial issue.

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### 1.0 PURPOSE

The Contractor / Owner Interface Requirements (COIR) outlines, at a high level, the responsibilities, accountabilities, activities, deliverables, and processes between OPG and the Contractor in the execution of contracted work.

The COIR supports the Engineering, Procurement and Construction (EPC) work at OPG Nuclear where OPG is the Owner/Constructor.

The COIR is an interface document which forms part of a contract. Depending on the work, some portions of the COIR may or may not apply. The contract should clearly identify which items of the COIR apply and which do not.

It may also be necessary that accountabilities of an interface item needs to be changed from either OPG to the Contractor or from the Contractor to OPG. The contract should clearly identify these changes with the use of the Deviations Form attached to this Guide.

### 2.0 EXCEPTIONS

- Owner Only contracts

### 3.0 DIRECTION

Accountability for the management of contracts to deliver project objectives is clearly stated in N-STD-AS-0028, Contract Management Standard. Project Manager is accountable for the deliverables by the contractor during execution of work at OPGN facilities, and shall apply the appropriate level of oversight as per N-STD-AS-0030, Project Oversight Standard. The COIR provides, at a high level, how the contract deliverables will be managed between OPG and the Contractor.

#### 3.1 Overview of the COIR Interface matrix

The COIR has the following sections: Project Management, Engineering, Procurement, and Construction. Sub sections of each are as follows.

1. Project Management Interface Matrix
  - a. General processes, i.e., SCR, Controlled Documents, etc.
2. Engineering Interface Matrix
  - a. Reports, i.e., Pre-Start Health & Safety, Conceptual Design, etc.
  - b. Regulatory Approvals, i.e., System Classification List (SCL), TSSA Registration, etc.

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- c. Engineering Change (EC) Activities, i.e., Master EC, Design EC, Electrical EC, Instrumentation & Control EC, Mechanical EC, Project EC.
  - d. Installation Related Activities, i.e., work plans, etc.
  - e. Commissioning Related Activities, i.e., Specifications, work plans, etc.
  - f. Available for Service (AFS) Related Activities, i.e., walk downs, Operations acceptance, etc.
  - g. Close Out Related Activities, i.e., incorporation of Bills of Material, Design Manuals, etc.
3. Procurement Interface Matrix
- a. Procurement Planning
  - b. Engineering Deliverables, i.e., updating CAT ID(s), Master Equipment Lists, etc.
  - c. Identification requirements to support changes to the Asset Suite (PassPort).
  - d. Purchasing Activities, i.e., source surveillance, factory acceptance testing (FAT), management of non-conformances, etc.
  - e. Receiving and Inspection, i.e., security screening, warehousing, spare parts list, etc.
  - f. Documentation Control and Records Management i.e., history dockets.
  - g. Contract Completion OPEX
4. Construction Interface Matrix
- a. Pre-requisite Work, i.e., prepare Inspection & Test Plans (ITP), Schedule, Work Order Assessing, etc.
  - b. Safety, i.e., Safety Program, Permit Execution, Radiation Protection, etc.
  - c. Construction Turnover, Field Changes, Currently Built (as built), Completion Assurance, etc.

### 3.2 Interface and Liaison Requirements

- 1. OPG will ensure that there is an OPG representative responsible for each item in the COIR. It is important to have this identified and documented so that the



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### **Guide for the Contractor / Owner Interface Requirements (COIR)**

Contractor will know who to work with when engaged in execution of work. The Project Management Plan (PMP), Organization Map may be used to document the contact list, identification of signing authorities, and other interface liaisons.

2. The Project Manager should be satisfied that the OPG representative has the knowledge and experience to perform the OPG activities described in the COIR. The Project Manager should seek involvement of OPG organizations such as, Engineering, Supply Chain, Operations, Maintenance, etc. to support interface activities.

### **3.3 Deviation to the COIR**

A deviation to the COIR is defined as a change to the accountabilities in the approved COIR. It may be beneficial that OPG may provide a deliverable to the Contractor when the COIR states that this is the Contractor's accountability or the Contractor may be in a better position to provide a deliverable to OPG when the COIR states it is OPG's accountability. Any deviation to the accountabilities must be noted and approved using the COIR List of Deviations Form (N-FORM-11583). Approval for the deviation must be obtained from functional organizations within OPG that are accountable for that deliverable and the Project Manager.

### **3.4 COIR Deliverables not Required**

Based on the work to be executed, items in the COIR may not be required. The Scope of Work document, or in the case of the Extended Services Master Service Agreement (ES MSA), the Worksheet, must explicitly state the COIR items which are required or COIR items which are not required (however it is easy to state). This will bring clarity to the Contractors who will consider these changes when providing responses to OPG's bid requests.

## **4.0 RECORDS AND REFERENCES**

### **4.1 Records**

- 4.1.1 Any controlled documents which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0003, Controlled Document Management.
- 4.1.2 Any records which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0042, Records and Document Management and N-MAN-00120-10001-RDM, Nuclear Projects Records and Document Management.
- 4.1.3 The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.



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### Guide for the Contractor / Owner Interface Requirements (COIR)

Record Created	Associated Form Number	QA Record Y/N?	Filing Information/Retention
COIR List of Deviations	N-FORM-11583	N	Original filed with Supply Chain Buyer, Copy filed in Asset Suite (PassPort) Records module

## 4.2 References

- N-COI-00120-00001, Contractor / Owner Interface Requirements



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### **GUIDELINE FOR CONSTRUCTION OVERSIGHT**

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## **Guideline For Construction Oversight**

**N-GUID-09701-10120-R000**

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Order Number: N/A

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## GUIDELINE FOR CONSTRUCTION OVERSIGHT

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### 1.0 VISION

The functional groups providing construction oversight for nuclear projects are aligned with all project stakeholders including the contractor. In performing oversight, the oversight staff shall work to complete the project safely, meet the quality requirements including minimizing rework, while always being sensitive to achieving cost and schedule plans. Oversight staff should act as “*Enablers*” supporting the executing groups.

### 2.0 GENERAL GUIDING PRINCIPLES:

1. Safety is our core value. We embrace the traits of a healthy nuclear safety culture.
2. Our ability to influence a positive outcome and thereby achieve all the project objectives is greatest before the execution work starts. Accordingly, adequate oversight is provided prior to field implementation thereby ensuring “readiness” which is critical to achieving successful field implementation.
3. Trust but verify. Building trust and relationships between execution groups is essential to meet project objectives. Verifications are seen by the contractor as process checks and are embraced.
4. Oversight and Project Staff work together as a team. There is no “they” or “them” only “we” and “us”.
5. Oversight will be performed in accordance with N-STD-AS-0030, Project Oversight Standard and according to the guidelines within N-MAN-09701-10002, Nuclear Projects Oversight Guide, and for P&M projects N-INS-09701-10007.
5. The level of oversight applied will be risk based and specific to each project as detailed in the Project Oversight Plan (POP).

### 3.0 PURPOSE

This guide takes authority from N-STD-AS-0030, Project Oversight Standard and demonstrates OPG due diligence by construction oversight during project execution.

### 4.0 DIRECTION

#### 4.1 General

4.1.1 It is expected that the POP will include construction oversight to confirm:

- Work is adequately planned and executed event free in accordance with the appropriate procedures. Quality requirements are satisfied.
- Industry accepted workmanship standards are maintained
- Contractor supervisory staff are adequate and effective
- Contractor “readiness” to execute work is per the plan

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- Use of Event Free Tools and safe work practices are exhibited when work is performed.
- Nuclear safety is maintained in both planning and execution of work
- Work is planned and executed in accordance with safety management systems and procedures stipulated in the contract/PO, and the requirements of the Province of Ontario OH&S Act & Regulations.
- Radiation work is planned and executed to achieve ALARA dose rate.
- Housekeeping is maintained and SATM requirements are achieved.
- Workers are adequately trained and qualified to perform the work
- Work protection program requirements are satisfied
- CWP, ITP (job documentation) requirements are followed
- Procedural compliance is maintained
- Crew sizes and work progression is monitored to validate invoicing on reimbursable costs. Contractor maximizes "wrench time".

4.1.2 Contractually, OPG employees performing construction oversight have access to the contractor's facilities, documents, records and work site. The PM will be familiar with the contractual language and any restrictions or protocols and will provide guidance and direction to the OS team on how to engage the contractor when planning and performing oversight activities.

### 4.2 Construction Oversight Planning

Construction Oversight should be planned as part of the POP that is prepared and approved by the PM in accordance with N-MAN-09701-10002, and for P&M projects N-INS-09701-10007. The PM will hold a kick-off meeting and seek input from the functional groups in preparing the POP. The POP is a living document that will be revised as required based on oversight results, risk and project status. This is best accomplished through scheduled recurring meetings chaired by the PM to review findings, discuss strategy and actions going forward with the OS team.

During the kick-off meeting the PM should discuss reporting and communication requirements for the OS team. Unless otherwise stipulated in the communication plan, all OS results should be forwarded to the PM.

### 4.3 Construction Oversight Execution

4.3.1 Construction oversight should be performed in accordance with the activities and frequency specified in the POP. Those performing the construction oversight are members of the project oversight team under the direction of the PM. Beyond the responsibility to execute the construction oversight activities, the oversight team members are also responsible to participate in regular oversight update meetings as may be requested by the PM.

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- 4.3.2 When performing OS activities an Oversight Report shall be initiated. For all P&M work this will be done using N-FORM-09701-00001.
- 4.3.3 One construction oversight element may include multiple Oversight Reports subject to complexity and progress of work.
- 4.3.4 Oversight findings that require follow up actions should be documented in the project oversight or action log.
- 4.3.5 As there may be multiple persons performing construction OS on any given project, it is recommended that a C-SPOC be assigned (by the functional manager) to represent the various members of the construction oversight team.
- 4.3.6 In preparation for recurring OS team meetings, the C-SPOC should review all of the construction OS results and recommend changes to the POP if warranted. At these meetings, the PM should be informed that the POP may require revision to the construction oversight activities.

### 4.4 Report Adverse Conditions / Non-conformance

- 4.4.1 Adverse conditions shall be documented and reported to the Project Manager in a timely manner, and in a SCR in accordance with N-PROC-RA-0022, Processing Station Condition Records.
- 4.4.2 When oversight identifies issues nonconforming to the contractor's quality program they shall be recorded using the SCR process (for trending and OPEX purposes). It is the Contractor's responsibility to disposition the non-conformance through his own QA program and/or problem identification and corrective action program.
- 4.4.3 For significant adverse conditions, the SCR should include an action to Supply Chain to investigate and issue a Non-conformance Corrective Action Request (NCAR) if required.
- 4.4.4 The SCR number should be recorded in the associated Oversight Report.

### 4.5 Stop Work

- 4.5.1 Anyone has right to stop a work activity when this work activity is likely to endanger personnel or have a high potential for harm (including nuclear, radiological, environmental and conventional safety). The condition of stopped work activity and associated concern shall be reported to his or her supervisor and Project Manager immediately.
- Note:** Stop work is in effect until the Project Manager authorizes the work to continue.
- 4.5.2 The Project Manager may direct work to be stopped when it is identified as nonconforming, i.e., nonconforming to design, deviating from approved plan, inadequate workmanship, not complying with procedures, material issues, etc.
- Note:** Stop work is in effect until the Project Manager authorizes the work to continue.

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**Note:** All instances of stop work initiated by oversight personnel shall be documented on an SCR as well as an Oversight Report.

### 4.6 Competency

The PM is accountable to ensure that persons performing construction oversight are competent. The PM should consult with functional managers to confirm adequacy of oversight resources.

### 4.7 Oversight Records

For all P&M projects Oversight Reports will be filed in accordance with N-INS-09701-10007.

## 5.0 DEFINITIONS AND ACRONYMS

### 5.1 Definitions

None

### 5.2 Abbreviations and Acronyms

<b>C-SPOC</b>	Construction-Signal Point of Contact
<b>EC</b>	Engineering Change
<b>ITP</b>	Inspection and Test Plan
<b>OPG</b>	Ontario Power Generation
<b>PM</b>	Project Manager
<b>P&amp;M</b>	Projects and Modifications
<b>POP</b>	Project Oversight Plan
<b>QA</b>	Quality Assurance
<b>QC</b>	Quality Control
<b>SCR</b>	Station Condition Record

## 6.0 REFERENCES

### 6.1.1 Performance References

N-STD-AS-0030, Project Oversight Standard  
N-FORM-09701-00001, Oversight Report  
N-INS-09701-10007, Project Oversight Planning and Implementation  
N-MAN-09701-10002, Nuclear Project Oversight Guide  
NK38-LIST-09701-10001, Project Oversight Plan – Health & Safety  
N-PROC-RA-0022, Processing Station Condition Records

### 6.1.2 Developmental References

N-PROG-AS-0007, Project Management



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### Appendix A: Construction Quality & Workmanship Oversight Elements List

Oversight Area	Oversight Activity
<b>CONSTRUCTION</b>	
	<b>Prior to fabrication and installation</b>
	Vendor Project Quality Plan reviewed
	Vendor QA/QC procedures reviewed
	Environmental certificate of approval obtained
	Detailed COMS performed
	Work Plan reviewed and accepted
	ITP reviewed. OPG Hold / Witness points added
	Review completeness of vendor's work package and work instructions.
	Concessions reviewed
	Vendor's QA/QC staff trained and qualified
	FME plan reviewed
	Format of contractor's proposed record set
	M&TE traceability
	Welding procedures reviewed by OPG welding eng
	Review scope and qualification of subcontractor
	Tooling / rental equipment
	<b>Off site fabrication</b>
	Fabrication ITP reviewed
	Material controlled
	Special processes monitoring performed
	Design ECC process (FIC) change control followed
	Vendor employee for fabrication qualified
	Records maintained
	Non-conformance Report processed
	<b>On site fabrication and installation:</b>
	Special processes monitoring performed
	Design ECC process (FIC) change control followed
	Non-conformance Report processed
	Report work progress status
	<b>Close-out activities:</b>
	Corrective action process followed
	Audit / assessment findings and observation have been addressed
	Review completeness and accuracy of Vendor QA/QC records
	Verify contractor's verification that installation is as per design at final inspection

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Oversight Area	Oversight Activity
	<b>Electrical Surveillance Activity</b>
	Device location, positioning
	Connection
	Cable routing, mounting, tie-down, numbering
	Foreign Material Exclusion
	Wire by wire checks
	Hardware, terminal torqueing
	Grounding of devices, stands, pans, conduits
	Equipment calibration, setting, adjustment
	Meggaring, Hi-potting, rotation checks, IR check
	Functional checks
	Painting, finish
	Tubing, fitting condition, cleanliness, deburring
	<b>Material description condition and certification</b>
	Mechanical joint checks
	Material traceability
	Proper tags and labels
	Tolerance and clearances
	Tube welding
	<b>Civil Surveillance Activity</b>
	Painting, film thickness, colour
	Material description, condition and certification
	Backfilling – Material sieve analysis, compaction testing
	Equipment location
	Material traceability
	Anchor torqueing
	Concrete check and tests, grouting, grout cube tests
	FME
	<b>Mechanical Surveillance Activity</b>
	Supports & hangers: location, welding, anchoring, restraints, adjustments
	System pressure tests, Operational pressure test, and leak checks
	Device location, positioning, alignment
	FME
	Tolerance and clearances
	Proper tags and labels
	Couplings, connections, shimming, doweling, torqueing
	Painting, corrosion protection
	Pressure Vessel
	Relieve valves and safety valves

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Oversight Area	Oversight Activity
	Pumps and other rotating equipment
	Other equipments and components
	Piping, fitting condition, cleanliness, deburring
	Item description, condition and certification
	Item storage & handling
	Item control and traceability
	Torqueing
	<b>M&amp;TE Surveillance Activity</b>
	Verify qualification of M&TE subcontractor
	Calibration procedure are established and maintained for M&TE.
	M&TE is calibrated in controlled environment
	M&TE calibrated using traceable standards.
	M&TE is identified to indicate calibration status.
	Calibration record for each M&TE complete
	M&TE handled and stored to prevent abuse, misuse, damage
	<b>Welding Surveillance Activity</b>
	Control of welding equipment
	Electrodes properly controlled
	Applicable approved welding procedure available at workface
	Welder / Brazers qualified
	Filler metal certified
	Comply with welding procedure, e.g., base material, fit up, pre/ post heat temperature, purge/backing, root pass/tack weld, welding parameters, inter-pass temperature, weld size/profile, reinforcement, surface finish, etc.
	Post weld heat treatment
	<b>NDE Surveillance Activity</b>
	Verify qualification of NDE subcontractor
	Review scope of required NDE
	NDE personnel certification and certification level
	NDE/ inspection procedures qualified
	Confirm NDE equipment calibration
	Observe adherence of NDE/inspection procedures
	Document NDE results
	Deficiency identified and dispositioned
	Review sample of RT/MT/PT report
<b>Pressure Boundary</b>	Valid vendor Pressure Boundary Certificate of Authorization
	Work is within the vendor Certificate of Authorization scope
	Control segregation and identification of PB items and traceability of documentation

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Oversight Area	Oversight Activity
	Control of PB welding consumables before and after issue for use
	Material identification (e.g., heat number) transferred when subdividing
	Monitor interface between vendor and local TSSA inspectors
	Control and justification of pneumatic pressure tests in lieu of hydrostatic pressure tests as specified in design
	Correct fasteners used as per design
<b>Work reporting</b>	Adequacy of work report for progress, quality, quantity, safety and other details of the work
<b>Change Control</b>	Intent changes processed
	Non-Intent changes processed
	Changes incorporated in Design EC revision
<b>CONTRACT ADMINISTRATION</b>	
	Tracking and monitoring subcontracts used by main contractor
	Contractor has conducted a Mark-up meeting
	Verification of Contractor qualifications and arrange for required OPGN-based training
	Attend Contractor Pre-Job Briefings at a frequency to be determined by the Project Manager
	Maintain a log (N-FORM-11487) to record Contractor activities, discussions and deficiencies.
	Complete N-FORM-11479, Contract Inspection Checklist (frequency to be determined by the Project Manager)
	Completion of N-FORM-11482, Safety Certification of Contractor's Equipment for all contractor/sub-contractor equipment.
	Review of applicable Safety Plan(s), JSA's, Critical Material Handling Plan, applicable Lift Plans
	Adequacy of Safety/ Briefing cards / rollouts / stand downs
	Review Work Plans
	Monitor material handling, storage, identification, and house keeping
	Monitor tooling and rental equipment
	Monitor the field conditions prior to demobilizing
<b>SAFETY</b>	
	Refer to items in NK38-LIST-09701-10001, Project Oversight Plan – Health & Safety
Safety for owner only project	<ul style="list-style-type: none"> <li>Project specific site safety plan</li> <li>Project site delineation and control plan (construction island)</li> <li>Emergency Response interface plans (OPG not responsible for first aid)</li> <li>Incident notification process (defined in contract and MOU)</li> <li>Hot work and fire response plan (part of project specific site safety plan)</li> <li>Tie-in plans and controls (both parties identify the OPG energies inside the construction island / control of hazardous energy process) (OPG executes the tie-in as constructor.)</li> <li>Environmental plans and controls by vendor</li> </ul>
Nuclear Safety	Adherence to N-POL-0001, Nuclear Safety Policy

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Oversight Area	Oversight Activity
	<p>Conduct in a manner consistent with the following Traits of a Healthy Nuclear Safety Culture:</p> <ol style="list-style-type: none"> <li>1. Personal Accountability</li> <li>2. Questioning Attitude</li> <li>3. Safety Communication</li> <li>4. Leadership Accountability</li> <li>5. Decision-Making</li> <li>6. Respectful Work Environment</li> <li>7. Continuous Learning</li> <li>8. Problem Identification and Resolution</li> <li>9. Environment for Raising Concerns</li> <li>10. Work Processes</li> </ol> <ul style="list-style-type: none"> <li>• Knowledge by workers of how work impacts on <b>Control</b> the power, <b>Cool</b> the fuel and <b>Contain</b> radioactivity (3C's)</li> <li>• Applying Event-Free tools and defences to prevent events</li> <li>• Reporting adverse conditions so they can be corrected</li> </ul>
Radiological Safety	Adherence to the requirements including ALARA specified in N-PROG-RA-0013, Radiation Protection
Work Protection	Adherence to the requirements specified in N-PROG-MA-0015, Work Protection
<b>OTHERS</b>	
	Documents preparation and distribution controlled



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### **GUIDELINE FOR ENGINEERING OVERSIGHT**

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## **Guideline For Engineering Oversight**

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### Revision Summary

Revision Number	Date	Comments
R004	2015-12-11	<p>Incorporated the following:</p> <p>Throughout document: Deleted the obsoleted documents FIN-MAN-CM-001, Contractor Management Process Manual and FIN-MAN-CN-002, Technical Contractor Management Process Manual and replaced with N-STD-AS-0029, Contract Management Standard and N-STD-AS-0030, Project Oversight Standard. (DCR 132838).</p> <p>Throughout document: Identified all paragraphs (using standard paragraph numbering format) to allow easier use and referencing of the document.). (DCR 130611).</p> <p>2.3 (a): Removed reference to N-MAN-09701-10002, Nuclear Refurbishment Project Oversight Guide from Rev.003. This document no longer mandates the 3 processes. (DCR126282).</p> <p>2.12 (b): Added "configuration management report" group words for clarification. (DCR 121576).</p> <p>4.1: Deleted NK38-INS-09701-10007, Nuclear Refurbishment Construction Completion Declaration process, which has been obsoleted and added N-GUID-09701-10021, Nuclear Refurbishment Construction Completion Declaration, in section 4.2; corrected the document number from N-PROG-MM-0001. Materials Management to OPG-PROG-MM-0001; Deleted unissued document N-DAI-00150-10000 and replaced with N-COI-00120-00001, Contractor\Owner Interface Requirements for Nuclear.</p> <p>4.2: Added N-PLAN-01900-10001, Change Management Plan - External Design Engineering Interface Strategy.</p> <p>DCR 130611:</p> <p>E.2.2: Reworded all for clarification.</p> <p>E.2.3: Added E.2.3 (b) (1) to (4) comments categorized for clarification.</p> <p>E.2.4: Added note following E.2.4 (a) use of comments categorization for format other than N-FORM-11109 is used.</p> <p>E.2.4: Added the Note following E.2.4 (b) for clarification.</p> <p>Appendix F and G from the previews revision merged into Appendix E.</p> <p>Appendix H renamed as Appendix F.</p> <p><b>Note:</b> Refer to Rev 003 for previous revision summary.</p>



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### 1.0 INTRODUCTION

- 1.1 This guideline has been prepared to assist Ontario Power Generation Nuclear (OPGN) Engineering staff in selection and application of engineering oversight activities required to support the OPGN Project Manager in the preparation of the Project Oversight Plan and to provide recommended practices during the preparation, execution and documentation of engineering oversight activities.
- 1.2 The purpose of this guideline is to communicate best practices and lessons learned from both internal and external nuclear projects to assist OPGN Engineering staff in identifying and specifying adequate engineering oversight activities using a graded approach based on the engineering risks.

### 2.0 ENGINEERING OVERSIGHT

#### 2.1 Objective

- (a) The goal of engineering oversight is to ensure that engineering deliverables produced by Contractors meet the design quality and procedural requirements and that the modification, when installed in accordance with the detailed design package, will perform its intended function without adverse impact on the plant's design basis or deterioration of the plant's design margin.
- (b) For Contractors involved in modifications, OPGN should provide the Modification Design Requirements, Modification Outline and Conceptual Design Report (where applicable) to the Contractor during the contracting phase. These documents together with the Contractor/Owner Interface Requirements (COIR) document (N-COI-00120-00001), Scope of Work (SOW), Interface Requirements (IR) (Appendix A) or Engineering Specification, should clearly define Technical, Procedural, and Quality requirements which the Contractor must satisfy.

#### 2.2 Principles of Engineering Oversight

- (a) Engineering oversight is performed throughout the lifecycle of the engineering activities.
- (b) Engineering oversight is applied using a graded approach such that higher level risk activities have more frequent and intrusive oversight. The degree of oversight selected should be commensurate with the risk, complexity of the project and the Contractor's past performance.
- (c) Engineering oversight is intended to ensure ongoing conformance of the engineering products or deliverables to the quality requirements and to allow early detection of potential issues so that corrective measures can be taken.

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### 2.3 Oversight Activities

- (a) Engineering oversight activities can be categorized as follows:
  - (1) In-Process Engineering Hold Points
    - (i) Elements in OPGN's Modification Process, N-PROC-MP-0090, that have special restrictions requiring OPGN Engineering in-line approval or authorization prior to proceeding further in the modification process. OPGN Design Authority (DA) authorization of the Design Plan is one such example.
    - (ii) Additional In-Process Engineering Hold Points may be specified by the appropriate Engineering/DA and included in the Project Oversight Plan. These additional hold points should be included as approved deviations in the Generic COIR or similar applicable contractual documents such as SOW, Engineering Specification or IR.
  - (2) Routine Engineering Oversight
    - (i) The ongoing interactions and scheduled periodic informal reviews of engineering products by OPGN engineering staff to seek evidence that the design quality requirements are being met and those assumptions (technical judgments) are identified and validated.
  - (3) Strategic Engineering Oversight
    - (i) Are those activities to be included in the Project Oversight Plan that require more intrusive oversight based on the higher risk to OPGN or critical evolution in the engineering process. Strategic Engineering Oversight may include formal design reviews, process oversight reviews, formal independent technical reviews and design challenge meetings (Appendix B).
    - (ii) Formal technical reviews should use the Comments and Disposition Process (Appendix E) to document and track OPGN's comments to resolution. Process or procedural compliance type oversight activities are referred to as Surveillance activities and should be planned and documented in accordance with Appendix C.
- (b) All Oversight activities to be conducted should be documented, managed and tracked to completion by the Project Manager in accordance with the Project Oversight Plan. In-Process Engineering Hold Points that require OPGN "Approval" or "Authorization" shall be included in the Design Plan where applicable.

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## 2.4 In-Process Engineering Hold Points

2.4.1 In-Process Engineering Hold Points occur at various stages of the design process and are intended to ensure the Contractor is progressing the product in accordance with OPGN's expectations and contractual requirements. In-Process Engineering Hold Points related to Technical Reviews or Design Challenges will be selected by the OPGN engineering lead based on the risk, the complexity of the project and the capabilities of the Contractor. In-Process Engineering Hold Points may include the following:

- (a) Engineering Mobilization Hold Point
- (b) Design Plan Hold Point
- (c) Constructability, Operability, Maintainability and Safety (COMS) Hold Point
- (d) Independent Technical Review/Design Challenge Hold Point
- (e) Design Completion Assurance (DCA) Hold Point
- (f) Engineering Change (EC) Release Hold Point
- (g) Construction Completion Declaration (CCD) Hold Point
- (h) Available for Service (AFS) Hold Point
- (i) Key event in engineering product development

## 2.5 Engineering Mobilization Hold Point

The Engineering Mobilization Hold Point occurs prior to any substantive engineering work being done by the Contractor. The intent of the hold point is to ensure alignment between the OPGN Design/Engineering Authority and Contractor regarding the technical expectations for the engineering work. The Engineering Mobilization meeting may include the following: Modification Design Requirements, Requirements Traceability Matrix, Design Plan, Oversight Plan, EC Release Plan, COIR, Staff Qualification Plan, Engineering Schedule, Analysis Codes/Software to be used, Operating Experience (OPEX), Station Condition Records (SCRs), Corrective Action Requests (CARs), Lessons Learned, Contractor Previous Performance, Special Processes, Controls and Documentation.

## 2.6 Design Plan Hold Point

The Design Plan shall be authorized by the appropriate OPGN DA prior to the Contractor proceeding with the detailed design activities.

## 2.7 COMS Meeting Hold Point

As required by N-PROC-MP-0090 and N-PROC-MP-0083, COMS meetings shall be held during the design process and include the mandatory quorum of OPGN stakeholders.

## 2.8 Independent Technical Review/Design Challenge Hold Point

2.8.1 If required by the Modification Process, N-PROC-MP-0090, and/or Modification Outline, N-FORM-10958, Independent Technical Reviews should be conducted in accordance with N-PROC-MP-0047, Design Verification. Technical Reviews are

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mandated based on the risk associated, design complexity and the criticality of the deliverable.

- 2.8.2 OPGN may opt to take ownership for arranging Independent Technical Reviews without Contractor involvement or may request the Contractor to arrange the review. In either case, OPGN will participate on the technical review team to observe and ensure oversight.
- 2.8.3 For certain projects a Design Challenge Meeting may be requested by OPGN. The Challenge Meeting Quorum may consist of OPGN Stakeholders and Contractor personnel. The meeting should cover the following areas:
- (a) Design inputs
  - (b) Design assumptions
  - (c) Validation of above inputs, technical judgements and assumptions (or validations that are outstanding)
  - (d) Adequacy and completeness of design requirements
  - (e) Additional oversight, walkdowns, or consultations undertaken to ensure adequacy of design
  - (f) Evidence of Operability and Maintainability input to design
  - (g) Technical Reviews such as Human Factors Engineering (HFE), Fire, etc.
- 2.8.4 The Contractor will present how design has addressed the above areas, and will be questioned by the OPGN Challenge Team regarding suitability to proceed to the next phase.

## **2.9 Design Completion Assurance**

- 2.9.1 DCA may be used on complex projects. Completion Assurance is one process by which the Contractor provides documented evidence to OPGN that the design and analysis work has been completed in accordance with the requirements of the OPGN's modification process N-PROC-MP-0090.
- 2.9.2 DCA occurs after detailed design has been approved by the Contractor and prior to OPGN acceptance and should be planned and documented in the Design Plan. The documented evidence to be submitted by the Contractor should include the DCA Certification letter, as a minimum.

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2.9.3 The Design Completion Assurance Certification Letter is to be prepared and signed by the Contractor's Design Manager and directed to the applicable OPGN DA/Engineering Manager. This certificate is a signed statement to confirm the following:

- (a) The detailed design as documented meets design and regulatory requirements
- (b) Design has been subjected to appropriate verification processes
- (c) Design methods, analyses, input data, activities and conditions were appropriately selected and applied
- (d) System and equipment interfaces are fully identified and are compatible
- (e) Input from other available technical sources and experienced personnel has been considered
- (f) Design documentation contains clear and complete information
- (g) All design output documents have been prepared, reviewed, approved, issued, and filed in accordance with OPGN governance.
- (h) Issues Tracking File, provided by the Contractor to identify technical issues and open items (including unverified assumptions) in the design along with an action plan for their resolution, is current.

## **2.10 EC Release Hold Point**

2.10.1 Acceptance of an engineering deliverable is the final step in the engineering oversight process. Previous oversight activities have demonstrated and should give confidence that evidence exists that the deliverable will meet the design/engineering quality requirements, is suitable for its intended use and meets process, format and content requirements.

2.10.2 The acceptance is the final check of the product. The following are some examples of documented evidence a contractor would provide to OPGN for acceptance.

- (a) Complete design EC/engineered product with preparer, verifier and approver signatures.
- (b) Issue Tracking File with issues either closed or open items dispositioned properly.
- (c) COMS issues resolution and their incorporation into the design.
- (d) Formal Technical Review report, if applicable.
- (e) Walkdown report.

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- (f) OPEX search / report.
- (g) Updated design plan to record completed activities.

## **2.11 Document Acceptance**

OPGN will indicate acceptance of a document by a suitable stamp on the document signatory or cover page, or by an OPGN Coversheet, identifying OPGN accepting signatories, which is then attached to the document being accepted, or by an electronic signature in the OPGN Asset Suite program. The acceptance process should use the Comment and Disposition (C&D) Process identified in Appendix E, F, G and H.

## **2.12 Construction Completion Declaration**

- (a) The CCD package may be required to ensure that all field work, modification or maintenance-related, has been satisfactorily completed prior to the commencement of commissioning. Systems and equipment will not be energized and commissioning activities for the modification will not proceed prior to the CCD. This is documented in the design plan and would typically be required for large modifications involving major construction and commissioning activities.
- (b) The Contractor will prepare a CCD package and will include required reference documentation such as work packages, configuration management report, field changes, non-conformance reports, marked-up drawings, SCRs, Inspection and Test Plans (ITPs) and any other documentation required by the OPGN Project Manager.

## **2.13 Available for Service**

Once commissioning activities are complete and accepted by Engineering via the Commissioning Report, the formal Available for Service (AFS) process is followed as per N-PROC-MP-0090, Modification Process. The AFS Meeting will be executed with stakeholders from OPGN including Operations, Maintenance, the OPGN Project Manager and the Contractor's Team Lead in charge of the modification.

## **2.14 Routine Engineering Oversight**

- 2.14.1 Routine design meetings should be held between the Contractor and OPGN Engineering on a regular basis. The purpose of the design meetings is to informally discuss the engineering work being performed by the Contractor and provide OPGN support and/or answer design related questions as required.
- 2.14.2 As per the Project Oversight Plan, meetings are to be organized by the OPGN Project Manager and the frequency mutually agreed by the OPGN Design Team Lead (DTL) and the Contractor.

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2.14.3 The intent of the meetings is to review the engineering work with a focus on the following:

- (a) Review the progress of the design and identify and issues that need to be mutually addressed.
- (b) Communicate and reinforce OPGN expectations with respect to quality and procedural requirements.
- (c) Identify emergent risks or OPEX issues that should be considered.

## 2.15 Strategic Engineering Oversight

2.15.1 Strategic Engineering Oversight is the process of requesting, planning, conducting and documenting an engineering review of specific engineering products and processes based on a determination that these products or processes are critical to the successful completion of the engineering activities being performed by the Contractor.

2.15.2 For Modifications, the level and frequency of Strategic Engineering Oversight should be consistent with the risk ranking in the Modification Outline, the critical design requirements in the Modification Design Requirements, OPEX related to the modification and the previous experience with the specific Contractor.

2.15.3 Strategic Engineering Oversight activities should include Technical Processes (e.g., Engineering Verification Procedure), Technical Products (e.g., Engineering Calculations), and Quality Processes (e.g., Staff Qualification Records).

2.15.4 Strategic Engineering Oversight may be performed at any time during the lifecycle of the project or production of the engineering deliverable. It is recommended that process or procedural (Surveillance type) oversight activities be performed early in the contract execution to ensure OPGN approved processes are being followed. Technical type oversight activities may be repeated multiple times at various stages during the development of critical engineering deliverables.

2.15.5 Consideration should be given to using a person independent of the in-process reviews for the Strategic Oversight of process activities. This independence will permit the in-process reviews to focus on the technical quality of the product.

2.15.6 These activities must be communicated to the Project Manager for incorporation into the Project Oversight Plan.

## 2.16 Preparing for Strategic Oversight

2.16.1 The following should be considered when preparing for Strategic Oversight.

- (a) Review the purpose and objective of the oversight activity and any reference documentation such as (reports, records, governing documents, etc.).



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- (b) Prepare a detailed checklist with the method, acceptance criteria and performance aspects of the activity and reference the exact source documents including revision numbers to be surveyed. Refer to Appendix D for tips in preparing oversight checklist.
- (c) Prepare a list of Stakeholders and make arrangements with the Project Manager and Contractor to perform the oversight activity.
- (d) Send the Oversight Execution plan to the Project Manager at least 2 weeks prior to the scheduled date. Refer to Appendix C for a Sample Oversight Template
- (e) Review the project schedule to ensure activities are scheduled.

### 2.17 Performing Strategic Oversight

2.17.1 The following should be considered when conducting oversight:

- (a) A Pre-Job Brief should be conducted to present the oversight plan, introduce the oversight team, confirm Contractor roles and responsibilities, establish channels of communication, review Contractor site safety and identify any particular areas of concern.
- (b) Using the oversight checklist, observe activities, review documentation, inspect hardware, etc., to ensure compliance with the specified technical and administrative requirements and to validate whether the performance objectives were attained as per the scope of the plan. Important information required to make valid conclusions from the quality oversight should be gathered in the checklist.

**Note:** The oversight checklist should not restrict the team from making observations that are not specifically included in the checklists.

- (c) Findings shall be supported (typically five occurrences of objective evidence or be dependent on the severity of the finding).
- (d) Document objective evidence (in enough quality and quantity) for conditions adverse to quality or observations in sufficient detail to ensure that the record clearly reflects who was contacted, what was observed, when it was observed or reviewed, and what results were obtained.
- (e) Document adverse conditions requiring immediate attention identified during the oversight. As well, identify areas of strength in which the Contractor adequately meets requirements.
  - (1) The results of each oversight check will include an evaluation of the degree of conformance of the activity or item to its applicable quality requirements and objectives.

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- (2) The adequacy of the work practice, the “In-Process” quality control activities observed and the effectiveness of the results. (When required, additional observations should be made or initiate follow-up oversights).
- (3) The need to schedule follow-up reviews/oversight for evaluation of weak areas.
- (f) If during oversight a potential issue outside the current scope of the planned oversight is identified, the issue should be evaluated with project manager and stakeholders to determine whether the issue should be added to the scope of the current oversight and/or advise and receive concurrence from the project manager accountable for oversight to initiate follow up action and/or add the scope to the next planned oversight. Findings to be recorded in the OPGN SCR database.
- (g) Conduct a Post-Job Debrief with the Contractor and obtain agreement on the oversight conclusions along with the corrective actions to be initiated by the Contractor. The discussions would also include any action required to be taken up by OPGN organizations. All findings in the report shall be documented in the Contractor’s Corrective Action Program (CAP) and the OPGN SCR database.

## 2.18 Reporting Strategic Oversight

2.18.1 Oversight staff should consider the following in regards to reporting results:

- (a) Prepare an oversight report summarizing the activities performed, dates, oversight team, Contractor staff, a summary of observations/findings, corrective action plan (CAP) for deficiencies identified and a SCR if applicable. Refer to Appendix C for a Sample Oversight Report Template.
- (b) The OPGN staff member responsible for Oversight should discuss the oversight report with the Project Manager and Engineering Manager (Information may be confidential and distribution restricted) and incorporate results into performance measuring with information sensitivity.
- (c) Identify the corrective actions to be initiated by OPGN. These should be managed through the SCR, CAP and Action Tracking Assignment processes, as applicable. Contractor Corrective Actions from the oversight should be issued to the Contractor involving Supply Chain Quality Services as per N-PROC-MM-0010, Establishing and Maintaining Ontario Power Generation Nuclear Approved Suppliers List.

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### 3.0 ABBREVIATIONS AND ACRONYMS

<b>ADL</b>	Affected Document List
<b>AEL</b>	Affected Equipment List
<b>AFS</b>	Available For Service
<b>C&amp;D</b>	Comment and Disposition
<b>CAR</b>	Corrective Action Request
<b>CAP</b>	Corrective Action Plan
<b>CCD</b>	Construction Completion Declaration
<b>COIR</b>	Contractor/Owner Interface Requirements
<b>COMS</b>	Constructability, Operability, Maintainability and Safety
<b>DA</b>	Design Authority
<b>DAI</b>	Deliverables and Activities Interface
<b>DCA</b>	Design Completion Assurance
<b>DTL</b>	Design Team Lead
<b>EC</b>	Engineering Change
<b>EPC</b>	Engineering Procure Construct
<b>HFE</b>	Human Factors Engineering
<b>IR</b>	Interface Requirements
<b>ITP</b>	Inspection and Test Plan
<b>OPEX</b>	Operating Experience
<b>OPGN</b>	Ontario Power Generation Nuclear
<b>PEP</b>	Project Execution Plan
<b>QA</b>	Quality Assurance
<b>SCR</b>	Station Condition Record
<b>SOW</b>	Scope of Work

### 4.0 REFERENCES

#### 4.1 Performance References

N-COI-00120-00001, Contractor\Owner Interface Requirements for Nuclear

N-DAI-01920-10001, Generic Design Agency Interface

N-LIST-01300-10006, List of Active Engineering Standards and Generic Engineering Specifications

N-PROC-AS-0028, Development Review and Approval of Technical Procedures

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N-PROC-MM-0010, Establishing and Maintaining Ontario Power Generation Nuclear Approved Suppliers List

N-PROC-MM-0016, Nuclear Procurement Activities

N-PROC-MM-0021, Supply Inspection

N-PROC-MP-0047, Design Verification

N-PROC-MP-0083, Constructability Operability Maintainability and Safety (COMS)

N-PROC-MP-0090, Modification Process

OPG-PROG-0009, Materials Management

N-STD-MP-0009, Contractor\Owner Engineering Interface and Oversight

N-STD-AS-0029, Contract Management Standard

N-STD-AS-0030, Project Oversight Standard

N-FORM-10958, Modification Outline

N-FORM-11109, Comment and Disposition Sheet

N-TMP-10185, Deliverables and Activities Interface Agreement

#### **4.2 Development References**

N-PLAN-01900-10001, Change Management Plan – External Design Engineering Interface Strategy

N-PROC-RA-0010, Facility Access and Working Rights (Radiological)

N-GUID-09701-10021, Nuclear Refurbishment Construction Completion Declaration

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### Appendix A: Interface Requirements

#### A.1.0 DELIVERABLES AND ACTIVITIES INTERFACE REQUIREMENTS

- (a) The methods that the Contractor will use to interface with OPGN staff and OPGN processes should be documented. This documentation is a listing of the responsibilities and accountabilities associated with the deliverables, not just a list of deliverables. For Project work this is typically covered by the COIR, and managed by Projects "Project Leader". What follows is a generic description for when no formal Project Leader is assigned. The minimum information required to document the OPGN Contractor interface, no matter the format, is:
  - (1) A list of deliverables and activities to be completed.
  - (2) Contractor's accountabilities and responsibilities including use of OPGN processes or portions thereof.
  - (3) OPGN's accountabilities and responsibilities.
- (b) The OPG Representative should document the Deliverables and Activities Interface (DAI) requirements in an IR document.
  - (1) The IR may be a standalone document or incorporated into other documentation (e.g., SOW or Engineering Specification) or the project may use N-TMP-10185, Deliverables and Activities Interface, template to develop the IR.
  - (2) N-TMP-10185 is a pre-populated template which provides a draft outline of an IR that may be used to document the DAI requirements. The draft IR created by this template should be:
    - (i) Modified as necessary to meet the needs of the project.
    - (ii) Used when the required information cannot reasonably and concisely be incorporated into other documentation.
    - (iii) Read as a guide to help ensure that all required aspects of the specific work are appropriately documented when the IR are documented in a SOW, Engineering Specification or other document.
- (c) Pre-developed or generic IRs may be attached, referenced or otherwise incorporated into a new IR or an addendum or deviations list may be attached to a pre-developed or generic IR, as long as the set of documents comprising the new IR continues to meet the requirements of this standard.

**Note:** The IR is distinct from the Project Execution Plan (PEP). The PEP is a project management tool prepared for the entire project and may include Contractor work and interfaces as a sub-set of the project scope.

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- (d) An IR defines Contractor involvement in project deliverables and activities, identifying which portions are handled by OPGN and which by the Contractor.
- (e) Typical contents of an IR include the following (the template is a guide that may be modified as necessary to meet the needs of the project):
  - (1) Deliverables and activities, or portions thereof, to be provided by the Contractor, including a list of specific documents to be delivered.
  - (2) OPGN and Contractor Accountabilities for the completion of each deliverable and activity (Refer to Section A.4 for Design Input Documentation specific guidelines).
  - (3) OPGN processes and management procedures or portions thereof, to be adhered to by the contractor. This should include mapping of roles and responsibilities in the procedures to Contractor Staff.
- (f) Contractor qualification requirements. Refer to Section A.2 for additional guidelines.
- (g) Training requirements for the Contractor. Refer to Section A.3 for additional guidelines.
- (h) Liaison requirements between the Contractor and OPGN. Refer to Section A.5 for additional guidelines.
- (i) Formats and standards to be applied by the Contractor to related deliverables include the following:
  - (1) Usage of specific forms, templates, checklists, cover sheets, travelers, approval letters, drawings and other controlled document formats.
  - (2) Provisions for electronic copies of documents at the completion of the project (e.g., Computer Assisted Drafting, Computer Aided Design, or stress analysis files). If these are required, OPGN should specify the required software for compatibility.
  - (3) Application of OPGN standards by the Contractor, such as shown in N-LIST-01300-10006, List of Active Engineering Standards and Generic Engineering Specifications. Standards associated with equipment numbering, drafting, and design disciplines, i.e., mechanical, electrical, instrumentation and control, and civil design should be included as required.
- (j) Documentation verification requirements. Refer to Section A.6 for additional guidelines.

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- (k) Review criteria and acceptance requirements to be applied to Contractor deliverables by OPGN, including the following:
- (1) Identifying specific areas of deliverables and activities to be reviewed and review criteria. Reviews ensure that:
    - Standards, procedures, codes and regulations are complied with. IR related requirements and contract terms are met.
    - Interfaces to Systems, Structures or Components (SSC's) or engineered tooling outside scope of Contractor work are addressed.
  - (2) Identifying review hold points (e.g., design completion stage, deliverable completion stage, or other criteria). Refer to N-PROC-MP-0078, Specification, Review, Acceptance, and Use of Vendor Technical Documents, and any OPGN-specific instructions where issued, for additional information pertaining to review and acceptance of technical documents from Contractors.
- (l) Methods to control distribution and use of Contractor documents.
- (m) Provisions for monitoring, including audits and surveys of activities, to verify Contractor compliance with the Quality Assurance QA program specified in IR. Refer to Section A.7 for additional guidelines.
- (n) Schedules for Contractor deliverables.
- Note:** If incentives are written in the contract, ensure incentives appropriately recognize proper worker behaviours rather than being based on speed of work. Personnel safety, quality of work performed, and the required rework on tasks performed by Contractor personnel may be considered for incentives.
- (o) Schedules for Interface meetings with the Contractor. The OPG Project Representative should define a schedule for interface meetings with the Contractor for the purpose of status reporting and resolving technical and administrative project issues.
- (p) The process for handling project scope changes, and design changes by both the Contractor and OPGN. Refer to N-PROC-AS-0028 Project and Portfolio Management and applicable Modification Process, N-PROC-MP-0090.

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- (q) Requirements for continued Contractor support to OPGN following issue of the project deliverables. Contractor involvement and support as required during design, procurement, installation, commissioning and closeout phases of the project, including the following:
  - (1) Processing of scope changes as well as design intent and non-intent design changes if applicable.
  - (2) Post-construction walkdowns and involvement in turnover or AFS meetings.
  - (3) Finalization of documentation, particularly incorporating Engineering Change Papers via revision to Engineering Drawings and other documents, including signoff by the Contractor.
- (r) Regulatory and legal interfaces the Contractor should handle, such as interfacing with Technical Standards and Safety Authority and municipal authorities for building permits and plumbing permits.
 

**Note:** OPGN should provide the interface with the Canadian Nuclear Safety Commission (CNSC).
- (s) Ownership of deliverables at end of contract and any restrictions on document use by third parties due to intellectual property or copyright concerns.
 

**Note:** Ownership information is normally contained in the commercial conditions. Ownership information is included in this list to allow collection of the information with the other Engineering, Procurement or Construction related information.
- (t) Indication of OPGN and Contractor input and accountability for producing post project management lessons learned and assessments and reports.
- (u) Departments that contract work out frequently may consider developing model IRs for use in future projects (e.g., N-DAI-01920-10001, Generic Design Agency Interface). Previously approved IRs may be used as input to the development of a new IR, as an attachment to a SOW, Engineering Specification, or other project document to be approved in accordance with Section A.8 of this standard.
- (v) IR may be part of, or in addition to, a SOW or Engineering Specification. If the SOW or Engineering Specification is used in place of an IR, the minimum information required to replace the IR is the list of deliverables and activities to be supplied by the Contractor and the Contractor's and OPGN accountabilities with respect to these tasks.



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- (w) IR should form part of the contract document for retention of Contractor services and act as input to Request for Proposals (RFP) processed in accordance with N-STD-AS-0029, Contract Management Standard or N-STD-AS-0030, Project Oversight Standard and Request for Quotations (RFQ) processed in accordance with N-PROC-MM-0016, Nuclear Procurement Activities.

#### A.2.0 CONTRACTOR QUALIFICATION REQUIREMENTS

- (a) Supply Chain is accountable to ensure the Contractor is evaluated in accordance with N-PROC-MM-0010, Establishing and Maintaining Ontario Power Generation Nuclear Approved Suppliers List, and to ensure only qualified agencies are listed in the Qualified Bidders List.
- (b) The contractor should have an OPGN approved QA program meeting the QA program requirements specified by OPGN or follow OPGN's QA program. The Contractor has the responsibility for maintaining accuracy of technical content and compliance with the Contractor's QA program.
- (c) The Contractor should have and maintain a working knowledge of OPGN's configuration management standards and procedures to ensure that design basis and plant configuration management standards are maintained throughout the project life cycle.
- (d) Contractor staff qualification shall be ensured either by full compliance with OPGN training and qualification requirements or via OPGN accepted qualification under the Contractor QA program. The following may be considered for inclusion in the IR:
  - (1) OPGN may request the Contractor provide proof of staff qualification to OPGN.
  - (2) OPGN may require the Contractor to provide resumes of staff involved in project activities. This may include requesting a list of Contractor staff, their qualifications, and engineering work they perform, which the Contractor submits for approval before commencing work.
  - (3) The Contractor may be required to identify changes in Contractor staff or their responsibilities and submit to OPGN for approval.
- (e) Contractor engineers approving or supervising engineering work shall be licensed as prescribed by the Professional Engineers Act of Ontario and comply with the Professional Engineers of Ontario (PEO) guidelines on sealing engineering drawings and documents.

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- (f) The following list of additional considerations may also be factored into determining suitability of Contractors for specific projects:
- (1) Familiarity with OPGN modification processes and design management processes.
  - (2) Familiarity with OPGN SSCs or engineered tooling undergoing modification.
  - (3) Familiarity with statutes, regulations, standards, and codes applicable to the design of nuclear and non-nuclear SSCs and engineered tooling, normally associated with nuclear generating facilities.
  - (4) Familiarity with OPGN standards, such as equipment numbering.
  - (5) Familiarity with OPGN project management processes.
  - (6) Familiarity with OPGN procurement processes.
  - (7) Familiarity with OPGN field engineering and work protection processes.
  - (8) Required staff certifications.
  - (9) Familiarity with and qualification in Asset Suite for projects where the Contractor is provided Asset Suite access.
  - (10) Track record and results of Vendor Scorecard from involvement in previous projects (see N-STD-AS-0029).

**Note:** Ideally, a close, interdependent relationship between the Contractor and OPGN personnel is established that generates a spirit of cooperation. The relationship between OPGN and the supplier is typically not built on any single job but is developed and cultivated over years of service. The goal is to have the vendor organization be as familiar with OPGN processes and expectations as OPGN workers. If the relationship is not well established, OPGN may take compensatory measures to ensure effective communications of standards and expectations and provide the necessary technical and logistical details to support the contract work.

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#### A.3.0 CONTRACTOR TRAINING REQUIREMENTS

- (a) The OPG Project Representatives should identify training requirements for Contractor staff, when required. The following criteria should be considered:
  - (1) Specific training and mentoring of Contractor staff by OPGN may be required to provide or augment expertise.
  - (2) If Contractor personnel are required to perform unescorted walk-downs, monitoring, or surveillance activities inside controlled zones, qualification is required in accordance with N-PROC-RA-0010, Facility Access and Working Rights (Radiological).
  - (3) OPGN General Employee Training requirements should be reviewed for applicability to Contractor staff working on site.
  - (4) Contractor Supervisors overseeing the work of Contractor workers on site should be fully aware of OPGN standards for the conduct of work and hold workers accountable to those standards.

#### A.4.0 DESIGN INPUT DOCUMENTATION

- (a) If the project includes engineering design activities, the OPG Project Representative or engineering SPOC(s), in consultation with supporting OPGN design organizations, may conduct a review of design input documentation resources that may be needed by the Contractor, both for reference and revision (e.g., drawings, design manuals, and other documents).
- (b) Input and assistance for this review may be provided by DEs expert on SSCs and engineered tooling being modified and interfacing SSCs. To the extent possible, the review should determine the following during the preparation of the IR:
  - (1) Location of documentation and format available for use by the Contractor.
  - (2) Current status of documentation. Status may include determining applicable revision level and if there is concurrent work being done on the drawings or documents.
  - (3) Identification of accountability, OPGN or Contractor, for dispositioning outstanding documentation changes (e.g., changes indicated prior to the subject modification which have not yet been implemented in the field, or have not been issued as revisions to the documents).

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- (4) Whether documentation contains any OPGN proprietary information. The appropriate Section Manager should approve the release of any proprietary information required by the Contractor.

#### A.5.0 CONTRACTOR LIAISON WITH OPGN

- (a) Project liaison organizational roles between the Contractor and OPGN should be identified in the IR. Use a project liaison setup best suited to the project. The following provides guidelines:
  - (1) The Contractor may appoint liaison roles to interface with OPGN processes. For many projects, typical liaison role identification may include:
    - (i) Identification of the Contractor Project Representative and Contractor discipline specific staff providing liaison with OPGN.
    - (ii) Identification of signing authorities.
    - (iii) Identification of specific interdepartmental interfaces and processes required (e.g., Contractor design staff with OPGN Drawing Office, Contractor procurement specialist with OPGN Supply Chain).
    - (iv) Process requirements for resolution of issues at detail level. This may include rules and limitations for direct contact between Contractor staff and their counterpart at OPGN (e.g., via telephone or e-mail).
  - (2) For projects of large size and complexity, the Contractor may provide staff member(s), to act as representatives between the Contractor and OPGN.
  - (3) A Contractor Project Representative having overall accountability for project execution interface with OPGN. Accountabilities include, but are not limited to, the following:
    - (i) Execution Representative role for transmittal of project documents between Contractor and OPGN.
    - (ii) Distributing Contractor deliverables to OPGN for review and acceptance.
    - (iii) Reviewing performance, progress, schedules, changes, interface issues, and status of OPGN comments on Contractor deliverables.
    - (iv) Attending and maintaining minutes of meetings with OPGN.

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- (v) Meeting project schedules.
- (vi) Coordinating Contractor staff training with OPGN.
- (vii) Arranging for presence at site of Contractor staff.

**Note:** The OPGN counterpart for this role is typically the OPG Project Representative. Formal project related communication between the Contractor and OPGN may be established at this level.

- (4) For projects including engineering design activities the Contractor may assign a Contractor Engineering Lead having overall accountability for design execution. Accountabilities include, but are not limited to, the following:
  - (i) Coordinating detailed design activities by Contractor.
  - (ii) Producing specified design deliverables.
  - (iii) Liaising with OPGN engineering.
  - (iv) Attending meetings with OPGN.
  - (v) Ensuring technical staff interfaces are set up between the Contractor and OPGN at appropriate levels to provide efficient consultation links between OPGN design staff and the Contractor for resolving detailed technical issues.

**Note:** The OPGN counterpart for this role is typically an OPGN DTL.

- (5) OPGN representatives should not direct the efforts of the Contractor. The OPGN representative's accountabilities should be limited to providing oversight of the Contractor's activities to ensure:
  - OPGN QA program elements as specified in the IR are followed.
  - Design requirements are met.
  - Product schedules are met.
  - Operability, maintainability and constructability are achieved in vendor design.
- (6) Correspondence pertaining to changes in scope or to the contract in general, formal letters, progress reports, and documentation deliverables should be routed between Contractor and OPGN through the respective Contractor Project Representative, and OPG Project Representative.

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**Note:** Changes to the contract require processing in accordance with applicable OPGN contractor management processes, N-STD-AS-0029 or N-STD-AS-0030.

- (7) The Contractor Engineering Lead and OPGN engineering SPOC(s) are responsible for identifying and bringing to the attention of their respective Contractor Project Representative and OPG Project Representatives any proposed changes to Engineering SOW prior to any work on the change being performed. The OPG Project Representative is responsible for dispositioning any proposed changes.

#### A.6.0 DOCUMENTATION REQUIREMENTS

- (a) Documentation prepared by Contractors should be:
  - (1) Listed in IR, together with OPGN and Contractor accountability.
  - (2) Numbered in accordance with OPGN standards and procedures applicable to the type of document.
- (b) The Contractor should be accountable for verification and approval of the documents that it prepares as follows:
  - (1) Verification and approval requirements are normally contained in the Contractor's QA program. If not, those requirements should be documented in the IR.
  - (2) A Professional Engineer's seal shall be applied by the Contractor to engineering documentation to comply with the PEO "Use of the Professional Engineer's Seal" guideline on sealing Engineering Drawings and documents (that is, to all final documents that are within the practice of professional engineering).

**Note:** For Engineering Drawings in particular, the above means preparation, verification, approval and sealing of the associated Engineering Change Papers. This may be extended to incorporation of Engineering Change Papers into final drawings when the Contractor is accountable to produce finalized Engineering Drawings for issue.

- (c) Review and acceptance by OPGN of technical documentation prepared by the Contractor should be in accordance with N-STD-MP-0009, Contractor\Owner Engineering Interface and Oversight and N-PROC-MP-0078, Specification Review Acceptance and Use of Vendor Technical Documents.

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- (d) OPGN acceptance constitutes a declaration that the quality and content of the document meets OPGN expectations based on the specifications provided in the contract.
- (e) Acceptance should not be confused with approval that resides with the Contractor. Acceptance does not relieve the Contractor from responsibility for errors or omissions or from any obligation or liability under the contract.

#### A.7.0 AUDITS/SURVEILLANCE

- (a) Provisions for monitoring Contractor activities such as audits or surveys are at the discretion of the applicable group in OPGN. Refer to N-STD-AS-0029, N-STD-AS-0030, N-PROG-MM-0001 and N-PROC-MM-0010 for their performance.
- (b) If monitoring activities are planned, provision should be made in the IR and subsequent contract for the following:
  - (1) Schedules and associated project hold points.
  - (2) Access by OPGN and the regulator (CNSC) to the Contractor for monitoring purposes.
- (c) Audits and surveys are an effective means to determine Contractor compliance with contractual requirements. They are performed at Contractor premises. Areas assessed for compliance may include the following:
  - (1) Configuration management.
  - (2) Tools and facilities.
  - (3) Conformance to approved standards and procedures, as agreed to in IR.
  - (4) Detailed documentation (e.g., verification records, training and qualification records, testing logs, etc.).
- (d) Each audit or survey should have a precisely defined plan and goals. All audit or survey results should be presented to the Contractor. Action items should be confirmed with the Contractor with respect to timely response and closure.

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#### A.8.0 INTERFACE REQUIREMENT APPROVALS AND REVISION CONTROL

- (a) Documents that include the contents of an IR or serve the purpose of an IR, such as SOW, or Engineering Specifications, should meet the approval requirements specified below.
  - (1) The IR should be reviewed and concurred to by the accountable OPGN Stratum IV Managers, or higher, for each SOW included within the IR (e.g., Design Engineering, Installation/Commissioning Support [engineering Modification Team Lead role], Construction [construction and quality surveillance role], Procurement Engineering, Supply Chain).
  - (2) The accountable Stratum IV Manager, or higher, approves the IR document.

**Note:** Additional project specific approvals such as Project Sponsor, Executive Sponsor, or other approvals may be required based on project scope or other management direction.

- (b) Revisions to an IR should be reviewed, concurred to, and re-approved by the same organizations and stratum levels (or higher) as the original document.
- (c) Documents detailing deviations or amendments to the IR should be reviewed and approved by organizations impacted by the deviation or amendment and at the same stratum levels as required for the applicable original document.



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### Appendix B: Suggested Strategic Oversight Activities

#### B.1.0 REVIEW OF CONTRACTOR ENGINEERING STAFF QUALIFICATION PROCESS/RECORDS

##### B.1.0.1 Scope/Timing:

Review the engineering staff qualification records for compliance with the Contractor process for engineering staff qualification in accordance with their N286-05 OPG audited QA Program. Strategic Oversight should be performed immediately following initial Engineering Procure Construct (EPC) contract award and should be repeated periodically.

#### B.2.0 MAJOR EQUIPMENT SPECIFICATION REVIEW

##### B.2.0.2 Definition:

Equipment specification has been signed by Contractor as required by Interface Agreement (i.e., Prepared, Verified, and Approved), and ready for OPGN signature (if required by the Interface Agreement).

##### B.2.0.3 OPGN Oversight Activity:

- (a) As agreed upon in the Interface Agreement or Contractor Design Plan.
- (b) Engineered product of high consequence.

#### B.3.0 INITIAL DETAILED DESIGN REVIEW: PROCESS DESIGN COMPLETE AND CONFIRMATION THAT DESIGN REQUIREMENTS HAVE AND WILL BE SATISFIED.

##### B.3.0.4 Definition:

- (a) Flow Diagram, PID, Control Logic Diagram and/or Single Line Diagram finalized.
- (b) Contractor provides a draft summary of the proposed modification.

##### B.3.0.5 OPGN Oversight Activity:

- (a) Review draft design description.
- (b) Review Flow Diagrams, PID, Control Logic Diagrams and/or Single Line Diagrams.

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#### **B.4.0 MIDPOINT DETAILED DESIGN REVIEW: MAJOR EQUIPMENT LAYOUT / PIPING / CABLE RUNS FINALIZED**

##### B.4.0.6 Definition and Deliverables:

- (a) Major Equipment layout, Piping and/or Cable Runs finalized.
- (b) Contractor conducts a Field Walkdown.
- (c) ADL finalized.
- (d) AEL finalized.
- (e) Disposition of outstanding issues from Mod Outline provided.

##### B.4.0.7 OPGN Oversight Activity:

- (a) Review proposed layouts.
- (b) Review ADL and AEL for completeness.
- (c) Review of proposed Mod Outline issue dispositions.

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**Appendix C: Sample Templates**



**ENGINEERING OVERSIGHT SURVEILLANCE PLAN**

<b>Surveillance Ref #</b>	<b>Date:</b>
<b>Surveillance Title:</b>	
<b>Surveillance Team:</b>	
<b>Objectives:</b>	
<b>Scope:</b>	
<b>Reference Documents/Bases:</b>	
<b><u>Method of Approach/ Surveillance Checks :</u></b>	
<b>Milestones/TCD:</b>	
<b>Operating Experience and Corrective Actions Reviewed:</b>	
<b>Prepared by:</b> .....	<b>Reviewed by:</b> .....
<b>Approved by:</b> .....	

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**ENGINEERING OVERSIGHT SURVEILLANCE REPORT**

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<b>Surveillance Team:</b>	
<b>Objectives:</b>	
<b>Scope:</b>	
<b>Reference Documents/Bases:</b>	
<b><u>Method of Approach/ Surveillance Checks :</u></b>	
<b>Executive Summary:</b>	
<b>Details of Surveillance</b>	
<b>Areas for Improvement:</b>	
<b>Prepared by:</b> .....	<b>Reviewed by:</b> .....
<b>Approved by:</b> .....	

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### Appendix D: Guidelines to Prepare Oversight Checklist

#### D.1.0 TIPS TO BE CONSIDERED FOR QUALITY OVERSIGHT

D.1.0.1 Preparation of oversight checklist is considered the most important part of oversight preparation. Obtain comments and assistance, as appropriate, during the preparation of the checklist, from the respective subject matter experts. Given key points to:

- (a) Verify identified from the review of documents in preparation of the oversight. These documents could include applicable governing documents, procedure for the product activity being covered by the oversight.
- (b) Be verified based on the performance history, problems identified earlier etc.
- (c) Be verified based on the critical process activities involved in the specific engineering product, and their acceptance criteria.
- (d) Verify as evidence of quality planning, as applicable to the specific engineering process /product.
- (e) Verify as evidence of In-Process quality control.
- (f) Verify as evidence of corrective actions and preventive actions and their effectiveness.
- (g) Verify as evidence of having complied with the applicable code requirements.
- (h) Any other points identified during the preparation for Quality oversight.

**Note:** When verifying evidence of each element for compliance, make sure that observations include five samples or based on severity as applicable.

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## Appendix E: Comments and Disposition Process

### E.1.0 INTRODUCTION

E.1.0.1 This Guide provides clarification around the review and acceptance of Contractor deliverables.

- (a) Although the Contractor assumes full legal liability for its work, OPGN as the Nuclear Plant Licensee is required to ensure all design work is compliant with Quality Assurance Standard CSA N286.
- (b) This Quality Assurance (QA) function, in part, is performed by the DA who will reject non-compliant design work. In support of this, OPGN staff must exercise due diligence to ensure that the delivered quality is adequate. OPGN exercises this due diligence by auditing vendor QA processes and by technical oversight of each job.

The level of oversight depends on the safety or financial significance of the job, the nature of the work (new, novel, standard, complexity), and the capability of the Contractor, and their experience with the specific work.

- (c) Technical oversight can be accomplished in a number of ways, including scheduling a formal technical review, performing an “in-process” inspection at the Contractor’s office, and review of the final deliverable. In-process inspection is particularly effective because it requires a relatively small amount of effort and identifies problems early.
- (d) It is critical to remember that in-process inspection should identify the problem that makes the product non-compliant and leave the solution of the problem to the Contractor.

### E.2.0 APPLICATION OF THE COMMENT AND DISPOSITION PROCESS

#### E.2.1 Oversight

The level of oversight to apply should be discussed with the Section Manager at the beginning of the work, and will consider the items mentioned in Section E1.0.

#### E.2.2 Usage

Use of the C&D process, including documents it should be used for, the number of review cycles, etc., should be documented in the COIR.

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#### E.2.2.1 Times of Use:

- (a) To document any Technical Review by a Contract organization performed in accordance with N-PROC-MP-0047, "Design Verification", **unless** a Design Verification Report (DVR) will be used instead in accordance with the Design Plan.

**Note:** The C&D process or a DVR should be used for every Contracted Technical Review even if only to document that no issues were found. A C&D form may be used as the minutes of meeting and therefore as an input to a DVR (for example if one DVR documents many Technical Reviews).

- (b) To document any requests for clarification, comments, or rejection of a document submitted to OPGN for acceptance.

**Note:** A document accepted by OPGN with no comments needs no C&D form.

- (c) To document any requests for clarification, comments, or rejection of a final document submitted for OPGN signature (e.g., for verification or approval).

**Note:** A document signed by OPGN with no comments needs no C&D form.

#### E.2.2.2 Suggested Times of Use:

- (a) To document teleconferences or other discussions or communications that are not face-to-face.

#### E.2.2.3 Optional Times of Use:

- (a) At any time desired by the contracted organization.
- (b) At any time other than the above as documented in the COIR at the discretion of the OPGN Design Section Manager.

### E.2.3 Comments

- (a) The C&D process is a key element in ensuring OPGN has obtained a product that conforms to all its requirements, from the Contractor. Comments should be made at the earliest review opportunity so that rework and project delays are minimized. Comments should be consolidated before being forwarded to the vendor.

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- (b) When N-FORM-11109 has been used to document the comments, the comments should be categorized as:
  - (1) TN - Technical, fix NOW, means the process should not continue until the issue has been dealt with (akin to a hold or rejection)
  - (2) TL - Technical, fix LATER, means the process may continue, but the issue should be dealt with at the next revision (akin to ACCEPT AS NOTED).
  - (3) Clarification request means the process may continue but additional information is needed. Clarifications generally have to be answered but may have no other action.
  - (4) Editorial comment or suggestion means a non-technical comment, which may be disposition by the Design Agency in the manner of their choosing.
- (c) Any suggestions that are outside the scope of the contract but that the Contractor interprets as a required change can become grounds for a cost extra. The Contractor should not be requested to evaluate the impact of suggestions and preferences for which the project knows it will not approve cost extras.
- (d) OPGN should exercise care in the manner it provides comments. When OPGN directs a Contractor to take specific action that contractually falls within the responsibility of the Contractor, the legal liability for the consequences are transferred from the Contractor to OPG. For this reason it is important to differentiate between a non-mandatory suggestion, and a mandatory direction.
- (e) OPGN may, of course, make suggestions to the Contractor. However, if it does so, it must be made clear to the Contractor that the suggestions are not mandatory and the Contractor retains full responsibility to meet the specifications and any negative consequences of the implementation.

#### E.2.4 Format

- (a) It is recommended that comments be documented electronically using N-FORM-11109, Comment and Disposition Sheet, to facilitate Record keeping and Consolidation.

**Note:** OPGN personnel are not required to use the C&D form when performing review of the documents prepared internally.

- (b) C&D format is at the discretion of the DTL and Design Section Manager on a case by case basis (i.e., mark-up of document being reviewed, hand written vs. electronic etc.), depending on the type of document being reviewed, the number of comments etc.



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**Note:** A spreadsheet may be used in place of N-FORM-11109, as long as at least as much information is available in the spreadsheet. Format is not important, only the content is.

- (c) For example, a hand mark up of the document may be more practical and efficient than transferring the comments onto N-FORM-11109.
- (d) In this instance, consideration should be given to numbering and identifying the individual comments, while still using the electronic form to capture the Categorization (Section E.2.6) and Signatures.

#### E.2.5 Consolidation

- (a) The OPGN DTL should collect and consolidate the Comments from OPGN reviewers.
- (b) The OPGN DTL should review the comments (in conjunction with MTL and/or Design Section Manager as required) to:
  - (1) Eliminate duplication;
  - (2) Remove illegitimate comments; and
  - (3) Ensure proper categorization of each comment.

#### E.2.6 Incorporation and Disposition of Comments by Contractor

- (a) OPGN DTL should present consolidated comments to Contractor for disposition. Rating of deliverables should be done in accordance with Appendix F.
- (b) If available, an electronic copy of N-FORM-11109 should be forwarded to the Contractor.
- (c) The Contractor shall disposition each comment and forward to OPGN for review and acceptance.
- (d) Upon satisfactory disposition of the Comments, both parties should sign the bottom of the completed N-FORM-11109 (Contractor is the Author and OPGN is the Reviewer).

#### E.2.7 Retention of Comment and Dispositions

- (a) OPGN DTL should keep the signed N-FORM-11109 with the Project File.
- (b) A PDF copy of the completed form should be stored within the "Working Files" in the Asset Suite EC folder, with a copy forwarded to the Design Department Manager for information.

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- (c) For frequently asked questions on the C&D Process, and examples, refer to Appendix E, Section E.2.8 and E.2.9

## E.2.8 Examples

### E.2.8.1 Noncompliance Type Comment

An example of a noncompliance type comment could be “The specification called for pumps to be sized for worst case design conditions. You have sized the pumps for normal operating conditions. Please revise your pump sizing to comply with the specification”. In this case, the Contractor must resize the pumps for the correct conditions that establish the pump size. Notice that the Contractor still retains the responsibility for a satisfactory solution because OPGs reviewer did not direct them to use a specific pump size.

### E.2.8.2 Clarification Type Comment

An example of a clarification type comment could be “It is not clear how your design has incorporated the requirement for the control system to resume operation after a short interruption of Class II power. Please explain how this is accomplished”. In this case, the Contractor simply needs to explain what they have done to satisfy the OPGN reviewer that work is compliant with the specification. If, however, the design cannot meet that requirement, the Contractor will identify there is a problem that needs resolution.

### E.2.8.3 Non-Mandatory Suggestion

- (a) An example of a non-mandatory suggestion type comment could be, “The specification requires you to control the pressure of the heating steam. Would it not be easier and cheaper for you to meet the specification using a pressure regulating valve for this service rather than a control valve?” In this case, the Contractor needs to explain to the OPGN reviewer why the pressure regulating valve will not work properly in that application. For example, the margin for the relief valve setting may be too small for a regulating valve to operate properly. However, if a regulating valve will work, the Contractor can choose to modify the design to provide a simpler and more cost effective option. In this case, however, the Contractor still retains the responsibility for a satisfactory solution as OPGs reviewer did not order them to change their design.
- (b) Work that is clearly in non-compliance with the specifications must be dispositioned to OPGs satisfaction. The required changes will usually not incur additional costs. On occasion, the change will be impractical to correct after the work has progressed beyond a certain stage and a concession to the specification may need to be processed formally by the Contractor. Whether the concession is approved by OPGN will depend on the impact on the success of the overall project.

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A further example to differentiate between a legitimate comment and an illegitimate direct order follows.

#### E.2.8.4 Legitimate Comment

The Contractor has specified a relief valve installation with the standard, very short inlet pipe, but in a location where it is difficult to provide regular maintenance and calibration. A legitimate OPGN comment would be “The specification required you to locate the new relief valve at a location for ease of periodic maintenance and calibration. The chosen location is inconsistent with that requirement. Please relocate the relief valve to meet that requirement”. In this situation, the Contractor would have to find a more suitable location, and then, if the pipe is any significant length, calculate the inlet line pressure drop, to satisfy the maximum allowable values in the ASME Boiler and Pressure Vessels Code. If the pressure drop was too large, the Contractor would have to come up with a solution. The Contractor retains the design responsibility for a complete solution for both maintainability and ASME code compliance.

#### E.2.8.5 Illegitimate Comment

Now suppose the OPGN reviewer stated “The relief valve is not in a convenient location for maintenance. Move the relief valve 5 feet west and 5 feet north of its present position”. This is a direct order and it can be interpreted by the Contractor to mean, move it blindly to the new location. This is especially true if the OPGN reviewer is a mechanical engineer who would be expected to know what he or she is doing. Since the OPGN reviewer did not ask for the inlet pressure drop calculation to be performed, the Contractor may simply move the valve and assume the OPGN engineer knew that the resulting inlet pressure drop was acceptable. The resulting pressure drop may in fact exceed the ASME Boiler and Pressure Vessels Code requirement for maximum pressure drop on the inlet line. When the valve chatters and fails under test, the Contractor may say they were ordered to move it and their original design location would have permitted the valve to work correctly, resulting in a contract dispute. It will take a considerable amount of time to resolve the dispute, as at this stage, there will be significant cost involved in fixing the problem.

### E.2.9 Frequently Asked Questions

#### (1) Should SCR's be raised for Technical Errors?

Yes, this should be discussed with your Section Manager. In addition, the Design Agency should also be notified and requested that they generate an internal “Non-conformance Report” as required by the Design Agency internal QA program. Significant trends should be identified through OPG Supply Chain via the Non-conformance and Corrective Action Request (CAR) process so that a formal reply to the identified deficiencies is obtained from the Contractor. Refer to N-PROC-MM-0021, Supply Inspection.

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**Appendix E (Continued)**

- (2) **Should the C & D process be used on Draft Documents submitted to OPG for review?**

Refer to Section E.2.2. This is at the discretion of the Section Manager, but should be discussed and agreed upon at the beginning of the work, as this could impact the schedule and also the Contractor Quality Program may not allow the release of "draft" documents.

- (3) **Does OPGN need to consolidate / type up hand written comments from the reviewers?**

Refer to Section E.2.5.

- (4) **What if the Contractor has its own Comment & Disposition process?**

Refer to Section E.2.0. This should be discussed and agreed upon at the beginning of the work as to how Comments & Dispositions will be handled.

- (5) **What if there are too many comments / document is unacceptable?**

This should be discussed with the Section Manager prior to rejecting the document. The reason for rejection should be documented in the Comment & Disposition form, and a SCR should be considered if appropriate.

- (6) **Is a C&D form required if the document is acceptable and OPG has no comments?**

No, refer to Section E.2.0.

- (7) **What if the Comments are not being dispositioned to the satisfaction of the Reviewer?**

This issue should be brought to the attention of the Section Manager to be resolved with the Contractor.

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**Appendix F: Contractor Deliverable Rating Criteria**

**F.1.0 UNACCEPTABLE**

- (a) Cannot be implemented without product revision.
- (b) Does not meet all Design Requirements / SOW Requirements.
- (c) Does not meet procedural requirements.
- (d) Significant documentation and reviews missing.
- (e) Missing major requirements.
- (f) Wrong conclusions and / or assumptions.
- (g) Document contains significant errors and is difficult to understand.
- (h) Implementation could result in non-conformance with nuclear safety, industrial safety, environmental compliance, or other regulatory areas.
- (i) Implementation of the product could result in significant loss of productivity or generation.

**F.2.0 NEEDS IMPROVEMENT**

- (a) Can be implemented, but should be revised to achieve best results.
- (b) Minor procedural compliance issues (improper forms, unchecked boxes, etc.).
- (c) May require rework to correct deficiencies.
- (d) Documentation is imprecise, contains editorial errors, and/or superfluous information.
- (e) Additional work may be required in the field if implemented as is.
- (f) Solution is workable but may not be most cost effective.
- (g) Assumptions not clear.

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**Appendix F (Continued)**

**F.3.0 MEETS**

- (a) Meets procedural requirements.
- (b) Requires no product revision to implement.
- (c) May contain some superfluous information.
- (d) May contain a few editorial errors (number dependant on size and complexity of product).
- (e) Documentation is understandable and at a level of detail adequate to support review and implementation by trained personnel.
- (f) Root cause identified and documented (reason for document development is clear).
- (g) Cost effective solution or resolution approach implemented.
- (h) All affected external organizations are evaluated and reviews completed.
- (i) Operational Experience and lessons learned considered and documented.
- (j) All testing and other requirements identified.
- (k) All documents requiring update are identified.

**F.4.0 EXCEEDS CRITERIA (SAME AS MEETS CRITERIA, EXCEPT):**

- (a) Documentation is to a level of detail and clarity that staff with reasonable levels of training and experience can review and implement.
- (b) Documentation with the correct level of detail, not too much or too little.
- (c) May contain innovative solution or resolution which provides reduced burden and life cycle cost beyond required.
- (d) Implements best practices from multiple sources.
- (e) May be an example for others to follow.



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## Nuclear Procedure

### TITLE

**INTEGRATED ON-LINE WORK SCHEDULE**

### AUTHORIZATION

SINGLE POINT OF CONTACT: E. Conde  
Sr. Advisor, Work Control

AUTHORIZATION AUTHORITY: V. Smyth  
Senior Manager, CFAM Work Control

COMPLIANCE DATE: Immediate

### PURPOSE

This procedure defines the process for scheduling, coordinating and tracking work activities to effectively direct company resources for the purpose of:

- Managing plant risk.
- Optimizing health of assets and health of process.
- Optimizing plant systems and components.
- Meeting licensing and regulatory commitments.

This document Supports programs CAN/CSA-N286-05, Management System Requirements for Nuclear Power Plants and N-PROG-MA-0019, Production Work Management.

### RELEVANCE TO NUCLEAR SAFETY POLICY

This procedure is most closely aligned with the requirement in Ontario Power Generation's Nuclear Safety Policy which states that "Sound and rigorous processes are implemented and enhancements proposed to ensure all work activities are planned and controlled to maintain plant configuration and condition within the design basis."

### EXCEPTIONS

Nuclear Security and Nuclear East Facilities are exempt from compliance with this procedure.  
Revision 19 should be used during the transition to the compliance date

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### Title: INTEGRATED ON-LINE WORK SCHEDULE

## 1.0 DIRECTION

This procedure provides the requirements for activities associated with scoping, planning and executing of any on-line work.

The *On-line Scheduling Process* is one part of the Work Management integrated process for the operation and support of our Nuclear Power Plants. It provides an organized, well coordinated station collaboration by which fully planned work, system and component tests, Corrective Maintenance (CM), Deficient Maintenance (DM), Preventive maintenance (PM), Other Maintenance (OM) and *Projects* are systematically identified, scoped, scheduled, executed, monitored and reported.

This procedure defines a sequence of accountabilities and milestones (T weeks) by which multiple departments are required to perform. These milestones build upon each other to identify, select, plan, schedule and execute work in a manner that helps ensure high levels of safe and reliable plant operation. Successful scoping, planning and scheduling of station online work require the support, participation and commitment of managers in all departments and Stratum levels. This commitment involves active, visible participation in all steps of the process. Site management should provide the necessary oversight and support for completion of the process milestones described in this document.

Each "T-week" in the process has an outline of what is to be achieved. Operational, production, personal and outage risks versus on-line risks, as well as the application of conservative operational decision-making and Job Safety Analysis are all considered.

The on-line work-week schedule is a timeline which begins just before week T-53 and ends at the post-execution critique week T+1. The process allows the scope of work to be selected, finalized, prepared, maintenance resources committed, detailed logic built, material holds removed, reviews completed, permits prepared and walk downs completed prior to execution. In the week following execution (T+1), a review is performed to analyze the countdown process and identify problems that were identified during the execution week so that they may be avoided in the future.

Work should be scoped in given work weeks assigned to specific primary equipment groups (PEG). A graded approach to scheduling shall be used. This improves both accountability and ownership of the schedule and provides management with the appropriate emphasis on the different systems, structures and components to properly maintain the facility.

The on-line work-week schedule shall include work performed to maximize the reliability of the station's equipment.

Reference the following appendices for further information:

- Appendix A, Meeting and Team Purpose and Criteria
- Appendix B, Milestone Activities.
- Appendix C, Examples of Cycle plan type work
- Appendix D, Scheduling process Milestones
- Appendix E, Ontario Power Generation Cause codes

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## 1.1 Cycle Plan

Major on-line work due for field execution in one year or more shall be identified as *Cycle Plan* to ensure sufficient time to get work properly planned, including availability of long lead-time materials.

### 1.1.1 Cycle plan Scope Criteria

1.1.1.1 The following work should be selected for Cycle Plan Scope and flagged as such in Asset Suite 7 (WO attribute Importance 52 week look ahead, also known as 52w):

- Work that imposes significant operating restrictions on one or more units.
- Work requiring significant electrical coordination.
- Maintenance programs for critical equipment.
- Work that historically has required significant effort to schedule due to the prerequisites or unit conditions required.
- High profile work that should be completed to meet a management action or regulatory commitment.
- Work orders (WOs) with type CC, CN, DC, DN which are not already in approved scope for execution in less than a year.

1.1.1.2 All work meeting the criteria of the *Cycle Plan* shall be identified, submitted, coded in AS7 and reviewed during the quarter preceding the cycle plan scope identification which is at T-52. Then it should follow the milestones described in Appendix B.

### 1.1.2 Sources for Cycle Plan Work

- System Health (SH) Program (Plant Reliability List – (PRL))
- Preventive Maintenance (PM) Program
- Safety Related System Tests (SRSTs)
- Technical Operability Evaluation (TOE) Actions
- Regulatory Commitments
- Management Commitments
- Operator Burdens and Operator Work Around's (OWAs)
- *Projects* and Modifications.

1.1.2.1 Outage support work with potential to impact on the On-line *Cycle Plan* shall also be identified as such.

1.1.2.2 *Project* work meeting the criteria of *cycle plan* shall be identified as such.

## 1.2 Resource planning

Analysis of the Supply and Demand for Maintenance Resources should be performed on a regular basis and should support the Annual Business Planning process. The aim is to

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ensure that all on-line and outage production work demands, including *project* and *Cycle Plan* work can be supported by available resources prior to approval of the *Cycle Plan*.

#### 1.3 Management oversight

Successful achievement of on-line scheduling goals requires the support, participation and commitment of all departments and stratum levels. This commitment involves active, visible participation in activities (communications, meetings) which ensure work readiness. Specific accountabilities are defined in Section 2.0.

#### 1.4 Online scheduling goals

The ultimate goal of the online scheduling process is to provide a resource-balanced, stable schedule of ready work for execution crews. Success is measured by meeting the completion, survival and stability targets.

#### 1.5 Online scheduling milestones

On-line scheduling milestones are based on industry best practices and Nuclear needs. Successful work execution can only be achieved by adherence to all the milestones in the order and at the time prescribed in the process.

1.5.1 Completion of scheduling milestones shall be monitored regularly by various indicators in the online process metrics suite (OPM) and will ultimately lead to healthy plant condition.

1.5.2 Deviations from milestones should be reported with an Station Condition Record (SCR).

##### 1.5.3 Major Milestones and deliverables

An overview of the on-line work scheduling process is found in Appendices B and D, Work Week Scheduling Process Overview and Online Milestones. Several deliverables are identified leading up to work execution.

Major phases of the online scheduling are:

- Cycle plan scope identification
- Cycle plan scope preparation
- Cycle plan scope freeze
- All online scope commitment
- All online scope freeze
- Walkdowns
- Schedule freeze
- Execution

Detailed milestones, defined in Section 1.7 support the completion of the major phases of online scheduling.

##### 1.5.4 On-line process metrics (OPM)

Milestone status is tracked and documented by the indicators in the OPM suite of metrics.

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The OPM metrics provide a consistent, standardized reporting basis for on-line work preparation, scheduling and completion. They are designed to focus site and corporate management attention on specific deliverables and their respective progress to completion.

### 1.6 Project and Minor modifications work

*Projects* meeting the criteria of *Cycle plan* work should follow the cycle plan (52w) milestones identified in sections 1.7.1 to 1.7.9.

#### 1.6.1 EPC Project identification

The following rules apply to *Projects* awarded to external suppliers as EPC contracts (Engineering Procurement Construction).

##### 1.6.1.1 The project organization or Project manager should ensure the following:

- (a) The *Project* [and any associated temporary modification]- is identified via a work order in NIMS at least one year ahead of the targeted execution date.
- (b) EPC Projects may be scoped in quarterly increments i.e. the scope is entered in NIMS once per calendar quarter.

##### 1.6.1.2 By the end of T-21 (T-21 of the first in project which involves station interface)

The EPC project leader should submit to work control an outline of the project including the following:

- (a) A Schedule or work plan showing critical path, all interface points with station equipment. and any temporary modifications needed to execute the project.
- (b) A "job owner" or project leader shall be identified for such EPC work orders. The job owner shall attend all "T" meetings to provide updates on project tasks status.
- (c) Committed resource profile including non-station resources to be used for project execution.
- (d) A report on parts needed for task execution with status of purchase orders: parts procured by entities other than OPG supply chain should have a committed delivery date to support targeted execution.

**Note:** Any parts procured by OPG should follow the milestones identified in this document.

##### 1.6.1.3 By the end of T-19

The EPC project leader should submit all draft work plans to Operations, Maintenance and/or Field Engineering for review.

##### 1.6.1.4 By the end of T-16

The EPC project leader or "job owner" should ensure the following:

- (a) All work plans are reviewed and approved by Operations and Maintenance.

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- (b) All tasks requiring OPG detail of assessing are identified and fully planned according to N-PROC-MA-0002, Work Planning.

### 1.6.1.5 By the end of T-13

The EPC project leader or “job owner” should ensure:

- (a) all tasks requiring operator assessing are planned per 1.7.12.  
(b) All tasks requiring walkdown are identified.

### 1.6.1.6 By the end of T-10

The EPC project leader or “job owner” should inform OPG work control of any change to the planned execution dates or the planned duration of tasks, or confirm current dates and duration.

## 1.6.2 Minor modifications work

- 1.6.2.1 Minor modification work which are not cycle plan linked to business objectives shall be identified in the scheduling process as follows:

- 1.6.2.2 Minor modifications or shorter term projects should follow the scheduling milestones (non 52w) to ensure integration of their work with the online schedule. Key milestones for modifications are:

### 1.6.2.3 By the end of Week T-19

- Modifications manager or team leader should make draft work plans available to Operations, Maintenance and Field Engineering.
- Non-Station resources needed for the work should be identified.

### 1.6.2.4 By the end of Week T-16

Modifications manager/team leader should ensure all work planning (assessing) is complete and work plans are approved.

**Note:** Long lead items should be identified to Supply Chain as early as possible when the design is approved to ensure delivery by the end of T-6.

## 1.7 Online Scheduling process milestones

### 1.7.1 By the end of Week T-53

Objective:

- Call for cycle plan scope complete

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- a) Work control manager should ensure an action request to identify non-PM cycle plan work is issued once per quarter to all organizations likely to have input to scope meeting the cycle plan criteria (Projects and mods, Engineering, Operations, Outage).
- b) Organizations receiving a scope request should provide a response by initiating or identifying any supporting work requests no later than T-53.
  - (1) All work needs meeting the criteria of the *cycle plan* including *projects* should be identified to work control.
  - (2) Organizations provide committed preliminary resource profile.
  - (3) Commit (non-station) Project resources.

#### 1.7.2 By the end of T-52

##### Objectives:

- All cycle plan type work is in scope.
- Identify estimates of resources available (incl. for *project* & minor mods work).
- Scope all currently unscheduled CC, CN, DC, DN WOs to proper PEG with 52 weeks lead time; add 52w attribute.
- Enter the online/outage split in the Resource Balancing Tool (RBT).

#### a) Work control manager should ensure the following activities are performed:

- (1) All cycle plan type work is approved in scope for a given work week in NIMS (Nuclear Inage Management System) with the 52w attribute (importance 52 week look-ahead in Asset Suite).
- (2) All currently unscheduled CC, CN, DC, DN WOs are approved to proper PEG with 52 weeks lead time; and coded with the 52w attribute.
- (3) The split of resources to support Online or Outage work should be pre-determined consistently with the business plan, and estimates entered into the *Resource Balancing Tool* (RBT).
- (4) Any meetings or reviews required to support cycle plan work are held as appropriate

#### b) All organizations which own resources (Maintenance, Projects & Mods, Operations etc.) should identify all resources available in the *RBT* estimates field.

#### 1.7.3 By the end of T-48

##### Objectives:

- Complete planning for cycle plan work.

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- Address any outstanding Preventive Maintenance Living Program (PMLP) feedback for cycle plan PMs.
- a) Maintenance and Operations Managers, with support from Project and Contract Managers should ensure that the following activities are performed:
- (1) Complete 100 percent of the planning and work package preparation for 52w WOs in approved *Scope* in accordance with N-PROC-MA-0002.
  - (2) For fully planned tasks, set the task status to ready or apply a valid hold code for tasks requiring resolution from support organizations.
  - (3) Forward Action Alert Awareness (AAA) messages to alert group codes responsible for the hold resolutions in accordance with N-PROC-MA-0002, Work Planning.
  - (4) Identify Permit requirements.
  - (5) Prepare and submit PC1-Ns (application for work protection) and N-FORM-10185, PC1-N Application for Work Protection to Operations including external and contractor permit requirements.
  - (6) Any required Material requests (MRs) should be fully approved.
  - (7) Address any outstanding PMLP feedback for 52w PM type WOs. Outstanding PMLP is defined as follows:
    - PMLPW\_INTFC\_v\_FEEDBACK\_CORR: (Status: New, Assigned)
    - PMLPW\_INTFC\_v\_FEEDBACK\_GEN: (New, Assigned)
    - PMLPW\_INTFC\_v\_FEEDBACK\_TRADE\_PM: (Status: New, Assigned)
    - PMLPW\_INTFC\_v\_CHNG\_RQST\_TBL: (Status: New, Assigned, Approved)
- b) Project Manager should identify the tasks which may be scheduled over a number of weeks (*windows* or *Long duration tasks*). Non-station resources shall be supplied for *project* tasks scheduled over a *window*.

#### 1.7.4 By the end of T-47

##### Objectives:

- Initiate purchase requests for cycle plan work orders.

Supply Chain manager should ensure purchase requests are initiated as needed for all cycle plan WO tasks.

#### 1.7.5 By the end of T-42

##### Objectives:



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- Resolve all Engineering holds for 52w tasks
- Resolve BMU (Bill of material update) holds for 52w work orders
- Ensure all parts holds have purchase orders (POs)

a) Alert group code owners should perform the following activities:

- Resolve all engineering holds assigned to their groups for 52w tasks.
- Resolve BMU holds for 52w work orders
- Inform Work Week Leader or Work Control Team Leader (WWL/WCTL) and other affected groups of unresolved holds.

b) WWL/WCTL or delegate should remove from the schedule, *WOs* or tasks where engineering holds are not resolved.

c) Supply Chain manager should ensure all parts holds (PH) on cycle plan work have a PO.

1.7.6 By the end of T-40

Objectives:

- All 52w WO tasks set to ready except tasks with PH and holds for pressure boundary and Inspection and Test plan (MPA, MPB, MPD, ITP)
- All PH on 52w tasks have a committed T-21 delivery date

a) WWL/WCTL should remove from scope, *cycle plan* WOs or tasks with unresolved holds except tasks with committed parts holds, pressure boundary or inspection & test plan holds.

b) Supply Chain manager should ensure all parts holds on tasks in cycle plan scope have a committed delivery date for T-21.

**Note:** Cycle plan scope is considered frozen at this point; re-scheduling of any 52w WO beyond this point requires approval from the work control manager or delegate.

1.7.7 By the end of week T-24

Objective:

- Prepare detailed design packages for minor modifications work
- Identify long lead items and resources needed for minor modifications work
- Conduct PM review meeting.

a) Modifications Manager should ensure detailed design is approved and *long lead items* are identified to Supply Chain and Procurement Engineering for minor modifications package.

b) Modifications or Project Manager should identify resources required for the work and the material requirements.

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**Note:** Long lead items should be identified to Supply Chain as early as possible when the design is approved to ensure delivery by the end of T-5.

- c) Maintenance manager should ensure a PM review meeting is conducted in accordance with the guidelines in Appendix A.

#### 1.7.8 By the end of week T-21

##### Objective:

- All parts holds are removed from cycle plan work orders; or WOs rescheduled
  - Outlines of EPC projects are submitted
  - Organizations provide committed resource profile including non-station resources to be used for minor modifications work.
- a) Supply chain manager should ensure all parts holds committed for cycle plan WOs are cleared.
  - b) WWL/WCTL should ensure any cycle plan WOs with unresolved holds except pressure boundary or ITP holds are removed from scope
  - c) Maintenance Manager should provide committed maintenance resources for on-line schedule.
  - d) Operations Manager should provide committed operator resources for On-line schedule.
  - e) EPC project leaders should submit to work control an outline of the project as described in 1.6.1.1.
  - f) Projects and Modifications Managers should identify resources to execute *Project* and minor modifications work.
  - g) All committed resources shall be identified in the *Resource Balancing Tool* (RBT) estimated resources fields.

#### 1.7.9 By the end of T-20

##### Objectives:

- Scope identification
  - Provide preliminary scope with priority weighting scores (1 week prior to T-19 meeting)
  - Resource balance scope within 20% (maximum 120% of disciplines MC, MM, MS)
  - Review preliminary scope list in preparation for T-19 meeting
- a) The following departments shall provide input to the Work Control organization on scoping needs, which are consistent with the business plan:
    - (1) Operations Manager identifies operations significant issues for On-line schedule.

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- (2) Engineering Managers identify system health improvements and support preparation of the work.
- (3) Outage Managers identify prerequisite work and resources to execute the work.
- (4) Project and Modification Managers identify *Project* work.

b) Work Control Manager should ensure the following activities are performed:

- (1) Scope all on-line scheduled work utilizing Nuclear Inage Management System (NIMS)
- (2) Prepare and issue a consolidated preliminary *scope list* for all work needs identified and seek assistance from the requestors when required. The scope list should be available one week prior to the scope commitment meeting held in T-19
- (3) Priority weighting scores, as determined with the scoping priority matrix in effect at site, for all jobs scoped are made available for scope reviewers.
- (4) Integrate *Cycle Plan* work in the scope of the relevant work week.
- (5) Resource balance all on-line scope for the disciplines of mechanical, control and civil maintenance to a maximum of 120% of estimated resources.

c) Department Managers requesting work should review the preliminary scoping list in preparation for the scope commitment meeting held in T-19 and feedback any concern to the WWL/WCTL.

1.7.10 By the end of T-19

Objectives:

- Draft work plans for minor mods and EPC projects available.
- Hold T-19 scope commitment meeting
- Provide Supply intelligence recommendations on items in scope

a) Project or modifications Manager should ensure the following activities are performed:

- (1) Work plans are submitted to Operations, Maintenance and Field Engineering.
- (2) Work Plans and Asset Suite 7 (formerly known as PassPort) identify any station support tasks required.
- (3) Project/Modifications staff and Work Control staff discuss minor modifications tasks which will be scheduled over a number of weeks (*window*) and ensure they are planned as such. Agreement should be reached on the duration and timing of installation *windows*.
- (4) Non-station resources to be used for tasks scheduled over a *window* are supplied.

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- a) Work control manager should ensure a Scope Commitment meeting is conducted in accordance with the guidelines in Appendix A.
- b) WWL/WCTL or delegate should perform the following activities:
  - (1) Add or remove work from the preliminary *Scope List* as required.
  - (2) Identify work requiring planning to the affected Planning organizations.
- c) Supply Chain manager or delegate should provide recommendations on items in scope based on the probability of parts delivery for the targeted date.

#### 1.7.11 By the end of Week T-16

##### Objectives:

- Review *EPC and* minor mods work plans, resolve concerns.
  - Complete Maintenance and field engineering planning; all tasks are set to ready or contain a valid hold code.
  - Prepare PC1-Ns and submit to Operations.
  - Identify any conflicts or operational issues in the scope list.
  - Identify Eng holds & PE which cannot be cleared by T-13 & T-12 respectively
  - Identify parts holds for non 52w tasks that cannot be resolved by end of T-6.
  - Hold a Scope Rationalization meeting.
- a) Modifications manager/team leader should ensure work plans are reviewed and concurred by Operations, Maintenance and Field Engineering.
  - b) Maintenance, Projects and Project & Modifications Managers should ensure that the following activities are performed when planning needs are identified:
    - (1) Complete 100 percent of the planning and work package preparation identified on the *Scope List* in accordance with N-PROC-MA-0002.
    - (2) For fully planned tasks, set the task status to ready or apply a valid hold code for tasks requiring resolution from support organizations.
    - (3) Forward AAA messages to alert group codes responsible for the hold resolutions in accordance with N-PROC-MA-0002.
    - (4) Fully approve any required Material requests (MRs).
    - (5) Identify Permit requirements.
    - (6) Prepare and submit PC1-Ns and N-FORM-10185, PC1-N Application for Work Protection to Operations including external and contractor permit requirements.
  - c) Project or Modifications Manager or team leader should identify the tasks which may be scheduled over a number of weeks (*windows or Long duration tasks*) and ensure they are

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planned to the first T-16 milestone for that window. Non-station resources shall be supplied for *project* tasks scheduled over a *window*.

d) Operations Manager or qualified delegate, should perform the following activities:

- (1) Review preliminary *Scope List*.
- (2) Perform initial operations review as follows:
  - (i) Confirm the plant can be configured safely to perform the desired work.
  - (ii) Verify Operations personnel are properly resourced taking into account all operations station activities.
  - (iii) Identify pre-maintenance, post-maintenance and operational testing requirements and associated resources to support the work.
  - (iv) Inform WWL/WCTL of any concerns.

e) Alert Group Code Owners responsible for hold resolutions should perform the following activities:

- (1) Review holds and disposition where required.
- (2) Identify engineering (non-procurement) holds that cannot be resolved by end of T-13 in preparation for the Scope Freeze review held by the end of T-8.
  - (i) Determine Target Completion Date (TCD) and obtain reason for the delay prior to the meeting, and enter the information into the Holds toolkit or via the Engineering Work Management System (EWMS).
  - (ii) Tasks with non-parts holds not expected to be resolved by end of T-13 should be removed from the scope list .
- (3) Identify procurement holds that cannot be resolved by the end of T-12 in preparation for the Scope Freeze review to be held by the end of T-8.
  - (i) Determine TCD and obtain reason for the delay prior to the meeting, and enter the information into the Holds tool kit .
  - (ii) Tasks with Engineering parts holds not expected to be resolved by end of T-12 should be removed from the scope list.
- (4) Identify parts holds that cannot be cleared by end of week T-6 in preparation for the Scope Freeze review held by the end of T-8.
  - (i) Determine TCD and obtain reason for the delay prior to the meeting, and enter the information into the Holds toolkit.
  - (ii) Tasks with part holds not expected to be resolved by end of T-6 should be removed from the scope list.

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- f) Work Control Manager should ensure a Scope Rationalization meeting is held as described in Appendix A.

**Note:** The scope survival metric takes effect at this point.

#### 1.7.12 By End of Week T-13

##### Objectives:

- Resolve Engineering non parts holds.
- Complete Operations Assessing
- Create all permit tasks
- Identify all permit support tasks, Maintenance to assess

- a) Alert group code owners responsible for hold resolution should perform the following activities:

- (1) Resolve all engineering non-parts holds due by end of T-13.
- (2) Inform WWL/WCTL and other affected groups of unresolved non parts holds.

- b) Operations managers, with support from maintenance managers should ensure the following is done:

- (1) All tasks to prepare and check permitry are created for scheduling 4 weeks prior to the projected execution week.
- (2) All PC1's are reviewed and a permit scope is established for the targeted execution work week.
- (3) All permitry support tasks (e.g. scaffolding, running hoses, rubber areas etc. required for permitry) are identified, created and assessed in a WO.
- (4) Identify to work control jobs where permit tasks cannot be scheduled at least 48 hours prior to the start of the actual maintenance activity.

#### 1.7.13 By End of Week T-12

##### Objectives:

- Resolve procurement engineering holds.
- Resolve BMU holds
- Tasks not set to ready or which do not have a valid hold code are pulled from scope.

- a) Alert Group Code Owners should perform the following activities:

- (1) Resolve all engineering parts (procurement) holds including but not limited to Procurement Engineering (PE) holds, Parts gone Obsolete (PGO) holds, Holds for Master Equipment List (MEL) Updates (MDA)/MDU).
- (2) Update hold status in appropriate toolkits.

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- (3) Inform the WWL/WCTL or any affected group of any unresolved procurement hold.
- (4) Resolve all BMU holds.

b) WWL/WCTL or delegate should perform the following activities:

- (1) Remove from the scope, WOs or tasks where procurement engineering holds cannot be resolved.
- (2) Schedule all “prepare and check permit” tasks 4 weeks prior to execution work week
- (3) Prepare a revised *Scope list*. Tasks not assessed (not set to ready status), tasks that do not contain a valid hold code and all parts holds not committed to be cleared by T-6 should be removed from the list.

**Note:** Any items not ready (without a valid hold code) kept at risk past this milestone shall have a committed resolution date prior to T-10 and an owner assigned by work control or the task will be cut by end T-11.

#### 1.7.14 By End of Week T-10

Objective:

- Refine schedule logic
- Issue materials at risk report
- Finalize committed resources in the RBT to support T-8 scope freeze

a) Work Control Manager should ensure:

- (1) Refining, tracking, and modifying of the the schedule from T-10 through to T-9 to provide an executable plan for the T-8 scope freeze reviews.
- (2) Schedule logic is built.
- (3) “Apply Permit” tasks are scheduled at least 48 hours prior to the start of the actual maintenance activity, unless otherwise specified by Operations.
- (4) Confirm any operating or functional test (as-found test) required for PM Work orders with an OTR (Operability Test Required) flag are scheduled prior to the actual preventive maintenance.”
- (5) any WOs or tasks not ready with non valid holds are removed from scope

b) Supply Chain should provide a “Material At Risk” report for required and contingency parts for the targeted execution work week.

c) Resource owners should ensure resource levels in the RBT are accurate and assigned at crew level to support the Scope Freeze meeting process.

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#### 1.7.15 By End of Week T-9

##### Objective:

- Review Material at Risk report in preparation for scope freeze.
  - Issue a “logic driven” *scope* for review 1 week prior to scope freeze meeting.
- a) Work Control Manager should ensure a logic driven, resource balanced schedule is issued one week ahead of the scope freeze meeting held by the end of T-8. Specifically, WWL/WCTL or delegate should perform the following activities:
- (1) Prepare a revised *Scope list*. Tasks not set to ready status, tasks that do not contain a valid hold code and all parts holds not committed to be staged by T-5 should be removed from the list.
  - (2) Review the material at risk report with work group coordinators and Supply Chain to determine work which may remain in scope with at risk material. Tasks where material delivery are deemed an unacceptable risk should be removed from scope.”
  - (3) Notify the site Inspection and Maintenance Services (IMS) contract Manager for any removal or addition of IMS work.
  - (4) Notify the Hydro One Single Point of Contact (SPOC) in Work Control prior to the removal of any switchyard or main power output work.
  - (5) If change in scope affects the switchyard, obtain approval from the Independent Electricity System Operator (IESO) prior to the change.
  - (6) Balance worker estimated resources to align with final scope.
  - (7) Issue the scope list.
- b) Work Control Hydro One SPOC should perform the following activities:
- (1) Monitor Hydro One switchyard or main power output work preparations for execution of switchyard and main power output work.
  - (2) Ensure plant will be aligned to allow work to proceed.
  - (3) Ensure necessary Work Protection is prepared and applied to allow work to proceed as scheduled.
- c) Department Managers should prepare for the Scope Freeze Meeting held by the end of T-8, by ensuring all their milestones deliverables are met.

#### 1.7.16 By End of Week T-8

##### Objectives:

- Conduct Scope Freeze Meeting.



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- Begin preparation of permits.
  - On- line Scope Addition Form in effect beyond this point.
  - Resource levels are considered frozen beyond this point.
  - Scope Stability Measure in effect beyond this point.
- a) Work Control Manager should ensure a scope freeze meeting is held in accordance with Appendix A.
- b) Scope freeze meeting attendees should perform the following activities:
- (1) Review the *Scope List* prior to the meeting and be prepared to discuss the following:
    - Any remaining holds (except PH or MPA/MPB/MPD).
    - Tasks not set to ready status.
    - Hydro One switchyard or main power output work.
    - IMS work.
    - *Project* work.
    - *Cycle Plan* work.
    - Resource comparison (estimated supply vs. demands) reports for all major disciplines.
  - (2) Recommend disposition and reschedule of work as appropriate considering the following:
    - Next available PEG system *window*.
    - Sequencing.
    - Station priority.
    - System health.
    - Regulatory commitments.
    - PM Late dates.
    - Manpower issues.
    - Material deliveries that cannot support pre-staging by Friday of T-5.
    - Committed TCDs for hold removals.
    - Impact on *Cycle Plan*.
  - (3) Reach agreement on a revised *Scope List*.
- c) Operations Manager should ensure preparation of permits is initiated with the goal of completing all requirements by end of T-4 noting that PC1-N requirements were submitted by end of T-16 and finalized in T-13.

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- d) Department Managers should follow the rules of the Scope Addition Process as described in Section 1.8 when requesting addition of new *WOs* (*WOs* not tasks).

**Note:** Estimated resource levels are considered frozen beyond this point.

- e) Should changes to resources be required inside the T-8 window, resource owners should:

- (1) Notify Work Control and the site RBT administrator of the new levels.
- (2) Initiate an SCR to document and trend the deviation.
- (3) Take corrective actions when required.

#### 1.7.17 By End of Week T-6

##### Objectives:

- Issue frozen scope list for review
- Clear all parts holds

- a) Work Control manager should ensure the frozen, resource balanced schedule is issued for preliminary review.
- b) Supply chain manager should ensure parts holds are cleared and should initiate the part staging process.

#### 1.7.18 By End of Week T-5

##### Objective:

- Stage all parts
- Remove tasks with unresolved parts holds from the schedule.

- a) Supply Chain Manager should perform the following activities:

- (1) Ensure all parts are pre-staged by Friday of T-5.
- (2) Ensure WWL/WCTL is informed of any materials concerns.
- (3) For *project* tasks scheduled over a number of weeks (*window*), parts must be pre-staged by Friday of T-5 of the first week of that *window*.

- b) WWL/WCTL or delegate should remove tasks with unresolved parts holds from the schedule and resource balance as required.

#### 1.7.19 By End of Week T-4

##### Objectives:

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- All permits prepared, checked and ready for review
- Perform preliminary operability review
- Perform preliminary reactor safety review
- Remove all pressure boundary holds

a) Operations Manager should ensure the following activities are performed:

- (1) Ensure all permits are prepared, checked and ready for review by Friday of T-4.
- (2) Ensure preliminary operational and reactor safety considerations are addressed.
- (3) Identify to Work Control any activities where permitry should be applied inside the 48 hour rule (Sections 1.7.12.b.4 and 1.7.14.a.3).

b) Reactor Safety Manager should perform the following activities:

- (1) Ensure a preliminary reactor safety review is performed by Friday of T-4.
- (2) Inform WWL/WCTL of reactor safety concerns and if maintenance testing tasks need to be added to the schedule.

c) Design Engineering Manager should ensure all holds for Pressure Boundary nuclear item release (MPA, MPB, MPD) are cleared.

#### 1.7.20 By End of Week T-3

Objective:

Perform First Line Manager (FLM) walk down.

- a) Work Control Manager should ensure a resourced and executable schedule is available T-3 through to T-0.
- b) Execution FLM, First Line Manager Assistant (FLMA) or qualified delegate in appropriate departments, and Project Leader for Project work should conduct work package walk down by Wednesday of T-3 at the latest. Refer to N-PROC-MA-0006, Work Performance for full details.
- c) Supply Chain, Work Control, Maintenance and Operations Managers should ensure all issues identified during the walk down are addressed prior to the T-2 schedule freeze meeting.

#### 1.7.21 By End of Week T-2

Objectives:

- Disposition walk down feedback prior to Schedule Freeze meeting
- Conduct Schedule Freeze meeting
- Finalize and issue Schedule.

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- a) Maintenance Manager, Engineering Managers, Operations Manager and other department Managers, as required, should ensure the following activities are performed:
    - (1) Review the disposition comments entered in the walk down tool kit.
    - (2) Initiate resolution prior to the Schedule Freeze meeting as follows:
      - (i) If resolution cannot be resolved prior to the meeting, obtain a commitment date as to when the issue can be resolved.
      - (ii) Prepare for discussion at the meeting.
      - (iii) Update status in Walk down tool kit.
  - b) Work Control Manager should ensure a Schedule Freeze meeting is held to review FLM walk down comments and finalize any required changes to the schedule as a result of the walk down or of changing plant conditions. Refer to Appendix A for details.
  - c) Meeting attendees should perform the following activities during the Schedule Freeze meeting:
    - (1) Review resolution feedback from support organizations.
    - (2) Justify keeping tasks on the schedule if the discrepancy can be resolved (with a firm commitment date) by T-1.
    - (3) Remove the task(s) from the schedule prior to issuing it if the discrepancy cannot be resolved by T-1 after a TCD for resolution has been entered into the Holds tool kit. Comments should be added in the Walk down tool kit.
    - (4) Review estimated resource variance reports and obtain agreement on a revised schedule.
- Note:** At this point all work groups and resource owners are committed to executing the work on the frozen schedule.
- d) WWL/WCTL or delegate should perform the following activities:
    - (1) Remove from the schedule any task(s) as agreed at the Schedule Freeze meeting.
    - (2) Resource balance the schedule as required.

#### 1.7.22 By End of Week T-1

##### Objectives:

- Disposition *Carry-in Work*.
- Complete reactor safety reviews.
- Complete operability reviews.
- Post final schedule.

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- Issue Level “D” job jar work list.

a) WWL/WCTL or delegate should perform the following activities:

- (1) Review the current execution work activities and identify any work that cannot be executed as scheduled.
- (2) Determine if unexecuted work can be added to the following week’s schedule considering the following:
  - (i) Determine if the schedule is under resourced or if overtime is approved.
  - (ii) If (i) applies, review the addition of work activities with the next week’s Execution FLM or Work Group Coordinator and obtain concurrence.
  - (iii) If concurrence is received, add *Carry-in-Work* from current execution week to the schedule.
- (3) Revise the schedule and resource balance as appropriate.
- (4) Issue a job jar of level “D” work for each crew.

b) Manager, Reactor Safety should ensure the following activities are performed:

- (1) Reactor safety reviews of the final schedule are completed.
- (2) Reactor safety concerns are communicated to the WWL/WCTL and direction is provided as required.

c) Manager, Operations should ensure the following activities are performed:

- (1) Operational and reactor safety issues are addressed.
- (2) Operational and reactor safety issues are communicated to the WWL/WCTL and direction is provided as required including any activities where permitry should be applied inside the 48 hour rule (Section 1.7.14 [a] [3 &4]).

#### 1.7.23 By End of Week T-0

##### Objectives:

- Execute work
- Re-enter *Long duration Tasks* into following week schedule
- Conduct daily status meetings, provide Carry-over updates as required.

a) Execution organizations should perform work activities in accordance with N-PROC-MA-0006.

b) Execution organizations should update the status of all work (including percent complete of *long duration tasks*) in T-0 throughout the week and make recommendations for carry-over to future weeks.

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c) Manager, Work Control should ensure:

- (1) Addition of *Long durations Tasks (window)* which are not yet complete to the scope of the upcoming work week.
- (2) Scoping of work which is not expected to be completed in execution week and is expected to be carried over to the following work week, into the next week's schedule.
- (3) Daily status meetings are held during execution week; carry over should be discussed during the meetings. Refer to Appendix A for details.
- (4) Re-level the updated T-1 schedule [execution schedule for the following week] if the new scope represents more than 10% of available crew resources.

#### 1.7.24 By End of Week T+1

Objective:

Critique meeting.

Manager, Work Control should ensure that a critique meeting is held to perform the following activities: (Refer to Appendix A for meeting purpose and criteria)

- a) Review work performance against the frozen schedule.
- b) Review online process metrics (OPM) to identify improvements required.
- c) Identify gaps.
- d) Document and inform appropriate organizations of action items to ensure lessons are learned for future work weeks.
- e) Ensure SCRs are initiated in accordance with N-PROC-RA-0022, Processing Station Condition Records to identify failures to meet milestones and document corrective action for future improvements.
- f) Review scheduling process leading to that work week to identify any gaps or non-compliance.

## 1.8 Scope Addition Process

The primary objective of the Scope Addition Process is to control addition of work into the scope after it has been frozen by the end of T-8. The intent is to minimize any risk of creating potentially adverse conditions due to scheduling conflict or diverting of resources. The following considerations would benefit the Scope addition process:

1.8.1 When requesting addition of new *WOs* (*WOs* not tasks), Department Managers shall follow the rules of Scope Addition:

- a) Complete N-FORM-10312, On-line Scope Addition Request.

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b) Obtain signature approvals as follows:

- Work Control Manager for concurrence to proceed.
- Reactor Safety concurrence, if required.
- Support groups review and commitment inaccordance with section 3 of N-FORM-10312.
- T-8 to T-0, approval by WWL/WCTL and SPOC.
- T-6 to T-0, Sponsoring Manager and Work Control Manager.
- T-2 to T-0, Sponsoring Director and Director of Operations and Maintenance (DOM). When the DOM is the Sponsor, the Director of Work Management should approve.

c) Submit approved N-FORM-10312 to the WWL/WCTL for input to the schedule.

1.8.2 Department requesting addition Work Control manager should ensure the following activities are performed when addition of work has been approved:

- a) Ensure Assessor resources are available to support the addition of work to the schedule.
- b) Initiate preparation of work package.
- c) Ensure Manager Operations is notified of changes for review of operational impact as a result of emergent work, and permits can be prepared in time, as required.
- d) Ensure any required material is available.

1.8.3 WWL/WCTL or delegate should perform the following activities upon receiving approved form N-FORM-10312:

- a) Review approved form.
- b) Refine and modify the Scope List as appropriate.
- c) Resource balance if adding this scope brings crew demand above 110%.
- d) File completed N-FORM-10312 in the facility Work Control department, in accordance with local filing instructions, for the purpose of future effectiveness reviews, post job reviews and internal self-assessments. Maintain a minimum of 12 months retention.

1.8.4 When a block of resources becomes available, the WWL/WCTL may add new scope without the use of N-FORM-10312 providing communication with affected organizations has been performed to verify the following:

- Resource availability
- Parts availability

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- Assessment (planning) is complete
- Walk down is complete
- Permits are prepared, checked and ready
- Work is ready with no holds
- Work will not cause scheduling or reactor safety conflicts with already approved scope.

1.8.5 The Work Control Manager may authorize keeping work on the schedule past any of the milestone gates in the *On-line Scheduling Process* provided the relevant work group commits to resolving the issue by an agreed upon date. An SCR shall be filed to document these limited cases.

## 1.9 Scope variation Review/Trend code input- T-7 through T-1

1.9.1 The WWL/WCTL or delegate shall ensure that:

- An approved cause code is identified in the approved database for all transactions (tasks added or removed T-7 through T-1) from approved scope. The cause code selected should reflect the “root” cause i.e., the condition that if corrected would prevent recurrence. Typically asking “why” 3 times should identify that cause. Approved cause codes are listed in Appendix E, Ontario Power Generation Cause Codes and are reflected in the scoping database.
- A review of the cause codes for the work week is done at the T+1 critique meeting for lessons learned.

1.9.2 The Work Control Manager shall ensure appropriate analysis of the top three cause-code trends once every quarter. An SCR shall be initiated to capture the trend analysis and corrective actions.

1.9.3 The Work Control Manager may exempt a top cause code from analysis if:

- it is a repeat occurrence from the previous quarter and
- it is deemed that action plans have not had adequate time to achieve desired results.

## 1.10 Break Plan Work

Priority Code 1 or 2 work that needs to be added to the schedule after T-3 walk downs is considered *Break Plan Work*.

1.10.1 If *Break Plan Work* is within the *Fix-It-Now (FIN)* Team capabilities, work should be managed in accordance with N-INS-08400-10000, Fix-It-Now Process to protect the schedule. Contact *FIN* Team Leader for direction.

1.10.2 If *Break Plan Work* is outside the *FIN* Team capabilities, new work may be added to the schedule without N-FORM-10312 at the discretion of the Work Control Manager provided the following criteria are met:

- Resources are made available.
- Walk down is complete.



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- Assessment (planning) is complete.
- Work is ready with no holds.
- Parts are pre-staged.
- Work will not cause scheduling conflicts with already approved scope, including reactor safety concerns.

#### 1.11 Resource Balancing Tool (RBT)

- 1.11.1 The RBT is the tool used for identifying resources available to support operation and maintenance of the plants.
- 1.11.2 The split of resources to support Online or Outage work should be pre-determined on a yearly basis as part of the business plan, and estimates entered into the RBT.
- 1.11.3 Changes in the relative needs of these groups may arise due to unforeseen circumstances (e.g. forced outage). Review and adjustment of the resource supply-demand should take place via regular meetings of the Maintenance, Outage and Work Control Managers.

#### 1.12 Graded Approach to Scheduling

- a) This approach has four levels of work scheduling: Levels A, B, C and D. Each level has specific criteria associated to it.
- b) All tasks on the execution schedule should be clearly graded A, B or C by schedule freeze.
- c) Level "D" tasks should be identified in a list separate from the execution schedule.
- d) All tasks on a WOs that are scheduled within a work week should have the same grade assigned.

##### 1.12.1 Level A Tasks

- Level A grading is used when the highest level of schedule control and schedule adherence is required. This type of scheduled tasks should be reserved for work activities which impact on safe operation of the facility, due to Licensing Conditions or limits in the Operating Policies and Principles (OP&Ps).

Level A Tasks should be completed within one hour of their scheduled time. This type of task typically requires a ROMS (Resource Outage Management System) slip input or could have an economic or public image impact and should be monitored at least once per day.

##### 1.12.2 Level B Tasks

- a) Level B scheduled activities are the second highest level of schedule grading. This type of schedule activity should be logic-driven and risk-significant only to the point that it should be completed in one 12-hour shift so as not to impact other planned work on subsequent shifts or days.

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- b) Tasks requiring multi-discipline involvement and coordination or specific shift/day finish should be coded Level B as a minimum.
- c) Level B tasks should be completed within one 12-hour shift of their scheduled time and should be monitored daily.

### 1.12.3 Level C Tasks

- a) Level C scheduled activities are the lowest level of schedule grading. Level C activities should pose no risk of impairment on systems and are expected to be completed any time within the work week.
- b) Any type "C" tasks should be evaluated to be acceptable to be worked in combination with any other planned task for the entire week.
- c) This type of schedule should be reserved for work that is routine and typically does not require the details of a logic-driven schedule.
- d) Level C scheduled tasks may be shown on the schedule on the day or shift they are targeted to be completed but may move within the work week at the discretion of the execution organization.

### 1.12.4 Level D tasks or "Job Jar"

Level D work is normally managed at the FLM and technician level. This work should not be included in the weekly resource-loaded schedule. This work is typically classified as support work, or non-plant impact work and does not require support from other organizations. Level D work may be completed any time on any day of any week. The minimum amount of ready work in the job jar for each crew should be agreed upon with work group delegates.

## 2.0 ROLES AND ACCOUNTABILITIES

### 2.1 All department managers

Commit to and meet milestones identified in the online-scheduling process.

### 2.2 Alert Group Code Department Managers

Ensure holds assigned to their group are cleared by the established "T" milestones.

### 2.3 Managers, Engineering

2.3.1 In collaboration with Operations, identify plant reliability work for the Cycle Plan.

2.3.2 Ensure input to Scope identification and prioritization is provided.

2.3.3 Ensure minor modifications work is identified and follows the milestones of the online scheduling process and of the Cycle Plan if appropriate.

2.3.4 Ensure all engineering holds are cleared in accordance with the process milestone timelines

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### 2.4 Manager, Maintenance

- 2.4.1 Ensures work is fully planned and assessed in accordance with N-PROC-MA-0002.
- 2.4.2 Provides accurate resource availability and supply projections to support the work via the *Resource Balancing Tool*.
- 2.4.3 Notifies Work Control Manager of any changes in resource levels past T-19.
- 2.4.4 Ensures walk downs are performed and comments are fed back and resolved.
- 2.4.5 Ensures assigned work is executed as planned.
- 2.4.6 Ensures active participation at all meetings.
- 2.4.7 Ensures review of *Project* work packages.
- 2.4.8 Develops strategy to resolve resource gaps.
- 2.4.9 Recommends bundling of approved work to maximize maintenance efficiency.
- 2.4.10 Identifies opportunities for horizontal planning to the materials Supply Chain representative at the Cycle Plan review meetings.
- 2.4.11 Resolves BMU, task planner (PLH) and work package planner (WPP) holds.

### 2.5 Manager, Operations

- 2.5.1 In collaboration with Engineering, identifies Plant Reliability List (PRL), System Health (SH) and Operations priority work for the scope.
- 2.5.2 Provides input to prioritization of work.
- 2.5.3 Provides operational safety review of scheduled work.
- 2.5.4 Ensures operability considerations are identified and communicated by the established "T" milestones.
- 2.5.5 Ensures plant alignment is adequate for maintenance to occur taking into account reactor safety and operational considerations.
- 2.5.6 Provides accurate resource availability and supply projections to support the work via the *Resource Balancing Tool*.
- 2.5.7 Supports assessment and schedule development activities.
- 2.5.8 Ensures preparation of Permits and walk downs to the established "T" milestones.
- 2.5.9 Completes operability review of the committed scope (T-16) and any proposed or required changes to the frozen Cycle Plan execution schedule or scope.

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- 2.5.10 Provide estimate for Operations resources to support Cycle Plan work.
- 2.5.11 Commit to and meet process milestones (detailed assessment, reviews, permit preparation or walkdowns).

## 2.6 Managers, Projects and Modifications

- 2.6.1 Ensure *Project* work and minor modifications are identified and follow the milestones of the online scheduling process and *Cycle Plan*.
- 2.6.2 Ensure funding is available for projects.
- 2.6.3 Provide fully assessed work packages to work control.

## 2.7 Manager, Reactor Safety

Ensures review of the schedule and ensures reactor safety related considerations are identified and communicated by the established "T" milestones..

## 2.8 Manager, Supply Chain

- 2.8.1 Ensures all material related holds are cleared by identified milestones.
- 2.8.2 Ensures parts required are staged by identified milestone.
- 2.8.3 Leads the Holds resolution team in accordance to the criteria in appendix A.8.

## 2.9 Manager, Work Control (SFAM)

- 2.9.1 Oversees and continuously improves the work management process with focus on reducing backlogs and improving plant conditions, by ensuring a high quality schedule is provided to the execution groups.
- 2.9.2 Co-ordinates the overall process.
- 2.9.3 Ensures all scheduling process meetings are held in accordance to the guidelines in appendix-A.
- 2.9.4 Ensures Work Orders (WOs) are identified in Asset Suite 7 (formerly known as PassPort) using the appropriate attributes e.g. "52W" WO attribute
- 2.9.5 Ensures all WOs are approved for a given work week in the Nuclear Inage Management System (NIMS).
- 2.9.6 Identifies any known resource gaps to Maintenance and /Operations.
- 2.9.7 Delivers a balanced schedule of ready-work.
- 2.9.8 In collaboration with Outage Manager, allocates resources to support on-line, outage execution, and outage pre/post-requisite work.

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2.9.9 Ensures owners are identified, as required, as soon as practical, for work programs or individual WOs to provide appropriate oversight during work planning and execution.

## 2.10 CFAM, Work control

2.10.1 Ensures OPM metrics are available on a weekly basis.

2.10.2 Ensures governance is accurate.

2.10.3 Leads a peer team of work control managers.

2.10.4 Identifies gaps and leads their resolution through the peer team.

## 2.11 Director, Operations and Maintenance

Approves N-FORM-10312, On-Line Scope Addition Request.

## 2.12 Director, Work Management

2.12.1 Approves N-FORM-10312 when the DOM is the requesting Manager.

2.12.2 Ensures coordination between Outage and Work Control to identify unit outages.

2.12.3 Ensures issues pertaining to the resource split between online and outage are resolved.

## 2.13 All Directors

Sponsor initiation of N-FORM-10312 for their own line.

## 3.0 DEFINITIONS AND ACRONYMS

### 3.1 Definitions

**Break Plan Work** - Priority Code 1 or 2 work that is added to the schedule after T-3 walk downs.

**Carry-in Work** - Scheduled work that could not be executed during a frozen work week and is carried over into following work weeks.

**Cycle Plan** - A 1 or 2-year rolling process used to identify, scope, plan, and schedule major on-line work that supports and provides input to the station business plan. The process is built on the principles of repeatability and achieving maximum system/equipment availability while optimizing the use of maintenance resources.

**Fix-It-Now** –(FIN)- Special cross functional working team assembled as a self-sufficient work group capable of independently performing work with minimal support from any other organization. The primary responsibility of the Fix-It-Now team is to address emergent, high and minor work activities such that the scheduled and planned work activities are protected and the normal shop resources are not distracted from their assigned tasks.

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**Long duration Task** - Task where the work spans more than one work week.

**Long lead item** – Material for which the catalogue identification (cat id) has a vendor order lead time (VOLT) greater than 90 days

**On-line Scheduling Process** - A developed schedule established from considerations such as preventative maintenance predefineds, reduction of plant risks, required surveillance activities, seasonal plants risks and maintenance history. The Scheduling Process is used as a guideline to establish preferred work windows for specific systems and may include emergent or minor work. The large majority of emergent and most minor work is covered by the Fix-It-Now team.

**OTR**- Operability test required. A flag or attribute placed on a predefined work order when an as found test is needed prior to performing a time based PM. Specific rules for the OTR are detailed in N-PROC-MA-0026.

**Project** - A Project is defined as a temporary endeavor valued at greater than \$200,000 (per unit) over and above base Operation, Maintenance, and Administration (OM&A) that is undertaken to create a unique product or service. Execution duration is limited, with defined start and finish dates.

**Resource Balancing Tool- RBT** - A tool used to optimize plant resources by comparing estimated and actual resource supply against estimated on-line and outage resource demands over time.

**Scope List** - Work activities that may be scheduled to be performed during a target week.

**Window** - A block of consecutive weeks selected for the installation phase of certain project tasks.

**Work Order- WO** - A work document which specifies the affected equipment and contains work instructions used to authorize, perform, control and document activities. Activities can include corrective, preventative or modifications work.

### 3.2 Abbreviations and Acronyms

<b>AAA</b>	Action Alert Awareness
<b>BMU</b>	Hold for BOM Update
<b>BOM</b>	Bill of Materials
<b>Cat Id</b>	Catalogue Identification
<b>CFAM</b>	Corporate Functional Area Manager
<b>CM</b>	Corrective Maintenance
<b>DM</b>	Deficient Maintenance
<b>DND</b>	Darlington Nuclear Division
<b>DOM</b>	Director of Operations and Maintenance
<b>EPC</b>	Engineering, Procurement, Construction
<b>EPG</b>	Emergency Power Generator
<b>EWMS</b>	Engineering Work Management System
<b>FEG</b>	Functional Equipment Group
<b>FIN</b>	Fix-It-Now

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<b>FLM</b>	First Line Manager
<b>FLMA</b>	First Line Manager Assistant
<b>IESO</b>	Independent Electricity System Operator
<b>IMS</b>	Inspection and Maintenance Services (Division)
<b>HVAC</b>	Heating Ventilation, Air Conditioning
<b>ITP</b>	Inspection and Test plan hold
<b>MC</b>	Control Maintenance
<b>MCC</b>	Motor Control Centre
<b>MDA/MDU</b>	Hold for Master Equipment List updates, PND, DND
<b>MEL</b>	Master Equipment List
<b>MM</b>	Mechanical Maintenance
<b>MPA</b>	Hold for pressure boundary nuclear item release, PND1-4
<b>MPB</b>	Hold for pressure boundary nuclear item release, PND 5-8
<b>MPD</b>	Hold for pressure boundary nuclear item release, DND
<b>MR</b>	Material Request
<b>MS</b>	Civil Maintenance
<b>NIMS</b>	Nuclear Inage Management system
<b>OM</b>	Other Maintenance
<b>OM&amp;A</b>	Operation, Maintenance and Administration
<b>OPM</b>	Online Process Metrics
<b>OP&amp;P</b>	Operating Policies and Procedures
<b>OTP</b>	Operator Test Procedure
<b>OTR</b>	Operability Test Required
<b>OWA</b>	Operator Work Around
<b>PC1-N</b>	Application for Work Protection
<b>PE</b>	Procurement Engineering
<b>PEG</b>	Primary Equipment Group
<b>PH</b>	Part Hold
<b>PGO</b>	Part Gone Obsolete hold
<b>PM</b>	Preventive Maintenance
<b>PMID-RQ</b>	Equipment or Predefined identification Requirement
<b>PMLP</b>	Preventive Maintenance Living Program
<b>PND</b>	Pickering Nuclear Division
<b>PO</b>	Purchase Order
<b>PRL</b>	Plant Reliability List
<b>RBT</b>	Resource Balancing Tool
<b>ROMS</b>	Resource (MW) Outage Management System
<b>SCR</b>	Station Condition Record
<b>SFAM</b>	Site Functional Area Manager
<b>SH</b>	System Health
<b>SPOC</b>	Single Point of Contact
<b>TCD</b>	Target Completion Date
<b>TRF</b>	Tritium Removal Facility
<b>SFAM</b>	Site Functional Area Manager
<b>SG</b>	Standby Generator
<b>SRST</b>	Safety Related System tests.
<b>SST</b>	Safety System Test
<b>TOE</b>	Technical Operability Evaluation
<b>VOLT</b>	Vendor Order Lead Time
<b>WC</b>	Work Control

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**WO** Work Order  
**WWL/WCTL** Work Week Leader/Work Control Team Leader

### 4.0 RECORDS AND REFERENCES

#### 4.1 Records

- 4.1.1 Any controlled documents which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0003, Controlled Document Management.
- 4.1.2 Any records which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0042, Records and Document Management.
- 4.1.3 The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (PASSPORT Type/Sub-Type)
Original "signed" copy.	N-FORM-10312	N	In Facility Work Control Department. Maintain a minimum of 12 months retention.
Minutes of some "T" Meetings.	N/A	N	On the Work Control website; at the discretion of the Work Control Manager. One year retention.
Scope List	N/A	N	In the scoping/scheduling tool database or website; at the discretion of the Work Control Manager. One year retention

#### 4.2 References

##### 4.2.1 Performance References

N-FORM-10185, PC1-N Application for Work Protection  
N-FORM-10312, On-line Scope Addition Request  
N-INS-08400-10000, Fix-It-Now Process  
N-PROC-MA-0002, Work Planning  
N-PROC-MA-0006, Work Performance  
N-PROC-MA-0020, Predefined Process  
N-PROC-MA-0026, Preventive Maintenance Technical Specifications  
N-PROC-RA-0022, Processing Station Condition Records

##### 4.2.2 Developmental References

CSA-N286-05, Management System Requirements for Nuclear Power Plants  
INPO AP-928, Work Management Process Description  
N-INS-06931-10001, On-line cycle planning process



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N-POL-0001, Nuclear Safety Policy of The OPG Board Of Directors  
 N-PROC-AS-0042, Quality Assurance Records  
 N-PROC-MA-0012, Work Protection  
 N-PROG-AS-0005, Business Planning  
 N-PROG-MA-0019, Production Work Management  
 N-STD-AS-0028, Project Management  
 OPG-MAN-08133-0001 Sheet 01-03-01, Records Retention

## 5.0 REVISION SUMMARY

**This is an Intent revision. Revision bars have not been used.**

- Added section 1.6.1 on EPC projects
- Updated section 1.7 and appendices A & B to reflect the rules for EPC projects
- Updated abbreviations and acronyms 3.2
- Corrected minor errors or “typos” throughout document
- Clarified wording in sections 1.7.12 and 1.7.13
- Added N-PROC-MA-0020, Predefined Process in section 4.2.1 per DCR 124149

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### Appendix A: Meeting and Team Purpose and Criteria

#### A.1.0 PM REVIEW MEETING

A.1.1 The PM Review meeting is held by the end of T-24, sponsored by the Maintenance manager or delegate. This meeting provides a platform for PM screening and review prior to scheduling the PM within its pre-determined work week. Representation from the following groups is required:

- Maintenance
- Engineering
- Operations
- Work Control.

A.1.2 The PM review includes the following elements:

- a) Update PM scope or technical basis to reflect new or revised requirements.
- b) Revise PM scope and/or frequency based on component performance.
- c) Appropriately credit PMs for past work completed via other work orders
- d) Early identification of planning or materials issues.
- e) Early identification of pending holds associated with procedures.
- f) Recommendations on coordination of PM tasks with other scheduled work may be made.

#### A.2.0 SCOPE COMMITMENT MEETING

A.2.1 The Scope Commitment or Scoping meeting is held in week T-19, sponsored by the Work Control Manager or delegate. The purpose of the meeting is to ensure the proper work orders (WOs) are scoped to meet station needs and to obtain agreement on Preliminary scope. Representation from the following organizations is required:

- Engineering
- Operations
- Projects and Modifications
- Work Control
- Maintenance
- Any other organization with input to the Scope e.g. EPC project leader or "job owner"

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- A.2.2 Work is brought into scope based on input from key groups such as Engineering and Operations considering the following:
- PEG cycles
  - System health (SH) and Major Projects
  - Plant safety and reliability needs
  - *Cycle Plan*.
- A.2.3 Work Control should send out the proposed scope for the target work week one week prior to meeting, including priority scores of WOs.
- A.2.4 Representatives of EPC Projects should provide the following information:
- an outline of the project including identification of all project tasks which involve station interface (resources and/or equipment)
  - Intelligence that any parts procured independently will be available and staged for targeted execution i.e. part is ordered (PO #) with a suitable delivery date.
- A.2.5 Prior to meeting, participants should review the scope list priority weighting score and be prepared to raise any exceptions to priority of weighting at the T-19 meeting.
- A.2.6 Expected Meeting Outcome
- Ensure scoped WOs redundant equipment will be available (i.e. identify operability, testing, permits issues, etc).
  - Ensure work week execution resources are balanced at approximately 110% as outcome of the T-19 meeting.
  - Identify any known holds that cannot be resolved by subsequent milestone.
  - Identify any known holds that need resolution expedited.
- A.2.7 Multi-departmental representation ensures that vulnerabilities and priorities are evaluated broadly and that necessary work is scoped.
- A.2.8 A revised Preliminary *Scope List* is agreed to at the conclusion of the meeting and submitted for review.
- A.3.0 SCOPE RATIONALIZATION MEETING**
- A.3.1 The Scope Rationalization meeting is held in week T-16 by the Work Control Manager or delegate and sponsored by the Engineering manager. The purpose of the meeting is to

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discuss additional input needed (holds), rationalize the scope against available resources, known plant or unit configurations and ensure alignment with the PEGs.

A.3.2 Representation from the following organizations is required:

- Engineering
- Operations
- Outage
- Projects and Modifications
- Supply Chain

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- EPC project leader or “job owner” with work in scope **Appendix A (Continued)**

- Work Control
- Maintenance
- Any **other organization** required to support the work in scope.

#### A.4.0 SCOPE FREEZE MEETING

**A.4.1** The Scope Freeze Meeting held by the end of T-8 by the Work Control Manager or delegate and is overseen by the Operations manager. Representation from the following organizations is required:

- Engineering
- Fuel Handling
- Maintenance
- Operations (Oversight organization)
- Outage
- Projects and Modifications
- EPC project leader or “job owner”
- Supply Chain
- Work Control
- Any other organization who may have requested work.

**A.4.2** The purpose of the review is to reach concurrence on the scope of work in the work week taking into account the following factors:

- Plant safety
- Worker safety
- Schedule logic
- Minimizing commercial risk
- Minimizing out-of-service time
- Optimizing plant resources.
- Ensuring any operability tests required for Equipment or Predefined identification Requirement (PMID-RQs) with the OTR flag are scheduled appropriately

**A.4.3** All support requirements and overall coordination of work activities are reviewed and discussed at the meeting.

**A.4.4** Review participants are expected to be familiar with specific job aspects and discuss job sequencing and required resources.

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- A.4.5 Meeting participants should review resource comparison reports. Representatives of resource owners are expected to address and obtain resolution on any gaps in the resources available compared to the work load assessed.

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A.4.6 A review of all gaps is performed and a final *Scope List* is agreed to and issued.

## A.5.0 SCHEDULE FREEZE MEETING

A.5.1 The Schedule Freeze meeting is held by the end of week T-2 by the Work Control Manager or delegate and is overseen by the Maintenance manager. The schedule freeze meeting is held, following completion of the FLM walk downs, and resolution of the issues identified during the walkdown. Representation from the following organizations is required:

- Maintenance (Oversight organization)
- Operations
- Fuel Handling
- Projects and Modifications
- EPC project leader or "job owner"
- Supply Chain
- Work Control
- Any other organization with work on the schedule.

A.5.2 The purpose of the meeting is to finalize any changes that need to be made to the schedule as a result of the walk down.

A.5.3 Participation at this meeting is crucial since after T-2 all execution work groups and resource owners are committed to executing the work on the frozen schedule. After T-2 Maintenance is accountable for execution of the schedule.

## A.6.0 DAILY STATUS MEETINGS.

A.6.1 The purpose of the meeting is to report progress on execution of tasks on the frozen schedule, to report issues which require expediting and to ensure coordination between work groups.

A.6.2 Participation from the following is required:

- Work control manager or delegate (WWL/WCTL- execution)
- Maintenance coordinators (Mechanical, Control, Civil)
- Operations
- Outage if required.

A.6.3 Review of progress on schedule grade C task execution should be done to ensure completion by end of week.

A.6.4 Recommendations for work carry-over should be made by execution work groups. A decision on work to be carried over should be made (rejected or accepted) by WWL/WCTL.

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#### A.7.0 T+1 CRITIQUE MEETING

A.7.1 The T+1 meeting is held following completion of the work week and is sponsored by the Work Control Manager. Senior management representation from the following organizations is required:

- Maintenance
- Operations
- Projects and Modifications
- Supply Chain
- Work Control
- Any other organization that impacted the schedule.

A.7.2 The purpose of the meeting is to identify process deficiencies, enhancements, transaction cause codes and good work practices.

A.7.3 Individuals of the work groups are encouraged to attend to feedback comments so that corrective actions are implemented the next time the work is planned and scheduled.

A.7.4 Unexecuted tasks and missed milestones are reviewed.

#### A.8.0 HOLDS RESOLUTION TEAM

A.8.1 A Hold Resolution Team should be convened to support hold resolution and scope rationalization.

A.8.2 The Supply chain Manager shall lead the Holds Resolution Team lead. Participation to the team and quorum requirements will be determined in accordance to team charter and site directives.

A.8.3 The purpose of the team is to ensure resolution of identified holds in a timely manner to support future milestones of the *On-line work scheduling process*. Regular meetings of the team will provide a forum to actively seek other groups' cooperation, improve working relationships and meet performance objectives.

A.8.4 The goal of the team is to reschedule – only once - work which cannot meet the *On-line Scheduling Process* milestones. This requires a firm commitment for resource issues from the various stakeholders and re-scheduling of the work into a work week where this commitment is sustained.



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## Integrated On-Line Work Schedule

### Appendix B: On line Milestone Activities

By the end of Week	MILESTONES	DEPARTMENTS A = accountable I = input C = concur R = review							
		ENGINEERING	MAINTENANCE	SUPPLY CHAIN	OPERATIONS	OUTAGE	PROJECTS & MODIFICATIONS	WORK CONTROL	ALL
Q-5 to T-53	(a) Call for cycle plan scope [once a quarter WC requests various departments to identify cycle plan type work (non-PM)]							A	
	(b) Provide input to <i>cycle plan</i> scope	A			A	A	A		
	(c) All EPC <i>project</i> work is identified						A		
SCOPING AND PLANNING	T-52	(a) Ensure all cycle plan type work is in scope (major equipment work, major <i>Project</i> *work and/or long lead items)						A	
		(b) Identify estimates of resources available (incl. for <i>project</i> & minor mods work)	A	A		A	A		
		(c) Scope all currently unscheduled CC, CN, DC, DN WOs to proper PEG with 52 weeks lead time; add 52w attribute						A	
		(d) Enter the online/outage split in the RBT						A	
	T-48	(a) Complete planning (assessing) for 52w WOs in approved scope: all tasks are set to ready or contain a valid hold code; MRs are approved; BMU holds are cleared		A			I Field eng		
		(b) For 52w PM type WOs also address any outstanding (PMLP) feedback **		A					
	INDICATOR - % of planning complete for 52 w WOs & tasks								
	T-47	Initiate purchase requests for <i>Cycle Plan</i> WOs (52w WO attribute)			A				
	INDICATOR – Purchase request outstanding metric – cycle plan.								
	T-42	(a) Resolve all Engineering holds for 52w tasks	A						
		(b) Ensure all parts holds have purchase orders			A				
	INDICATOR – Hold code outstanding metric – cycle plan.								
	T-40	(a) All 52w WO tasks set to ready except tasks with PH and MPB/MPD/ITP		A					
		(b) All PH on 52w tasks have a committed T-21 delivery date			A				
		<b>Note:</b> <i>Cycle plan</i> scope freeze in effect: no 52w work orders rescheduled beyond this point without approval from work control manager							
	T-26	(a) Prepare detailed design packages for <i>minor mods</i> work.	A						
		(b) Identify long lead items and resources needed for minor mods work*	A						
	T-24	Conduct PM review meeting	R	A		R			
	T-21	(a) All holds removed on 52w WOs (except MPB/MPD, ITP) or WOs re-scheduled		A				A	
		(b) Organizations provide committed preliminary resource profile including non-station resources to be used for minor mods work		A		A	A		
		(c) All EPC <i>project</i> outlines are submitted including critical path and resource profile					A		

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INDICATOR – Online readiness metric – cycle plan.									
By the end of Week	MILESTONES	DEPARTMENTS A = accountable I = input C = concur R = review							
		ENGINEERING	MAINTENANCE	SUPPLY CHAIN	OPERATIONS	OUTAGE	PROJECTS & MODIFICATIONS	WORK CONTROL	ALL
T-20	(a) Provide preliminary scope with priority weighting scores (1 week prior to T-19 meeting)	I			I	I		A	
	(b) Resource balance scope within 20% (maximum 120% of disciplines MC, MM, MS)							A	
	(c) Review preliminary scope list in preparation for T-19 meeting								R
T-19	(a) Draft work plans for minor mods and EPC available.	A					A		
	(b) Hold T-19 scope commitment meeting							A	I
	(c) Provide Supply intelligence recommendations on items in scope			A					
	(d) For holds already in scope, identify Eng & PE holds which cannot be cleared by T-13 & T-12 respectively and provide a committed date for others	A							
	(e) Provide updated list post-meeting							A	
T-16	(a) Review EPC <i>project</i> and minor mods work plans, resolve concerns.		R		R		A		
	(b) Complete Mtce and field eng. planning. All tasks are set to ready or contain a valid hold code. (moved from T-13)		A				A		
	(c) Prepare PC1-Ns and submit to Operations.		A				I		
	(d) Identify any conflicts or operational issues in the scope list-				A				
	(e) Identify Eng holds & PE which cannot be cleared by T-13 & T-12 respectively	A							
	(f) Identify parts holds for non 52w tasks that cannot be resolved by end of T-5.			A					
	(g) Hold a Scope Rationalization meeting- <i>Engineering sponsored</i>	A						A	I
INDICATORS - % of planning complete (WOs and tasks), Scope Survival T-15.									
T-13	(a) Resolve Engineering non parts Holds.	A							
	(b) Complete Ops Assessing & Ops review of plan;				A				
	(c) Create all permit tasks.				A				
	(d) Identify & create all permit support tasks; Maintenance to assess		A		A				
T-12	(a) Resolve procurement engineering holds.	A							
	(b) Resolve Bill of material updates holds (BMU)		A						
	(c) Tasks not set to ready or tasks that do not contain a valid hold code or tasks with parts holds not committed to be staged by T-5 are pulled from scope.							A	R
	<b>Note:</b> Items kept at risk past milestone shall have a committed date prior to T-10 and an owner or work cut by end T-11							A	C

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## Integrated On-Line Work Schedule

By By the end of Week	MILESTONES	DEPARTMENTS A = accountable I = input C = concur R = review							
		ENGINEERING	MAINTENANCE	SUPPLY CHAIN	OPERATIONS	OUTAGE	PROJECTS & MODIFICATIONS	WORK CONTROL	ALL
T-10	(a) Refine Schedule logic.							A	
	(b) Issue "materials at risk" report [contingency parts]			A					
	(c) Finalize committed resources to support T-8 Scope Freeze.		A		A		A	R	
T-9	(a) Review Material At Risk report in preparation for T-8 scope freeze		R	R				A	
	(b) Issue a "logic driven" scope for review 1 week prior to T-8 meeting							A	R
T-8	(a) Conduct Scope Freeze meeting. (Ops accountable)	I	I	I	A		I	A	I
	(b) Begin preparation of permits.				A				
	(c) N-FORM-10312 needed for addition of new WOs beyond this point.							A	A
	(d) Resource levels are frozen beyond this point.		A					R	R
	(e) Scope Stability Measure in effect beyond this point.								A
INDICATOR – Scope Stability T-7 to T0									
T-6	(a) Issue frozen scope list for Operability Review			R	R			A	
	(b) Clear parts holds			A					
T-5	(a) Stage parts			A					
	(b) Remove WOs with unresolved parts holds from scope list							A	
T-4	(a) All permits prepared, checked and ready for review.				A				
	(b) Perform operations review.				A				
	(c) Perform preliminary reactor safety review.	A							
	(d) Remove all pressure boundary holds	A							
INDICATOR - # of WOs pulled from schedule due to unresolved parts holds									
T-3	Perform FLM walk down.		A		A		A		
INDICATOR - # of WOs pulled from schedule due to walk down findings									
T-2	(a) Disposition walk down feedback prior to Schedule Freeze meeting.	I	I	I	I	I	I		R
	(b) Conduct Schedule Freeze meeting. Review walk down feedback and finalize changes.		A					A	R
	(c) Finalize and issue Schedule.							A	
	<b>Note:</b> at this point all work groups and resource owners are committed to executing the work on the schedule								
T-1	(a) Disposition Carry-in Work	A						A	
	(b) Complete reactor safety reviews								
	(c) Complete operability reviews				A				
	(d) Post final schedule.							A	
	(e) Issue Level "D" job jar.		R					A	

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## INTEGRATED ON-LINE WORK SCHEDULE

	By the end of Week	MILESTONES	DEPARTMENTS A = accountable I = input C = concur R = review							
			ENGINEERING	MAINTENANCE	SUPPLY CHAIN	OPERATIONS	OUTAGE	PROJECTS & MODIFICATIONS	WORK CONTROL	ALL
EXECUTION	T-0	(a) Execute work		A		A		A		
		(b) Re-enter long-duration tasks into following week schedule						A	A	
		(c) Conduct daily status meetings; provide carry over info as required		A		A	A	A	A	
	INDICATOR – % of tasks completed									
	T+1	Critique meeting.							A	I

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**INTEGRATED ON-LINE WORK SCHEDULE**

### Appendix C: Examples of Cycle plan type of Work

#### Darlington

Type of Work	Specific Items or Examples
Maintenance <i>Projects</i>	Battery Replacements Pump overhaul programs Instrumented Steam Relief Valves program Heating steam header outages Water Treatment Plant Sewage Treatment Plant Chiller, Upgrade program Trash Racks Cranes (depends on impact on other station work)
Electrical Work	Battery Capacity Tests Inverter, rectifier, regulator maintenance Bus, transformer outages Tie breaker maintenance or testing
Switchyard work.	System Service Transformer (SST) Outages E1/E2 or A1/A2 bus outages Maintenance where a single failure or error would result in loss of a unit or transfer bus.
Work requiring intensive No Fuel Window coordination	F&P wiring harness replacement program
Station drills/Housekeeping days.	
SG, EPG and TRF Outages	
Unit Outages	
IPG work/programs requiring completion to support outages.	
Quiet mode related work.	
SRSTs	Requiring multi workgroups or extended operating restrictions
OTPs	OTP-72710.02 Domestic Water Annual Fire Pump Flow Test
CC, CN, DC, DN	Selected corrective or deficient work orders not already in approved scope

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### Appendix C (Continued)

#### Pickering

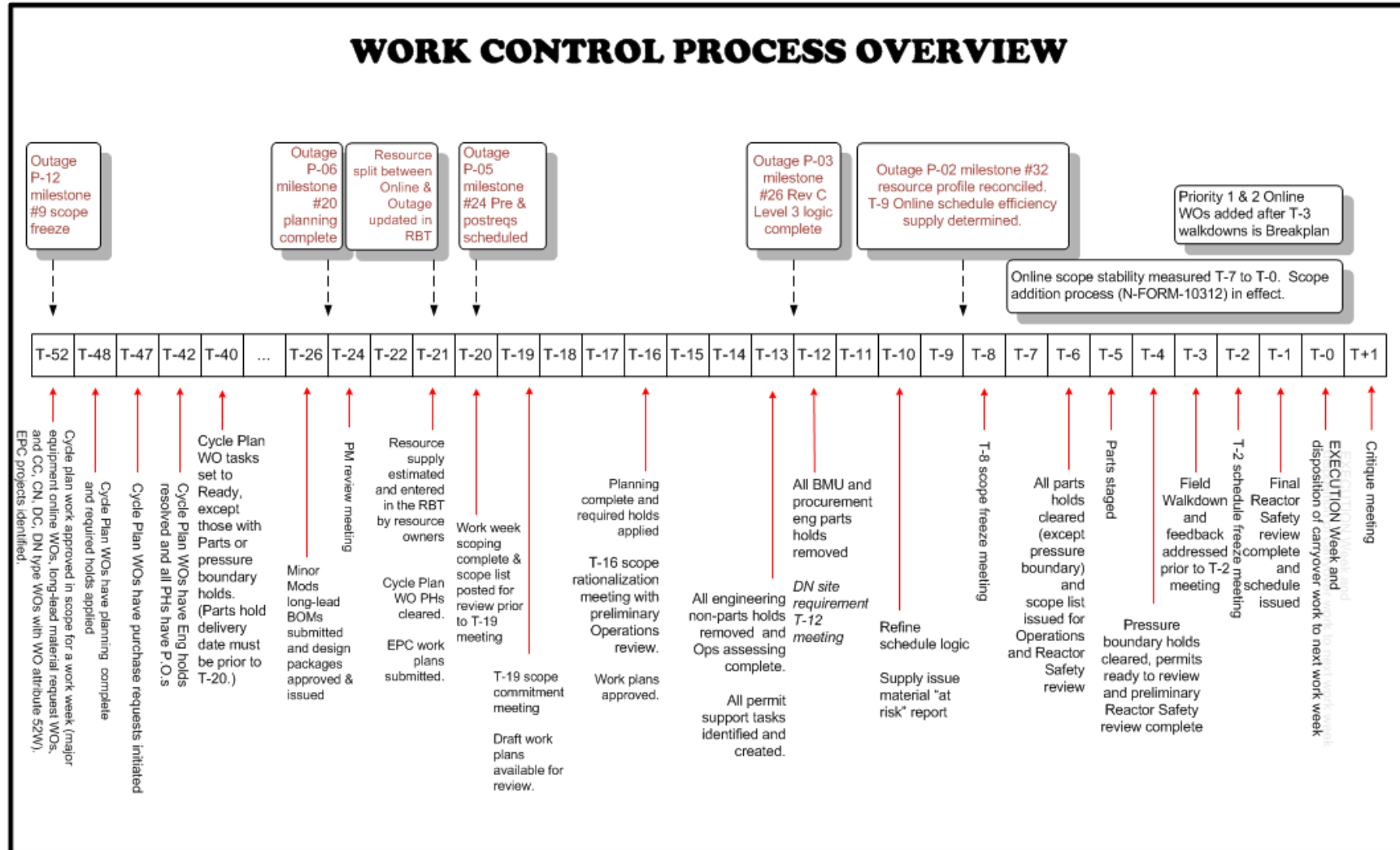
Type of Work	Specific Items or Examples
Major Equipment: Maintenance Programs/ <i>Projects</i> /Overhauls/Modifications	Rotating Equipment/Major Pump overhaul programs Valves (Motorized, Control, Relief) Heating steam header outages Reheat and heater bank outages, Water Treatment Plant Heating, Ventilation, Air Conditioning (HVAC), D2O Driers, Chillers Upgrade programs Containment (Airlocks, dampers, long duration box-ups) Screenhouse Equipment. (screen overhauls, pumps, strainers, valves) Heat Exchangers Cleaning, inspections. Condensers/Debris filters (waterbox outages, tube cleaning system, debris filter upgrades) Major Cranes and Hoists Air Compressors and Driers Heavy Water (D2O) Upgraders and Sultzter outages Ion Exchange clean up system Tank Cleaning Active Liquid Waste System work
Electrical Work	Battery Replacements MCC, Bus, transformer outages Breaker maintenance or testing that results in operating restrictions. Site Electrical System (SES)/In station transfer bus (ISTB) maintenance.
Switchyard work	SST Outages Maintenance where a single failure or error would result in loss of a unit or transfer bus.
No Fuel Windows	Major fuel handling equipment maintenance windows, (Ram replacements, Pump and equipment overhauls, fuel bay maintenance, cranes, inspections)
Station drills/Housekeeping days	
SG, EPG Outages	Major, Minor & Mini outages.,( upgrades, modifications, battery replacements)
Unit Outages	Planned Outages, major evolutions impacting on on-line units
On-line work/programs requiring completion to support outages	Outage prereq's, maintenance on airlocks, D2O driers, etc...
Quiet mode related work	Safety System upgrades/ <i>projects</i> .
SRSTs	Requiring multi workgroups or extended operating restrictions.
Seasonal Programs	Winterization, Summerization (heat trace upgrades, major HVAC, Chlorination)
CC, CN, DC, DN	Selected corrective or deficient work orders not already in approved scope

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### Appendix D: Scheduling process Milestones-



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### INTEGRATED ON-LINE WORK SCHEDULE

## Appendix E: Ontario Power Generation Cause Codes

Revision 3- Apr 2012

Issue	Code	Cause
Automated	1	PassPort status changed to Complete or Cancelled, prior to T-0
	10	PassPort status changed to CXCL/REQ (cancellation request) -- new since Nov 2011
	NEW	New PassPort WO-task created after process milestone; auto-approved via WO approval
	Other	Task status reset (3); auto-carryover (4); data cleanup (6); upload to Excel (7)
Assessing	A A	Maintenance Planning assessment incomplete or Hold added after required milestone (includes outstanding PMLP updates on other occurrence WOs)
	A B	Maintenance Assessment Package Quality, incorrect identification of requirements or tasks
	A C	Operations assessment incomplete not meeting the process milestone
	A D	Operations assessment package quality, identified permit not adequate, incorrect identification of requirements or task missing
	A E	Fuel Handling Assessment incomplete or not adequate
	A F	Field Engineering or Other support groups assessment incomplete or not adequate
Configuration	C A	Plant configuration changed from expected, eg, redundancy u/a, dose rates, weather
	C B	Planned outage extended or Forced Outage
	C C	Configuration should have been known
	C D	Fuelling Machine out of service causing changes to scope/schedule
	C E	Fuelling was NOT as per the schedule (Use CD when recovering from fuelling machine having been out of service)
Discovery	D A	Condition could not have been known, eg, passing isolation
	D B	Testing failed
Eng	E A	Inside T-16 process, new PMID-RQ or frequency change / PM optimization
	E B	Engineering did not meet commitments
	E C	Declined deferral request OR new late date management, prior to T-0 execution
Non-issue	N A	Main task assessed as being greater than 40hrs (days crews) or 168hrs (shift crews)
	N B	Permit task added prior to T-10 milestone (ADD REASON ONLY)
	N C	Logic being defined prior to T-8
	N D	First time scoped: long VLT or new Cat ID that did not have previous purchasing information
Parts	P A	Procurement Engineering BOM, MEL, PE/EVAL not resolved as per the milestone
	P B	Material not staged as per process milestone
	P C	Inventory (Buyers) did not meet process milestone (no P.O. or late delivery from vendor)
T-0 Adherence Codes	T A	Permit not applied as scheduled (Use DA if passing isolation)
	T B	Control Mtce did not meet commitments
	T C	Mechanical Mtce did not meet commitments
	T D	Operations did not meet commitments
	T E	Civil Mtce did not meet commitments
	T F	Fuel Handling did not meet commitments
	T G	Projects, QC, Eng or other support groups did not meet commitments
	T H	Work reported complete; PassPort WO-task closeout required



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## INTEGRATED ON-LINE WORK SCHEDULE

### Appendix E (Continued)

Issue	Code		Cause
Work Control	W	A	Schedule quality issue, eg, incorrect logic, wrong time of year, etc
	W	B	Resource balancing prior to T-0: new resources identified or ready work cut from scope
	W	C	Approved Scope Change Form (# to be entered in comments) -- N-FORM-10312
Management	Z	A	Management decision to divert resource to outage or unscheduled work

### Choosing the right cause code -- Ask the "3 whys"

Example:	Why?	Ops didn't apply permit
	Why?	Ops working on breakplan
	Why?	There was a Forced Outage -- <b>cause code CB</b> -- Planned outage extended or Forced Outage
Example:	Why?	Control Maintenance task was not completed as scheduled
	Why?	Mechanical Maintenance did not complete their preceding task
	Why?	Unknown -- <b>cause code TC</b> Mechanical Mtce did not meet commitments (code on Control Mtce task)
Example:	Why?	No material
	Why?	Not identified on Material Request (MR)
	Why?	<b>Cause Code AB</b> -- Mtce Planning Assessment package quality, incorrect identification of requirements or tasks

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**ISLANDING PROJECT MANAGEMENT PLAN**


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**Islanding Project Management Plan**

**NK38-PLAN-09701-10159-R05**  
2016-05-13

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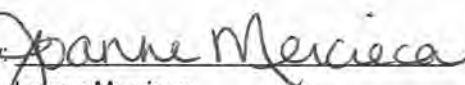
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### Revision Summary

Revision Number	Date	Comments
00	2013-04-16	Initial Issue For Gate 2 Islanding – Bulkhead and Containment Isolation
01	2013-09-17	Revision to incorporate Gate 2 Islanding (excluding Bulkhead)
02	2014-04-05	Revision to incorporate Gate 2B for Bulkhead
03	2015-05-19	Revision to incorporate Gate 3 Islanding (excluding Bulkhead)
04	2016-02-19	Revision to incorporate Islanding changes
05	2016-05-13	Revision to clarify OPG organizational chart and minor changes

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## 1.0 INTRODUCTION

Darlington Nuclear Generating Station (DN GS) requires a major refurbishment in order to extend the service life of all four production units. The refurbishment is currently planned to begin in 2016. The four units will be shut down in a partially overlapping sequence, with the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> units overlapping.

The Islanding Project has been grouped under the Retube and Feeder Replacement (RFR) project bundle. This is because the major scope of work (SOW) in Islanding (Bulkhead) is being executed by RFR JV vendor. The Islanding Project portfolio consists of a series of projects whose collective purpose is to establish a construction island and isolate the refurbishment unit, area, and systems from the operating units. The various projects in the Islanding portfolio are described below:

- Bulkhead and Containment Isolations – Establishes a new containment boundary to isolate the refurbishment reactor vault from operating containment.
- Pre-Requisite Modifications – Modifications to station systems on non-refurbishment units required to be installed in planned outages or Integrated Planning Group (IPG) in order to allow islanding of the first refurbishment unit.
- Nuclear Refurbishment Outage Execution –required to island systems from the operating units that are required to be installed during the refurbishment outage.
- Barriers/Area Islanding – Construction and personnel barriers, marked pathways and signage required to establish the construction island.
- System Islanding – Establishes the jurisdictional boundary on station systems to define the refurbishment island on a system level.

This revision of the Project Management Plan (PMP), Revision 004, addresses the entire Islanding project portfolio in greater updated detail as the project is nearing to breaker open.

OPG has awarded an Engineering, Procurement and Construction contract for the Darlington Refurbishment RFR Project (RFR EPC Agreement) to the SLN-Aecon Joint Venture.

The project is divided into four phases:

1. Definition,
2. Execution,
3. Commissioning, and
4. Closeout.

In order to gain efficiencies for the engineering and construction activities for the refurbishment unit reactor vault work, OPG has also awarded the Bulkhead and Containment Isolations project to the SLN-Aecon Joint Venture. The Bulkhead and Containment Isolations scope was added to the RFR EPC Agreement via a Project Change Directive issued in June of 2012.

Although the Bulkhead and Containment Isolations Project is an Islanding project the funding has been transferred to the RFR project for Gate 3 and beyond as it and the RFR Project is

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being executed under the same contract. Consistent with this approach portions of this document are derived from the RFR PMP NK38-PLAN-09701-10074. Any reference to the Bulkhead and Containment Isolations Project in this document applies only to Gates 1 and 2 funding unless otherwise noted. The management of the Bulkhead and Containment Isolation Project is still done by the Islanding team.

All Pre-Requisite modifications have been given to the Projects and Modifications Organization for oversight of either Engineering, Procurement, Construction (EPC) or Procurement, Construction (PC) contracts to be executed with the Extended Services Master Service Agreement (ESMSA) contract. Those modifications using the PC contracts are performing the Engineering portion in-house (OPG).

All of the NR Outage modifications will be executed by the Islanding project using in house resources. The Airlock and Vault Atmosphere (AL/VA) work in the Islanding project has been split into two groups. The Vault Vapour Recovery (VVRS) modification portion of the AL/VA work has been transferred to the Balance of Plant Project and is no longer in the Islanding project scope. The Airlock Islanding work is no longer being performed as a modification, but is still included in the Islanding NR Outage Modification sub-bundle.

The System Islanding bundle will be executed in house with support from the NR functional groups.

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## 2.0 GOVERNANCE STRUCTURE AND INTERFACES

### 2.1 Islanding Management Plans

The Islanding Project Management Plan has followed the guidance set within the OPG Governance per Figure 1. The content of this PMP is divided into nine knowledge areas as shown below:

- Section 4.0: Project Integration Management,
- Section 5.0: Project Scope Management,
- Section 6.0: Project Schedule Management,
- Section 7.0: Project Cost Management,
- Section 8.0: Project Quality Management,
- Section 9.0: Project Human Resource Management,
- Section 10.0: Project Communications Management,
- Section 11.0: Project Risk Management, and
- Section 12.0: Project Procurement Management.

Supporting Joint Venture Documents for Islanding PMP:

- RFR PMP – NK38-PLAN-09701-10074
- RFR Engineering Design Plan – NK38-DP-09701-10001
- Bulkhead and Islanding Contract Strategy- NK38-REP-09701-10100
- RFR COIR – NK38-DAI-09701-10008

Supporting ESMSA Documents for Islanding PMP:

- Extended Services Master Services Agreement
- ESMSA Request for Work – N-INS-00120-10025
- ESMSA COIR - N-COI-00120-00001 (Formerly N-DAI-00150-10000 or ESMSA Schedule 6)

Supporting OPG Management Plans for Islanding PMP:

- All sheets associated with N-MAN-00120-10001
- All sheets associated with NK38-NR-PLAN-09701-10001



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## 2.2 EPC Management Plans

A crucial input to the management and execution of the Islanding Project will be the schedule, scope, cost, risk and planning integration with the EPC Contractors. Each EPC contractor will follow their respective process for management including the preparation and issue of management plans as specified in the Contract Terms and Conditions.

The EPC management plans for the Bulkhead and Containment Isolations Project are shared with the RFR project and have been developed by the Joint Venture. The plans are listed in Table 1.

Table 1: Joint Venture EPC Management Plans		
Plan	Document Number	Status
Quality Assurance Plan	509407-0000-00000-38QP-0001	Issued
Project Estimating Plan	509407-0000-00000-33IM-0001	Issued
Project Management Plan	509407-0000-00000-30IM-0006	Issued
Schedule Management Plan	509407-0000-00000-32IM-0001	Issued
Engineering Plan	509407-0000-00000-40EP-0001	Issued
Cost Management Plan	509407-0000-00000-34IM-0001	Issued
Communication Plan	509407-0000-00000-30IM-0009	Issued
Resource Management Plan	509407-0000-00000-30IM-0002	Issued
Scope Management Plan	509407-0000-00000-30IM-0003	Issued
Risk Management Plan	509407-0000-00000-30IM-0005	Issued
Deliverables Plan	509407-0000-00000-30IM-0004	Issued
Project Controls Plan	509407-0000-00000-30IM-0001	Issued
Materials/Procurement Management Plan	509407-0000-00000-50IM-0001	Issued
Waste Management Plan	509407-0000-00000-40IM-0001	Issued
Infrastructure & Layout Plan	509407-0000-00000-60IM-0001	Issued
Space Allocation/Requirements Plan	509407-0000-00000-67IM-0001	Issued
Site Interface Coordination Plan (working with other Contractors)	509407-0000-00000-60IM-0002	Issued
FME Plan	509407-0000-00000-40IM-0002	Issued
Safety Management Plan	509407-0000-00000-68HP-0008	Issued

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Mock Up Training Plan	509407-0000-00000-73IM-0001	Issued
Trades Onboarding & Training Plan	509407-0000-00000-60IM-0003	Issued
Contingency Plans	509407-0000-00000-30IM-0007	Scheduled
Fire Safety Plan	509407-0000-00000-68HP-0003	Issued
Travel and Per Diem Policy FINAL	509407-0000-00000-30AG-0001	Issued
Project Admin Plan RPB	509407-0000-00000-30IM-0008	Issued
Confidential Information Procedure	509407-0000-00000-30WI-0001	Issued
Field Change Notice Instruction	509407-0000-00000-40WI-0002	Issued

Barriers/Area Islanding and Pre-Requisite bundles are to be contracted under the ESMSA. As stated in the ESMSA contract, project specific Subcontractor Management plans may be developed by the ESMSA as required. If project specific management plans are not required, then the overall ESMSA Management Plans will apply. Examples of these are:

Table 2	
Plan	Doc Number
Subcontractor Management Plan	FGP-MSA-001
Work Plan-Preparation and Development	FGP-MSA-002
Field Engineering Change Control	FGP-MSA-003
MSA Site Document Control	FGP-MSA-005
Risk Management Plan	FGP-MSA-006
Completion Assurance	FGP-MSA-007
Work Assessing	FGP-MSA-018
Processing External and Internal Operating Experience (OPEX)	SP-060

For Pre-Requisite projects, the Projects and Modifications organization will manage the interface with the ESMSA Management Plans.

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### 3.0 SAFETY

#### 3.1 Safety Management

Safety is a core value at OPG for Nuclear Refurbishment and is reflected in all safety management plans produced by OPG and contractors. The Islanding Project will adhere to all applicable obligations as defined in the Occupational Health and Safety Act (OHSA), the OPG expectations (N-POL-0001, OPG-POL-0001, and N-GUID-09701-10011), as well as the requirements set out in the EPC contracts terms and conditions. In line with the RFR Project, the Bulkhead/Containment Isolation Project safety oversight will comply with the following:

- RFR EPC Agreement – Site Specific Safety Plan (Execution),
- RFR EPC Agreement – Exhibit 2.6 Safety, and
- RFR EPC Agreement – Exhibit 2.13(a) Oral Review Board Process

In line with the Projects and Modifications Organization and other projects using the ES MSA, the Barriers/Area Islanding and Pre-Requisites will perform oversight to ensure compliance with the relevant sections of the ES MSA contract.

#### 3.2 Construction Management

The Islanding Project will adhere to all applicable obligations as defined in the Occupational Health and Safety Act (OHSA), the OPG expectations, and the terms and conditions for each EPC Contract under which Islanding work will be executed. OPG will have multiple construction roles throughout the various EPC contracts to be awarded under the Islanding project portfolio (see table 2).

Table 2: OPG Nuclear Refurbishment and Contractor OSHA Roles			
NR Construction Phase	Timeline	OPG Islanding NR Role (OHSA)	Contractor Role (OHSA)
1. Pre-refurbishment work including modifications (including unit barriers)	2013-2025 planned outages/IPG	Sponsor Only (P&M lead projects i.e. NPC, D2O, EQ of CB4)  Owner, Constructor and Employer (Islanding lead projects i.e Barriers, Containment Isolations.)	Employer
2. DNGS Protected Area Site Execution	Oct 2016 – Oct 2025	Owner, Constructor and Employer	Employer
3. Pre-refurbishment mock-up training	2014-2016	Owner, Constructor and employer	Employer

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### 3.2.1 Construction Roles under OHSA

OPG will be the Constructor for all installation activities in the Islanding Bundle. The Islanding Project will require construction activities to be undertaken prior to each unit refurbishment and during the unit refurbishment outage window. Pre-refurbishment work will include installation of modifications in planned outages and on-line leading up to breaker open. The pre-refurbishment work will also include installation of barriers which will allow the construction zone to be delineated. These barriers will need to be installed prior to Breaker Open of each unit refurbishment. They will not require planned outages to proceed.

For ESMSA executed pre-requisite work being managed by Projects and Mods (P&M), P&M Contract Management Office (CMO) will support field activities. The Refurb CMO will be used to fulfill oversight requirements per N-GUID-09701-10120.

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## **4.0 PROJECT INTEGRATION MANAGEMENT**

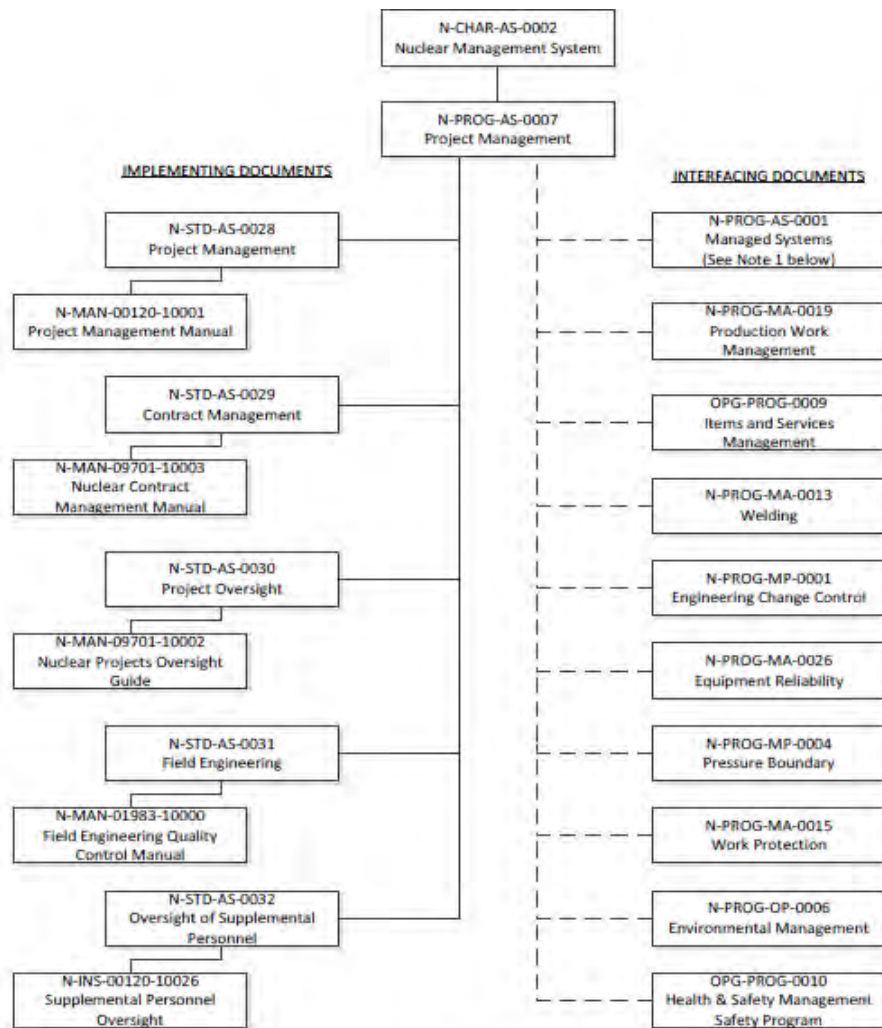
### **4.1 Integrated Governance**

The integration of OPG and EPC vendor processes will enable coordination of activities between OPG and EPC organizations. The Islanding Project will be managed in accordance with the governance illustrated in Figure 1. Each of the standards referenced in Figure 1 will be applied in providing contractor oversight to ensure contractors are working within OPG governance (where appropriate per the EPC model in Nuclear Refurbishment), within the requirements set out in the contract as well as within their Quality Assurance (QA) program.

The respective Contract Owner Interface Requirement (COIR) documents how the integration is achieved at the working level. A COIR document will be issued for each EPC Contract in the Islanding Project. The Bulkhead and Containment Isolations Project is governed by the RFR COIR NK38-DAI-09701-10008. The Pre-Req and Barriers/Islanding Projects will be governed by the ESMSA COIR (N-COI-00120-00001) as stated in the ESMSA Contract between OPG and ESMSA.

OPG will also review the EPC management plans (in Table 1) to ensure they integrate with OPG governance and expectations.

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**Note 1:**  
N-PROG-AS-0001 has been written to specifically address all of the generic requirements of CSA N286-05, Management system requirements for nuclear power plants and CSA N286-12, Management system requirements for nuclear facilities. As such it includes all of the following programs:

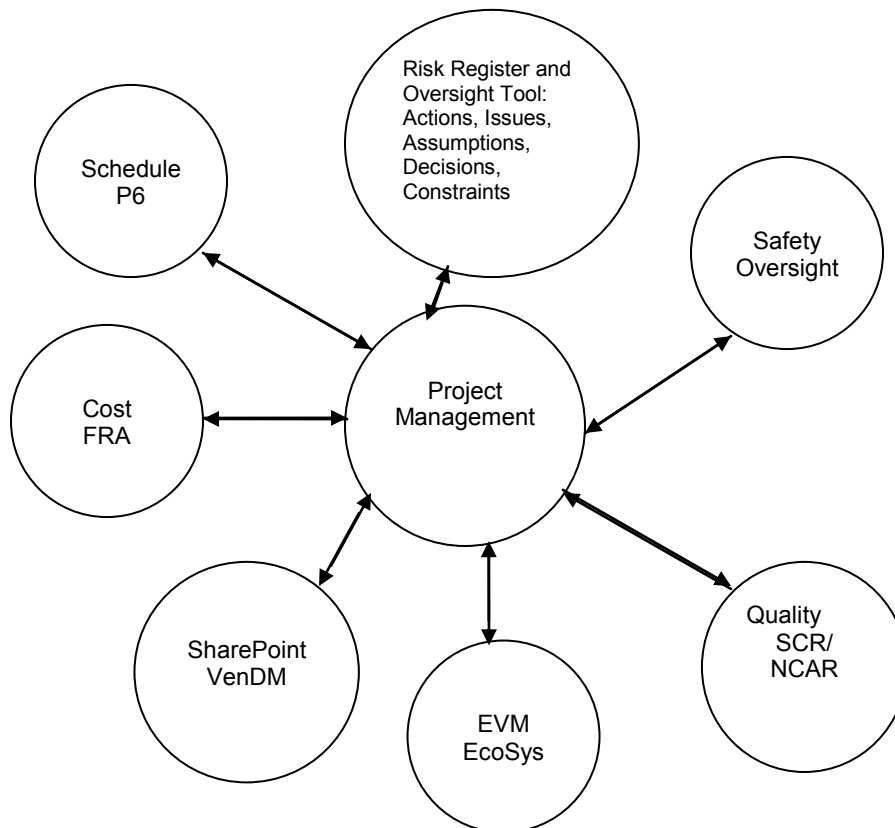
N-PROG-AS-0005	Business Planning
N-STD-AS-0020,	Nuclear Management system Organization
OPG-PROG-0001	Information management
N-PROG-AS-0002	Human Performance
N-PROG-TR-0005	Training
N-PROC-AS-0068	Organizational Change Control
N-STD-AS-0024	Change Management
N-PROG-MP-0006	Software
N-PROG-RA-0010	Independent Assessment
N-PROG-RA-0003	Corrective Action

**Figure 1: OPG Management System (N-PROG-AS-0007)**

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## 4.2 Project Management Toolset

The OPG project management toolset is illustrated below. The toolset will be used to manage OPG internal project activities, facilitate coordination with the EPC vendor activities and document and manage findings resulting from vendor oversight.



**Figure 2: Project Management Toolset**

## 4.3 Project Oversight

Project oversight of Islanding Projects will be executed per the items identified in the Islanding RMO Tool Oversight Logs according to the process outlined in N-MAN-09701-10002 Nuclear Refurbishment Project Oversight. Barriers/Area Islanding and Bulkhead and Containment Isolation Projects are currently addressed by this process. For Pre-Req modifications being managed by the Projects and Modifications Organization (P&M) all oversight of the EPC vendors or OPG resources will be done by P&M staff. Islanding Staff will monitor and support P&M staff as project sponsors. In addition, for the Bulkhead and Containment Isolations Project portions of the oversight will be provided by the RFR Oversight Plan. NR Islanding Outage mods and System Islanding work are being performed in house, with any required project management provided by Islanding staff.

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Formal observations from strategic oversight will be documented in updates to the risk register if appropriate and comments detailed in the Oversight Log for EPC contracts. Discovery of any significant observations will result in additional activities to be undertaken to mitigate impacts and reduce the probability of reoccurrence.

#### 4.4 Contract Management

The Islanding Project will be providing oversight on each EPC Contract in compliance with Contract Management Standard N-STD-AS-0029, to ensure that the terms and conditions of each contract are being followed.

The Islanding Contracting strategy is documented in NK38-REP-09701-10100.

As required, a specific contract management plan for the Islanding Project will be developed as the EPC contracts are awarded.

The Bulkhead and Containment Isolation Project contract management is in accordance with the RFR Contract Management Plan NK38-PLAN-09701-10150.

Contract Management for the definition phase of the RFR Project which includes execution planning and material procurement will involve the management and oversight of the following key items:

- Contractor adherence to the EPC Agreements terms and conditions
- Risk-based audits, e.g. Contractor adherence to their plans and schedule
- Development and completion of Notices / Project Change Directives
- Development and completion of Contract Amendments
- Reconciliation of Contractor invoicing against EPC Agreements, e.g. allowed / disallowed costs
- Management of Interfaces between OPG and all Contractors in RFR Project
- Staff Qualifications

The Pre-Req modifications bundle will document their contract management plans in their Project Management Plans. All Pre-Req modifications initially had NR Design Engineering providing design oversight for EPC modifications. The Negative Pressure Containment Project (TS780-2/TS780-3/TS780-8) EPC contract was terminated mid-engineering and completion of the engineering has been performed by OPG. The Procurement/Construction portion will use the SMSA process and OPG will provide Engineering Support.

The Barriers/Area Islanding contracts will be managed according to Contract Management Standard N-STD-AS-0029, the Darlington Refurbishment Contract Management Plan NK38-NR-PLAN-09701-10001Sht:0013, and the Nuclear Contract Management Manual N-MAN-09701-10003 for those portions of work that apply. A new Procurement/Construction contract will be issued for the Barriers Project.

The Islanding work that is being performed in house may have contracts established for augmented staff support or Owner Support Services tasks as required.



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## 4.5 Engineering Design Management

Engineering Design Management in Darlington Refurbishment follows the modification process outlined in N-PROC-MP-0090. All modifications had Modification Design Requirements (MDR) and SOW prepared in advance of launching EPC Contracts. Modifications completed in house by OPG did not have SOWs prepared.

The Engineering Design Management for the Bulkhead and Containment Isolations Project is described in the RFR Master Design Plan NK38-DP-09701-10001. The RFR contractor will also issue a design plan for each modification that is being completed. Two scopes of work (a subset of the Containment isolation project - TS810-4) will be completed in house using OPG/OSS resources. The first scope will be a documentation only modification (Containment Systems Isolations), and the second (Access Control) will be executed by updating a procedure.

All Pre-Req modifications were initially managed by Projects and Modifications with NR Design Engineering providing design oversight for EPC modifications or performing the design for those modifications being done in house. The Negative Pressure Containment Project (TS780-2/TS780-3/TS780-8) EPC contract was terminated mid-engineering and completion of the engineering performed by OPG. The Procurement/Construction portion will use the ESMSA process using OPG for Engineering Support.

Each EPC contractor working with the Islanding Project will also issue design plans for each modification. The Design Plan for the Barriers Project is NK38-DP-20100-10002, and the Engineering Design Management for Barriers/Area Islanding will be done by OPG resources. The revisions to the original design are being completed by OPG. Procure and Construct (PC) will use OPG for Engineering Support. .

The Construction Island Barriers scope of work (TS0790-1) was originally a temporary modification that was executed by an EPC contract. Due to high construction estimates, revisions were completed with OPG Design. P&C Contract will be awarded to complete the scope of work using OPG Design for Engineering Support. See DRAS 746 and 747 for details.

The Containment Button Up Logic Modification (TS780-1) was originally considered for EPC, however it was determined that the appropriate strategy was to complete the Engineering and Construction using OPG/OSS resources. This was due to there being no procurement required and the specialized construction could only be completed using OPG control maintenance. This decision is documented in DRAS 473 "OPG/OSS to complete TS780-1 Button-Up Modification". The Design Plan for this modification is NK38-DP-63426-10005. This work is grouped under the Nuclear Refurbishment Outage Bundle.

The Booster Pump scope of work (TS800-7) was originally a modification. Engineering analysis during the Preliminary Engineering determined that the scope of work under TS800-7 did not require a modification. This work will be executed via a procedure using the process referenced in N-PROC-AS-0028 "Development, Review and Approval of Technical Procedures". This decision has been documented in DRAS 634 "Non-Modification Solution for TS800-7 Unit Islanding Modifications for Common Systems: Modification to LPSW". This work is grouped under the Nuclear Refurbishment Outage Bundle.

The Airlock/Door Restraint scope of work (TS780-13/TS890-6) was originally a modification to be handled using EPC. It was determined that the modification process did not need to be followed based on N-PROC-MP-0090 exemptions and the EPC contract model was not

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required due to the small scope of work. This is documented in DRAS 493 “OPG/OSS to complete TS780-13/TS890-6 Airlocks and Door Restraints as a Non-Modification”. This work will be executed by creating a new procedure using the process outlined in N-PROC-AS-0028 and is grouped under the Nuclear Refurbishment Outage Bundle.

The Spill Skid scope of work (TS780-5) was originally a modification to be executed by an EPC contract, but after the completion of an engineering study it was determined that the spill skid can be procured and staged without doing a modification and the work performed by in house resources. Updated procedures will also be required. See DRAS 336 for details. This work is grouped under the Nuclear Refurbishment Outage Bundle.

The Emergency Coolant Injection (ECI) scope of work (TS780-10) was originally going to be executed as a modification under an EPC contract, but after engineering assessment it was determined that a soft solution was the preferable alternative and that ECI could be islanded by modifying existing operating and maintenance procedures. See DRAS 239 for details. This work is grouped under the Nuclear Refurbishment Outage Bundle.

The System Islanding scope of work is to establish the jurisdictional boundary between the NR unit and the operating station. Any areas or gaps in the systems that precluded the ability of the refurbishment unit to separate from the station have been identified as individual DSRs. The balance of the System Islanding work involves procedure updates for impacts of having a unit in a refurbishment outage, and identifying the operating boundary points between the NR operations organisation and the DNGS station operations organisation.

#### 4.6 Project Gate Progression Plan

The OPG gated process, described in N-MAN-00120-10001-GRB, is a critical project funding release process and requires integration with the EPC contractor's processes as various contractor inputs will be required for each gate. The gate progression strategy for the Islanding Project must take into account the needs and timing associated with the EPC contracts. Additionally, it is important to forecast the required funding as accurately as possible.

Each Gate package will include financial forecasts to the next planned gate. Overall project estimates will be refined further at each gate review. The approved progression plan at Gate 1 can be found in the NR Islanding Project Gate Progression Strategy Plan included in the GRB packages. A timeline of Gate 1 to Gate 4 is available in Appendix A.

Part of the Islanding Gating strategy is to group sub-bundles/project together into one gating package. This is to reduce the number of times the project needs to go through the Gate Review Board (GRB). As a result, when the Islanding bundle progresses to a Gate, the different projects will be at different stages in the project life cycle (e.g. some packages may be at Gate 2 or Gate 3 while progressing through Gate 2). Additionally, the sub-bundles being executed by the P&M organisation will follow an independent timeline which will not align with Islanding bundle gates. To streamline the gate release process, Islanding will request the funding from the GRB, and authorize P&M to spend the funds when they provide the appropriate funding approval request (e.g. a Project Authorization Package). Once authorized, Change Control Forms will be used to align P&M and Islanding cost and schedule.

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## 5.0 PROJECT SCOPE MANAGEMENT

The OPG Refurbishment project's governance structure for scope management is described in NK38-INS-09701-10001 "Darlington Nuclear Refurbishment Program – Scope Control". Islanding Project scope management will be executed in accordance with the overall Refurbishment Program scope management plan.

### 5.1 OPG Scope Management

#### 5.1.1 Scope Definition

This PMP will be updated as required to ensure it accurately reflects the work and proposed process for managing the work released. Through the NR scope control process, NK38-INS-09701-10001 "Darlington Nuclear Refurbishment Program – Scope Control", individual Darlington Scope Requests (DSR), composed of core scope, were bundled together to form the approved, scope for the Islanding Project. Appendix B contains a complete list of Islanding DSRs. Progression of these DSRs to completion is as per the process defined in Darlington Nuclear Refurbishment Program – Scope Control. Timelines for progression are as per the Islanding Schedule.

Table 3 below lists the applicable EPC Contract scopes of work for each Islanding project.

Table 3: Scope and Deliverable Breakdown		
Work Breakdown Scope and Deliverable	Scope Document and Detail	Document Number
Bulkhead And Containment Isolations	Darlington Refurbishment – Outage Unit Containment Isolations	NK38-SOW-09701-10005
Pre-req Modifications	DNGS Islanding – Negative Pressure Containment (NPC)	NK38-SOW-34200-0522061
	Scope of Work for DN Islanding Heavy Water Management	NK38-SOW-38000-10006
	Darlington EQ Trip Loop of 1\2\3\4-53140-5\6CB4 Scope of Work	NK38-SOW-53140-10001
Barriers/Area Islanding	Barriers/Area Islanding	NK38-SOW-09701-10045

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### 5.1.2 Work Breakdown Structure

The Islanding Project Work Breakdown Structure has been prepared in accordance with N-MAN-00120-10001-SCH-05 and can be found in the P6 schedule. P&M will align the WBS for Islanding Pre-req modifications.

### 5.1.3 Scope Control

The Bulkhead and Containment Isolations scope control is managed per the RFR EPC Agreement scope change process, including the issuance of Project Change Directives (PCDs) as outlined in Article 4 of the RFR EPC Agreement. Project Scope Management by the RFR EPC contractor is governed by their Scope Management Plan 509407-0000-00000-30IM-0003.

Pre-Req and Barriers/Area Islanding projects will have their scope controlled during the execution part of the contract as per the ESMSA scope change process or via the OPG Refurbishment DRAS process for the in-house work.

If there are any major scope changes from scope that was approved through the gate process, a gate refresh may be submitted. Minor scope changes will be handled using Change Control Forms per the Change Control Process outlined in N-MAN-00120-10001-PC.

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## 6.0 PROJECT SCHEDULE MANAGEMENT

Project schedule management is the process of defining, sequencing, and estimating resources and durations of the project activities which are integrated in the project schedule. Schedule development and monitoring to be integrated with OPG project and functional groups, EPC contractors and other contractors [e.g. Owner Support Service (OSS)] schedules.

### 6.1 OPG Schedule Management

Islanding project schedule management will be performed in accordance with the Nuclear Projects Schedule Management N-MAN-00120-10001-SCH.

The Projects and Modifications organisation will be preparing and managing their own schedules for the Islanding Pre-req modifications. The Islanding project will use this schedule to manually transfer the information for input into the Islanding level 2 schedule as required. The exception to this is the engineering portion of the NPC modification. Since OPG is performing the engineering, a decision was made to control the engineering portion of the schedule under the Islanding project, up to the level 3 schedule. NPC schedule will be maintained co-operatively with vendor and Islanding CSA. This exemption is only applicable until detailed design is complete. Integration with Station work and other Pre-requisite projects will be coordinated through the refurb Project Control Center (PCC).

### 6.2 EPC Contractor Schedule Management

Each EPC contractor has a process to address project schedule management. The EPC portion of the Islanding project Level 2 schedule will directly reflect the vendor Level 2 schedule (i.e. all activities with current status).

For the Bulkhead and Containment Isolations Project, schedule management and integration is governed by the RFR contractor Schedule Management Plan 509407-0000-0000-30IM-0003 and the following subsidiary documents:

1. Schedule Control – 509407-0000-0000-32WI-0001,
2. Schedule Development – 509407-0000-0000-32WI-0002,
3. Schedule Estimate Development – 509407-0000-0000-32WI-0005.

Barriers/Area Islanding projects schedule will be managed per the ES MSA Contract. The Pre-Req sub-bundles are being managed per the Projects and Modifications organization's processes in accordance with the ES MSA Contract. Activities for the in-house work, such as Button Up and airlock restraints, will be managed in the islanding oversight schedule.

Unit 2 Execution schedules will follow the direction provided by the Refurbishment Scheduling Department. Schedules will be developed in the OPG Primavera environment, and follow the execution schedule framework provided in the 'Vendor Level 3 Execution Schedule Template'.

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## 7.0 PROJECT COST MANAGEMENT

Project cost management is the process of budgeting and controlling overall project costs. Cost estimates and cash flow forecasts will need to integrate OPG, EPC contracts and other contracts (.e.g. OSS) costs in order to affect overall cost control for the Islanding Project.

### 7.1 OPG Cost Management

The Islanding Project cost management and integration is governed by the following documents:

1. Darlington Refurbishment program document N-MAN-00120-10001-PC, Project Controls
2. Nuclear Refurbishment Cost Management and Project Reporting, N-MAN-00120-10001-CST
3. Darlington Refurbishment Planning and Controls Program Management Plan NK38-NR-PLAN-09701-10001-0002

EPC contractor costs will be integrated with internal OPG Islanding Project costs to provide a total estimated cost for the project. Costs associated with support required by Refurbishment functional groups are not included in the Islanding execution estimates, and will be managed by the respective functional groups.

For Gate 2 scope, costs for external contracts to prepare modification design requirements and conceptual design reports were included in the projects. Engineering and Functional costs at the project level for projects executed by in-house resources were assigned to the individual projects.

For P&M cost management, WBS elements related to P&M managed scope will be required to reflect funding released to the P&M organisation via a Project Authorization Package or a similar funding request method. Funding released to the Islanding Bundle, but not yet requested by P&M will be held in a cost only WBS element in the OPG section of the WBS. When the funding is requested by P&M, a change control form will be used to move the funding to the appropriate project and WBS element assigned to P&M.

Gate 3 strategy includes identifying all functional support required for work planning and execution. Per RQE Directive #004-R0, Projectization Rule Set, for Islanding in-house mods, functional resource requirements will be identified for execution planning, however no budget will be requested within the Islanding project release to fund the support as these are deemed 'Project Indirects'. See Appendix C for RQE Directive #004-R0. Any resource requirements not available in the Refurb organization will have to be secured from other organizations. Budget will be required as this support will be a direct cost to the project. Any additional funding required for these direct costs will be secured via the Change Control Process (CCP).

Project cost reporting will utilize transactional reporting in the OPG Financial Reporting system (FRA) and the BI reporting tool for tracking release values and EV metrics. EPC contractor costs are incorporated in the project cost via the (FRA) Cost Reports. These costs are represented in Cost Management Systems by work packages based on the Work Breakdown Structure (WBS). Oncore load sheet are provided to each EPC contractor with the WBS

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indicated. This allows the EPC contractor costs to be captured at the work package level as determined by the project.

## 7.2 EPC Contractor Cost Management

Islanding baselines and cashflows will reflect the EPC Contract values. Estimates requested at the gates will be updated (if required) via Change Control Forms once the Purchase Order is issued and the actual values are known. Similarly for P&M, estimated purchase order values will be used for gate submissions and when P&M issues the purchase order, a change control form will be used to align the project budgets with the actual purchase order values.

For the Bulkhead and Containment Isolations Project cost management; their integration is governed by the RFR contractor Project Controls Plan 509407-0000-0000-30IM-0001 and the following subsidiary documents:

1. Budget Control – Accounting Plan 509407-0000-0000-35IM-0001,
2. Estimate Control – Project Estimating Plan 509407-0000-0000-33IM-0001, and
3. Cost Control – Cost Management Plan 509407-0000-0000-34IM-0001.

Pre-Req, and Barriers/Area Islanding projects, cost management of the contractor will follow the agreed ES MSA process.

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## 8.0 PROJECT QUALITY MANAGEMENT

The overall quality management process will apply to all work in the Islanding project; however, the particular QA requirements will be specified in each EPC Contract according to the nature of the work.

### 8.1 OPG Quality Management

The Quality Management of the Islanding Project will be in compliance to:

- N-CHAR-AS-0002 - Nuclear Management System,
- N-PROG-AS-0001 - Managed Systems,
- N-PROG-AS-0007 - Project Management,
- N-STD-AS-0028 - Project Management Standard,
- N-STD-AS-0029 – Contract Management Standard,
- N-STD-AS-0030 – Project Oversight Standard,
- N-STD-AS-0031 – Field Engineering Standard
- N-MAN-09701-10002 – Nuclear Project Oversight Guide,
- N-PROC-MM-0010 – Establishing and Maintaining Ontario Power Generation Nuclear Approved Supplier list.

#### 8.1.1 Quality Assurance

For EPC work, each contractor will be required to prepare a project Quality Assurance Plan, at the contract level, that addresses the interface responsibilities with external organizations. For all EPC quality assurance plans, each will address all applicable codes and standards including CSA Z299, CSA N286-12 and CSA N286.7 standards, as required, identifying what quality programs and procedures will be followed, including the contractor's and their sub-contractor's personnel responsibilities under the various quality programs. OPG will review and accept the contractor's project quality assurance plans.

During the different phases of project work, the project team, jointly with the functional groups will work to ensure that the quality of design, materials, and services provided and the quality of installation and commissioning work performed meet OPG standards, purchase order requirements, and are in compliance to applicable codes and standards.

In the instance of a quality system failure or a breakthrough event occurring for which the contractor is accountable; such adverse conditions will be documented per the contractor's QA Program, and per N-PROC-RA-0022 where appropriate. The contractor will be asked to initiate a Corrective Action as per their program for any identified quality issues. When there is a systemic failure of their implemented Quality System, a formal Non Conformance and Corrective Action Request process will be initiated by OPG Supply Chain Quality Services as per N-PROC-MM-0010.

To ensure compliance to OPG requirements, the contractor interface will be controlled by the Contractor Owner Interface Requirement (COIR) document forming part of each agreement.



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For internal quality issues the OPG Station Condition Record (SCR) and corrective action process will be followed.

For the Bulkhead and Containment Isolation Project, the RFR EPC Contractor quality will be managed following their Quality Assurance Plan 509407-0000-00000-38QP-0001.

For Pre-Req and Barriers/Area Islanding projects the contractor will follow their own Quality Assurance Program as stated in ESMSA. As listed in the COIR, a Construction Quality Assurance Plan will be provided for each design package prepared by the ESMSA contractor.

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## 9.0 PROJECT HUMAN RESOURCES MANAGEMENT

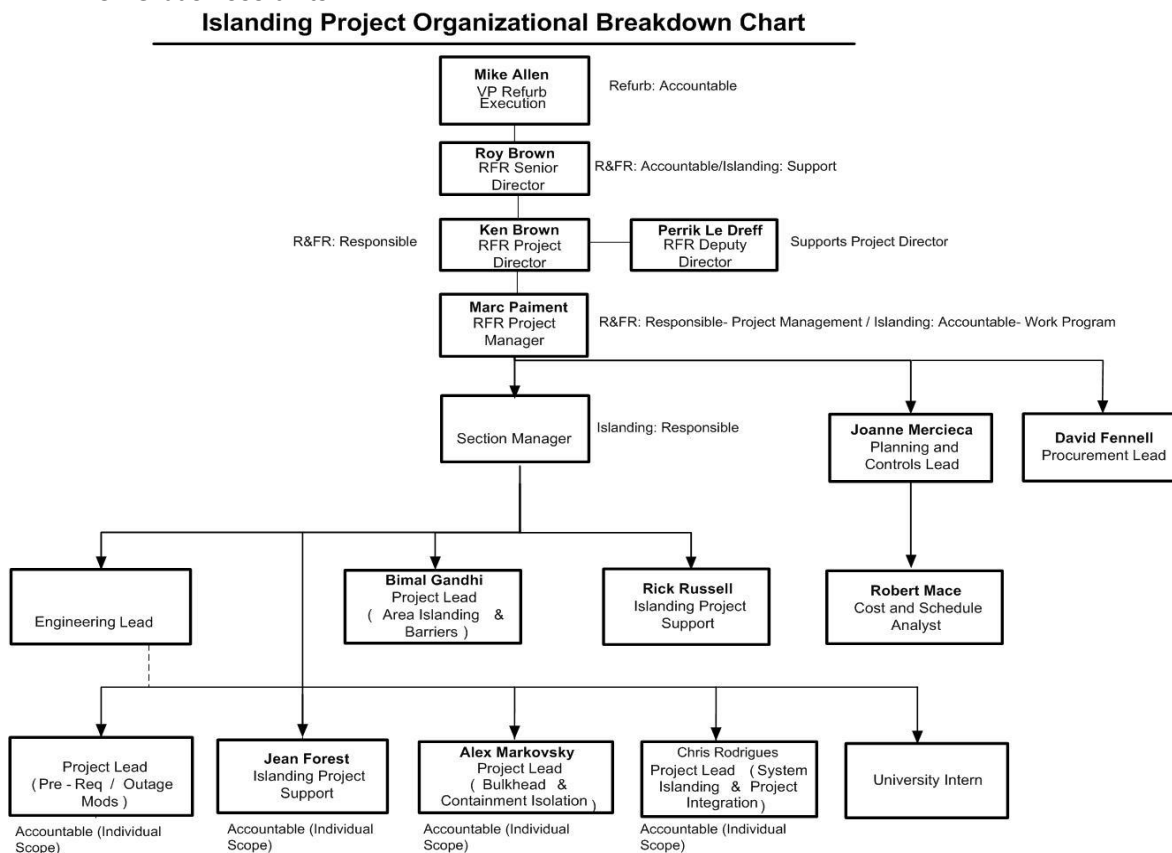
The Islanding Project human resources management will be in accordance with Refurbishment Program Staffing Management Plan NK38-NR-PLAN-09701-10001-0016.

### 9.1 OPG Human Resources Management

#### 9.1.1 Team Resourcing

The Islanding Project Organization is shown in Figure 3. The key roles and their respective accountabilities are described in Appendix D Project Organization.

Nuclear Refurbishment has elected to employ a Matrix organizational model to execute the Refurbishment Program. It is the Islanding Project's plan to staff the project team with OPG staff, and supplemented by Managed Task activities to meet the project schedule and needs. OPG staff will either be embedded in the team or will be matrixed from the NR functional support organizations. Where NR functional support staff are currently unable to fulfill a specific need, due to unavailability or missing skill sets, the project will either utilize managed task or augmented staff contracts to maximize outside experience or attempt to find staff within other OPG business units.



**Figure 3: Islanding Project Organization Team Development**

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## 9.1.2 Training & Resource Development

### Qualifications

Each project member that is matrixed will be assigned the appropriate qualifications by their respective functional manager to ensure compliance with the applicable standards for that group. A review of the current qualification set that are available for project management, contract owner and similar functions is performed by the project. Islanding staff performing the MTL role need to maintain QUAL 32144 Project Fundamentals, and QUAL 39093 NR OPG Modification Team Lead Qualification. Where deemed appropriate by the Islanding PM, Islanding will also maintain QUAL 32905 Contract Administrator.

In order to effectively provide oversight to the EPC contractors, one would ideally have like experience and training similar to that of the EPC contractor. The project will explore internal and external opportunities to develop these skills.

## 9.1.3 Training & Resource Development

The following assessments and methods will be employed and expectations communicated to all project team members:

- Annual Incentive Plan (AIP) Score Card,
- Project Performance Review (PPR),
- Monthly summary data sheets (Monthly Cost Reports and Quad Chart).
- Contract SOWs and Deliverables for contract staff

## 9.2 EPC Contractor Human Resources Management

Each EPC contractor will be responsible for the management of their staff. For the Bulkhead/Containment Isolations Project the RFR contractor resources will be managed in accordance with their Resource Management Plan 509407-0000-00000-30IM-0002.

The EPC contractor in the ES MSA for Pre-Req and Barriers/Area Islanding projects will develop a resource management plan for all staff and subcontractors in accordance with the ESMSA terms and conditions.

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## 10.0 PROJECT COMMUNICATIONS MANAGEMENT

Islanding Project communication management will be consistent across each project except if there are differences stipulated in each EPC contract. If major differences exist they will be documented in this plan.

### 10.1 OPG Communications Management

#### 10.1.1 Information Control

The main stakeholder communication methods are:

- Telephone and Email communications
- Submittals and Requests for Information (RFI)
- Meetings
- Publications and Reports

Emails: Regularly used to document interface with stakeholders, the project team and with contractors.

Meetings: Conducted face-to-face with available teleconference and videoconference as required. The stakeholder meetings involving the Islanding project and its stakeholders are listed in Table 4. Minutes of meeting and action list will be implemented where appropriate.

Records: The Communication Technology and Information distribution tools that will be used by the project include:

- SharePoint 2007: Internal document storage, exchange environment used for storage of project documents, deliverables, schedules and cost information,
- PDMC: This is the external instance of SharePoint used by SLN-Aecon JV for their documentation management. Some OPG staff have limited access to this site.
- Project Records will be maintained in SharePoint, Project Emails and MacroView
- VenDM: Shared environment used for information exchange and management of contractor submittals.

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Table 4: Stakeholder Meetings		
Meeting Title	Description	Frequency
Islanding Project Team Meeting	Discussion on project progress and status from Projects and Modifications on pre-req mods	Weekly
Executive Oversight Committee	Project Performance Update. Issue resolution. Chief Executive Update.	Quarterly
OPG/ESMSA Steering Committee	Project Performance Updates, Issue resolution.	Monthly
OPG/JV Steering Committee	Project Performance Updates, Issue resolution.	Monthly
RFR/JV Project Manager's Meeting	Project Performance Updates Issue resolution.	Weekly
Scope Review Board	This includes the related Technical Screening Committee and Funding Screening Committee meetings. Scope addition, removal, modification processing.	As Required
MRM Meeting	Review and processing of station condition records associated with Islanding.	Bi-Weekly
Project Status Review Meeting -NR	Project Performance Updates, Issue resolution.	Monthly
Operations and Maintenance Scope Status Meeting	Discussion of pre-refurbishment work orders and health of DSRs	Monthly
Operations and Maintenance & NR Execution PM Meeting	Alignment meeting	Daily PCC meeting
DN Refurbishment/CNSC Meeting	Alignment meeting	(As Requested)
Individual Project Schedule Review Meeting	Project Update	Weekly

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Table 4: Stakeholder Meetings		
Meeting Title	Description	Frequency
Weekly Engineering Alignment Meeting	Engineering alignment and issue resolution.	Weekly
Nuclear Refurbishment All Staff Face-to-Face Meeting	Project update	As Required
DN Refurbishment Execution Three-Stratum Meeting	Alignment, Issue resolution	Monthly
Bundle Progress Review Meeting	Readiness review	Weekly

### 10.1.2 Stakeholder Inputs

Stakeholder inputs are gathered through the various meetings conducted by and with the project team. Actions, issues and risks are then tracked in the appropriate system as described in the Risk Management Plan NK38-PLAN-09701-10117.

The major stakeholders for the Islanding Project are listed in Table 5.

Table 5: Stakeholder Register			
Identification	Main Expectations	Potential Influence & Phase of Most Influence	Stakeholder Classification
Darlington Nuclear Generating Station (DNGS)	Return of units 1-4 as per Refurbishment Program Charter	Owners of Plant Systems; Execution Phase	Internal
SLN-Aecon Joint Venture	Coordination with OPG and other EPC Vendors as per RFR EPC Agreement	Throughout the entire project	External

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Table 5: Stakeholder Register			
Identification	Main Expectations	Potential Influence & Phase of Most Influence	Stakeholder Classification
ESMSA Contractors	Coordination with OPG and other EPC Vendors as per ESMSA Agreement	Throughout the entire project	External
NR Function Groups:  Engineering, Nuclear Safety, Ops, Maintenance, Rad Protection, Reg Affairs	Establishment of functional standards, Consultation, input required for review of deliverables	Required to establish standards, perform oversight activities; Throughout the entire project	Internal
Darlington Engineering, Operations, Work Control and Maintenance Staff	Consultation as required when implementing modifications on the operating stations	Owners of the Plant Systems; Throughout the entire project	Internal
Darlington Fuel Handling	Coordination required when executing pre-req outage work and NR work during no-fuel windows	Owners of the FH system, critical impact to installation schedule of the project	Internal
Darlington – Mechanical Design Group	Provide input on containment pressure testing requirements	Owners and operators of station pressure testing equipment. Key stakeholder in developing pressure test strategy	Internal

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Table 5: Stakeholder Register			
Identification	Main Expectations	Potential Influence & Phase of Most Influence	Stakeholder Classification
Government of Ontario	Performance of Program on Time, on Budget, within Scope, to required quality and without Safety Incidents	Major influence in making go, no-go decision for Execution Phase	External
OSS Contractors	Coordination with OPG as per OSS Contract	SME support and support on Technical Assessments; Definition Phase  Managed task support as required	External
Unions	Upholding of Collective Bargaining Agreements	Entire Project	External
Canadian Nuclear Safety Commission	Compliance with Regulations	Throughout the Project	External
Technical Standards and Safety Authority (TSSA)	Compliance with Regulations	Throughout the Project	External
Municipality of Clarington	Compliance with Codes and By-laws	Throughout the Project	External
Ministry of Environment	Compliance with Regulations	Throughout the Project	External
Ministry of Labour	Compliance with Regulations	Throughout the Project	External
Electrical Safety Authority	Compliance with Regulations	Throughout the Project	External



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### 10.1.3 Performance Reporting

Performance reporting will be executed in accordance with the Darlington Refurbishment Planning and Controls Program Management Plan NK38-NR-PLAN-09701-10001-0002. Project cost management and reporting will be gauged and monitored in accordance with N-MAN-00120-10001-PC-13 – Nuclear Refurbishment Cost Management and Reporting.

The following reports are issued to Islanding staff and the Refurb Management Team to support Performance Reporting:

- Weekly cost details from RFA
- Weekly schedule updates
- Weekly Metrics
- Islanding Snapshot (internal project report)
- Monthly EV Reporting from Cost Management Systems
- Tempus
- Quad Chart

## 10.2 EPC Contract Communication Management

It is expected that each EPC contractor will issue individual communication management plans as required by the Contract Terms and Conditions.

For the Bulkhead and Containment Isolations Project communication by the Joint Venture is in accordance with their Communication Management Plan, 509407-0000-00000-30IM-0009.

The RFR EPC Agreement Exhibit 2.9(j) requires reporting for:

- Health, Safety & Environmental Performance;
- Schedule Performance including but not limited to:
  - Engineering Activities;
  - Procurement Activities;
  - Permitting Activities;
  - Construction Activities; and
  - Submittals.
- Cost Performance;
- Quality Performance;
- Risk & Contingency;
- Scope;
- Issues, Assumptions and Decisions; and

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- Training Activities.

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## 11.0 PROJECT RISK MANAGEMENT

Risk Management for the Islanding Project will require the integration of the Islanding Project Risk Management process and the EPC contractor risk management processes.

### 11.1 OPG Risk Management

OPG Risk Management follows the procedures outlined in these documents:

- NK38-NR-PLAN-09701-10001-0002 Darlington Refurbishment Planning and Controls Program Management Plan
- N-MAN-00120-10001-RISK OPG Risk Management Processes

Risks in Islanding are managed per the governance of OPG Risk Management. The Islanding Risk Management Plan NK38-PLAN-09701-10117 is specific to the documentation and management of risks in Islanding.

### 11.2 EPC Contractor Risk Management

EPC contractors will provide risk management plans as required in the Contract Terms and Conditions. For the Bulkhead and Containment Isolations the RFR EPC vendor manages risk in accordance with their Risk Management Plan 509407-0000-00000-30IM-0005. For the Barriers and Area Islanding project, ESMSA manages risk in accordance with Procedure FGP-MSA-006.

### 11.3 Risk Management Integration

EPC contractors will manage risks per their internal processes. Each EPC contractor may communicate risk to OPG through various methods. If the identified EPC contractor risks will impact the Islanding Project then those risks will also be added to the Islanding project risk register. In general risk communication can take place via the following methods:

- Review risks as part of project communication meetings
- Regularly scheduled risk work shops
- Project reporting

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## 12.0 PROJECT PROCUREMENT MANAGEMENT

For all procurement activities, the processes as defined in OPG-PROC-0058 Procurement Activities will be followed. Each EPC contractor will also develop specific procurement management plans for each project as required per the Contract Terms and Conditions.

### 12.1 OPG Procurement Management

Material to be procured by OPG to fulfill Islanding scope (e.g. vault spill contingency materials) will be procured using existing OPG processes and procedures.

### 12.2 EPC Contractor Procurement Management

For the Bulkhead and Containment Isolations Project the RFR EPC contractor manages procurement according to their Materials and Procurement Management Plan, 509407-0000-00000-50IM-0001 and the Materials Control Plan 509407-0000-00000-50IM-0002.

Specific procurement terms and conditions will be defined in each EPC contract. For the Bulkhead and Containment Isolations Project refer to the RFR EPC Agreement (including Exhibit 2.11 – Procurement Work and Contractor/Owner Interface Requirements (COIR) Section 4.0, Procurement Interface Matrix).

Procurement terms and conditions between OPG and the ESMSA contractor are specified in the ESMSA Appendix 1,2,4,6,8. This applies to Islanding Pre-req and Barriers/Area Islanding sub-bundles.

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### 13.0 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

AL/VA	Airlocks and Vault Atmosphere
AIP	Annual Incentive Plan
BCS	Business Case Summary
CAT	Cost Allocation Table
CBS	Cost Breakdown Structure
CCP	Change Control Process
COIR	Contractor Owner Interface Requirements
CPI	Cost Performance Index
CMO	Contract Management Office
D2O	Heavy Water (Deuterium Oxide)
DEC	Darlington Energy Complex
DSR	Darlington Scope Request
DRAS	Decision Record Analysis Summary
ECC	Engineering Change Control
ECI	Emergency Coolant Injection
EPC	Engineering, Procurement and Construction
EQ	Environmental Qualification
ESMSA	Extended Services Master Service Agreement
EV	Earned Value
JV	SNC-Aecon Joint Venture
GRB	Gate Review Board
ILW	Intermediate Level Waste
IPG	Integrated Planning Group
LLW	Low Level Waste
NFRA	Nuclear Financial Reporting and Analytics
NR	Nuclear Refurbishment
OAR	Organizational Authority Register
OHSA	Occupational Health and Safety Act
OSS	Owner Support Service

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P&M	Projects and Modifications
PC	Procure and Construct
PCC	Project Control Center
PCCS	Program Coordination and Control Schedule
PCD	Project Change Directives
PHTS	Primary Heat Transport System
PIMS	Program Integrated Master Schedule
P&M	Projects and Modifications Organization
PM	Project Manager
PMBOK	Project Management Body of Knowledge
PMP	Project Management Plan
PMSS	Program Milestone Schedule
PO	Purchase Order
PS	Project Schedule
QA	Quality Assurance
RFR	Reactor and Feeder Replacement
RFI	Request for Information
RMP	Risk Management Plan
SCR	Station Condition Record
SDH	Supplier Document Hub
SOW	Scope of Work
SPI	Schedule Performance Index
T&C	Terms and Conditions
WBS	Work Breakdown Structure
TOR	Terms Of Reference
VenDM	Vendor Document Management

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## 14.0 REFERENCES

- Extended Services Master Service Agreement (available on P&M website)
- N-CHAR-AS-0002, Nuclear Management System
- N-COI-00120-00001, Contractor/Owner Interface Requirements For Nuclear
- N-DAI-00150-10000, Contractor/Owner Interface Requirements For Nuclear (ESMSA Draft COIR – ESMSA Schedule 6 – Superseded by N-COI-00120-00001)
- N-GUID-09701-10011, Darlington Refurbishment - Safety Management Essentials
- N-INS-00120-10025, Extended Services Master Services Agreement Request For Work
- NK38-DAI-09701-10008, Retube Feeder Replacement Project Contractor\owner Interface Requirements
- NK38-DP-09701-10001, Retube and Feeder Replacement (RFR) Design Plan
- NK38-INS-09701-10001, Darlington Nuclear Refurbishment Program - Scope Control
- NK38-NR-PLAN-09701-10001-0002, Darlington Refurbishment Planning And Controls Program Management Plan
- NK38-NR-PLAN-09701-10001-0016, Darlington Refurbishment Staffing Program Management Plan
- NK38-PLAN-01060-10003, Darlington NGS Refurbishment Project Reference Plan – Scope Definition
- NK38-PLAN-09701-10074, Retube and Feeder Replacement (RFR) Project Management Plan
- NK38-PLAN-09701-10117, NR Islanding Project - Risk Management Plan
- NK38-PLAN-09701-10126, Retube and Feeder Replacement (RFR) Project Oversight Plan
- NK38-PLAN-09701-10150, Retube and Feeder Replacement Project Contract Management Plan
- NK38-REP-09701-10100, Darlington Refurbishment Bulkhead And Islanding Contracting Strategy
- N-MAN-00120-10001-PC-13 Nuclear Refurbishment Cost Management and Reporting
- N-MAN-00120-10001-GRB, Nuclear Projects Gated Process
- N-MAN-00120-10001-PC, Project Controls
- N-MAN-00120-10001-RISK, Nuclear Projects Risk Management Process
- N-MAN-00120-10001-RISK-04, Nuclear Refurbishment Risk Management
- N-MAN-00120-10001-RISK-06, Darlington Refurbishment Lessons Learned and OPEX Management
- N-MAN-00120-10001-RISK-07, Nuclear Refurbishment Assumptions and Decisions Management
- N-MAN-00120-10001-SCH-05, Nuclear Refurbishment Program/Project WBS Manual

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- N-MAN-00120-10001-SCH-07, Nuclear Refurbishment Earned Value Management
- N-MAN-09701-10002, Nuclear Projects Oversight
- N-POL-0001, Nuclear Safety Policy
- N-PROC-MM-0010, Establishing And Maintaining Ontario Power Generation Approved Suppliers List
- N-PROC-MP-0090, Modification Process
- N-PROC-RA-0022, Processing Station Condition Records
- N-PROG-AS-0001, Managed Systems
- N-PROG-AS-0007, Project Management
- N-STD-AS-0028, Project Management Standard
- N-STD-AS-0029, Contract Management Standard
- N-STD-AS-0030, Project Oversight Standard
- N-STD-AS-0031, Field Engineering Standard
- N-STD-MP-0009, Contractor\owner Deliverables And Activities Interface Control
- OPG-POL-0001, Employee Health and Safety Policy
- OPG-PROC-0058, Procurement Activities

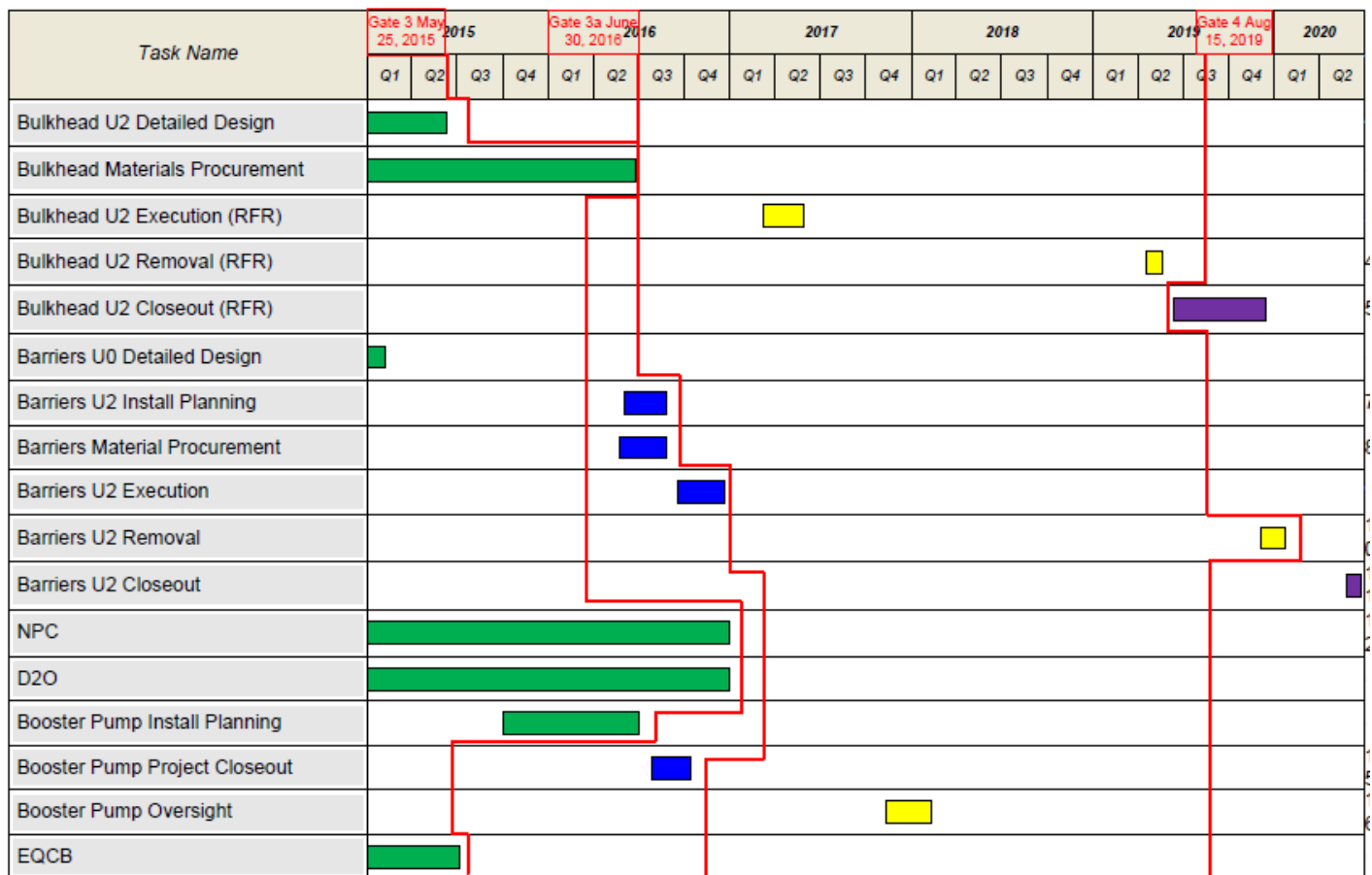


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## Appendix A: Islanding Gating Strategy

# Islanding Gating Strategy



### Legend:

- Proposed Islanding Gates
- Green Gate 2 Scope (Approved)
- Blue Gate 3 Scope (Approved)
- Yellow Gate 3a Scope
- Purple Gate 4 Scope

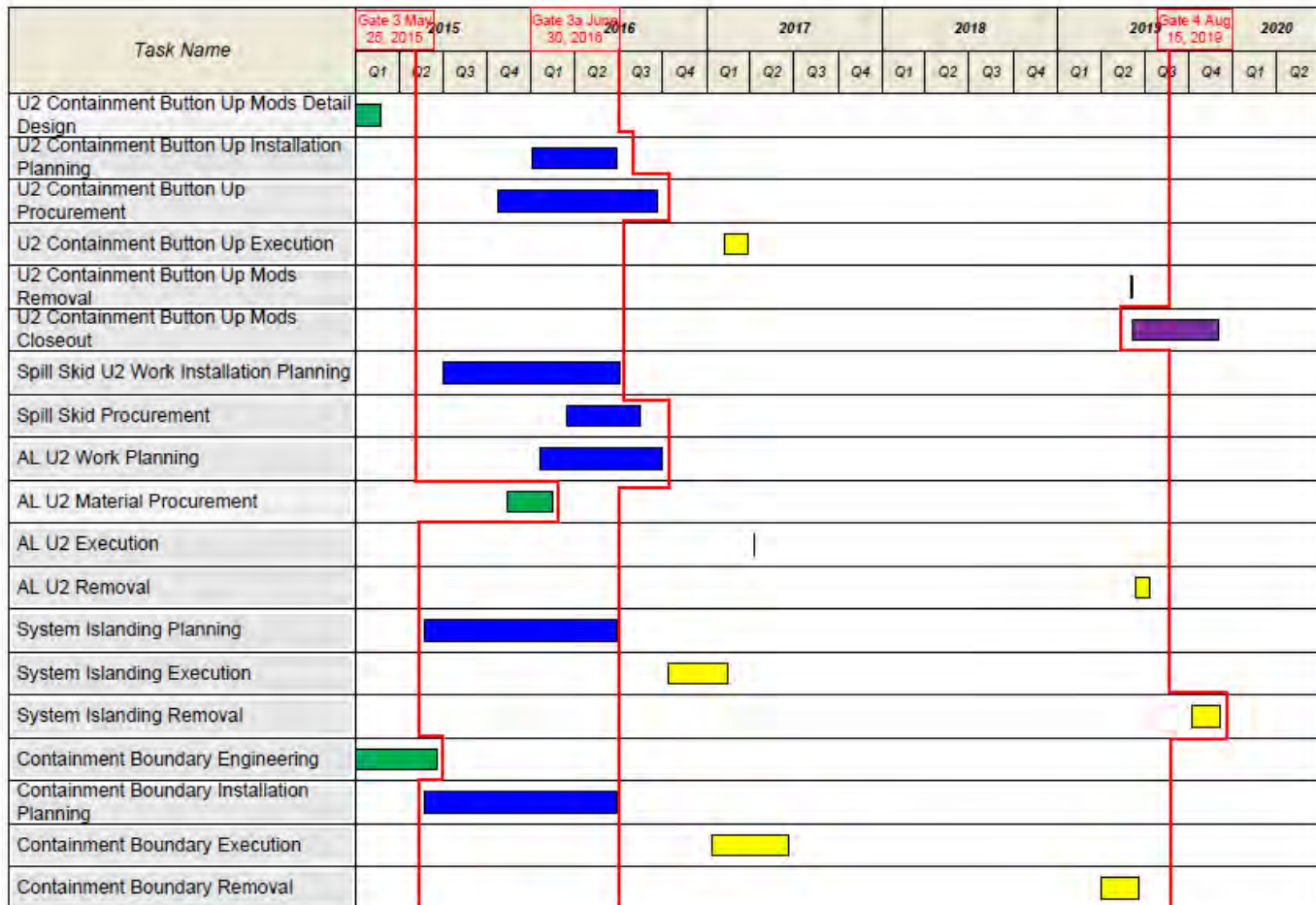
Note: Dates are approximation only. Gantt Chart is for illustrative purposes only.

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**Legend:**

- Proposed Islanding Gates
- Gate 2 Scope (Approved)
- Gate 3 Scope (Approved)
- Gate 3a Scope
- Gate 4 Scope

Note: Dates are approximation only. Gantt Chart is for illustrative purposes only.

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## Appendix B: DSR List

#	DSR	Title	Status
1	IP0570-1	ENHANCE LPSW RELIABILITY FOLLOWING AN SSLB	Closed
2	IP0570-2	ENHANCE LPSW RELIABILITY FOLLOWING AN SSLB	Approved
3	SI0270-3	SPV - Potential Redesign for Refurbishment: ASW Pressure Regulating Valve	Not Refurb
4	TS0780-1	Unit Islanding Modifications for Nuclear Systems: Containment Button Up Logic Modifications/ H2 Ignition Isolations	Approved
5	TS0780-2	Unit Islanding Modifications for Nuclear Systems: Containment Safety Monitoring – Common Containment Pressure	Approved
6	TS0780-3	Unit Islanding Modifications for Nuclear Systems: Containment In-service Leak Rate System	Approved
7	TS0780-4	Unit Islanding Modifications for Nuclear Systems: D2O Leakage and Recovery Systems	Not Required
8	TS0780-5	Unit Islanding Modifications for Nuclear Systems: D2O Liquid Recovery System Contingency	Approved
9	TS0780-6	Unit Islanding Modifications for Nuclear Systems: Primary Heat Transport Heavy Water Management System	Approved
10	TS0780-7	Unit Islanding Modifications for Nuclear Systems: Reactor Vault HVAC	Transferred to BOP
11	TS0780-8	Unit Islanding Modifications for Nuclear Systems: Emergency Filtered Air Discharge System	Approved
12	TS0780-9	Unit Islanding Modifications for Nuclear Systems: Re-circulated Cooling Water	Closed
13	TS0780-10	Unit Islanding Modifications for Nuclear Systems: Emergency Coolant Injection System	Approved
14	TS0780-11	Unit Islanding Modifications for Nuclear Systems: Moderator D2O Transfer System	Approved
15	TS0780-12	Unit Islanding Modifications for Nuclear Systems: Heat Transfer Tank Isolation	Approved
16	TS0780-13	Unit Islanding Modifications for Nuclear Systems: Airlocks	Approved
17	TS0790-1	Unit Islanding Modifications for Conventional Systems: Construction Island Barriers	Approved

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#	DSR	Title	Status
18	TS0800-4	Unit Islanding Modifications for Common Systems: Emergency Service Water Isolation – Steam Generator Emergency Cooling System	Not Required
19	TS0800-5	Unit Islanding Modifications for Common Systems: Emergency Service Water Isolation – Moderator Head Tanks	Not Required
20	TS0800-6	Unit Islanding Modifications for Common Systems: Low Pressure Service Water	Superseded by TS0800-7
21	TS0800-7	Unit Islanding Modifications for Common Systems: Modification to LPSW	Approved
22	TS0800-8	Unit Islanding Modifications for Common Systems: Electrical: Class III and IV Transfer Buses	Superseded by TS0800-7
23	TS0800-9	Unit Islanding Modifications for Common Systems: Electrical - Class III and IV Transfer Buses (Contingency)	Superseded by TS0800-7
24	TS0800-10	Unit Islanding Modifications for Common Systems: Inter-Unit Feed Water Tie	Closed
25	TS0800-11	Unit Islanding Modifications for Common Systems: Modification to Inter Unit Feed Water Tie	Not Required
26	TS0800-15	Unit Islanding Modifications for Common Systems: Powerhouse Steam Ventilation System	Closed
27	TS0810-1	Reactor Building Containment Bulkhead Isolation: Containment Bulkhead Installation	Approved
28	TS0810-2	Reactor Building Containment Bulkhead Isolation: Bulkhead Commissioning Test Design and Execution	Approved
29	TS0810-3	Reactor Building Containment Bulkhead Isolation: Isolation of Reactor Vault from Fueling Duct	Approved
30	TS0810-4	Reactor Building Containment Bulkhead Isolation: Systems Isolations	Approved
31	TS0890-6	Unit Layup Modification for Nuclear Systems: Airlock Transfer Chambers	Superseded by TS0780-13
32	TS1340-1	Islanding -Miscellaneous Support for Assessment and Execution of Conventional and Non-Conventional Systems	Approved
33	TS1430-1	REACTOR BUILDING CONTAINMENT ISOLATION (TEST CALANDRIA SEAL)	Approved
34	TS1430-2	REACTOR BUILDING CONTAINMENT ISOLATION (REPAIR CALANDRIA SEAL)	Approved

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## Appendix C: RQE Directive #004-R0

**RQE Directive #: 004-R0**

**Subject: Projectization Rule Set**

**Status:** Issued for Use



**Purpose:** Define the rule set for “projectization” of budgets at the Work Package Level to satisfy the following program objectives:

1. Enable Refurbishment life cycle cost estimates to be segmented and reported by:
  - Project costs (all costs attributable to project bundles, reportable by bundle – e.g. BoP, RFR, etc.)
  - Functional costs (pure functional program work, management overheads, and support for OM&A field activities)
2. Facilitate appropriate control of project support costs by Refurbishment Project Managers.

**Background:** For the purposes of estimate planning and “projectization”, costs may be categorized as follows:

1. **Project Directs:** Project Directs are costs associated with work packages included in project schedules, where budget is held within the project. All Matrix staff, direct PMT (including labor and Purchase Services) and EPC vendor costs are part of Project Directs.  
All support required from sources internal or external to OPG, that is not being provided via a Refurbishment functional organization, is Project Direct cost. Examples include specialist OPG support such as IMS, or centre-led expertise not provided via a Refurbishment functional organization.  
Project Directs are actively managed by the project teams.
2. **Project Indirects:** Project Indirects are defined as work directly in support of project bundles that is sourced and or funded by a Refurbishment functional organization. Examples of Project Indirects would be Seismic analysis, Human Factors, System Engineering, Operations permitry support of bundle work, MSO field surveillances of project work).
3. **Functional Indirects:** This is purely functional work to support Nuclear Refurbishment program deliverables or work in support of non-bundle work, and is managed by the Functions. Examples include:
  - program support such as process development and documentation, program level oversight and reporting, corrective action plan administration

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- non-bundle support such as routine system engineering surveillance, cyclical maintenance support.

For Release 4D, functional budget owners were directed to identify Project Indirects and Functional Indirect work in the estimate templates at the Work Package level. Work Packages could only contain one type of work, thus facilitating separate grouping and reporting of Project Indirects and Functional Indirects. While this methodology allows separation of project and functional costs at the program level, it does not ensure that Project Indirect Costs can be separated by bundle. The planning basis for Release 4D was that Project Indirects would be allocated on a standard % allocation basis by project using bundle life cycle cost as the basis for allocation.

For RQE, the intent is to structure the estimate to allow accurate estimation of life cycle costs at the bundle level for Project Indirect costs.

**Direction:**      **For populating RQE Owner Cost templates:**

1. **Projects:** All life cycle Project Direct OPG Costs are to be estimated within the Excel cost template provided. Project Indirect Costs are not to be captured within project cost templates as these will be included in functional estimates.

It is the accountability of the Project Manager to ensure all project support (Project Direct and Project Indirect Costs) have been identified and the amount and source of funding secured. In cases where funding for support cannot be secured through a Refurbishment functional owner, the Project Manager shall budget for such support as a Project Direct cost, and as necessary flag that cost for further resolution in the template.

2. **Functions:** All Project Indirect and Functional Indirect life cycle costs are to be estimated within the Excel cost template provided. A Work Package may only contain Project Indirect or Functional Indirect costs (not both).

The expectation (unchanged from Release 4D) is that functions will have secured agreement from the Project Managers for the level of Project Indirect support required (i.e. by bundle). The allocation of Project Indirects by bundle will be recorded in a dedicated tab in the cost template provided.

**Management Owner:**

Gary Rose, Director Planning & Controls

**Single Point of contact:**

Andy Elliott, Manager Planning & Controls

**Governance:**

TBD

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## Appendix D Project Organization

Project Sponsor: Senior Vice President, Nuclear Refurbishment Execution

Accountabilities:

- Ensure the program is fully staffed
- Ensure adherence to Nuclear Refurbishment Program
- Administer monthly Steering Committee meetings. Address any concerns escalated in a timely fashion
- Administer quarterly Executive Oversight Meetings. Address any concerns escalated in a timely fashion

Senior Project Director, RFR

The RFR Senior Project Director has the accountability for all aspects of the RFR Project as described in the RFR PMP, as well as supporting the RFR Project Manager in executing the accountabilities of the Islanding Project Manager.

Project Director, RFR

The RFR Project Director has the responsibility for all aspects of the RFR Project as described in the RFR PMP, as well as supporting the RFR Project Manager in executing the responsibilities of the Islanding Project Manager including:

- Environment, Health & Safety
- Scope
- Schedule
- Cost
- Risk
- Quality
- Staffing & Resources
- NR Program Governance adherence
- Reporting & Communications
- Oversight
- Contract Adherence

Deputy Project Director, RFR

The RFR Deputy Project Director will support the Project Director in all aspects of the project.

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#### Project Manager, RFR

The RFR Project manager has the responsibility for all Project Management aspects of RFR and the accountability for all aspects of the Islanding Project including:

- Environment, Health & Safety
- Scope
- Schedule
- Cost
- Risk
- Quality
- Staffing & Resources
- NR Program Governance adherence
- Reporting & Communications
- Oversight
- Contract Adherence

#### Section Manager, Islanding

The Islanding Section Manager has the responsibility for all aspects of the project including:

- Environment, Health & Safety
- Scope
- Schedule
- Cost
- Risk
- Quality
- Staffing & Resources
- NR Program Governance adherence
- Reporting & Communications
- Oversight
- Contract Adherence

#### Project Leads

Each Islanding sub project is assigned a project lead. Each lead has the overall accountability for the successful delivery of their sub projects which includes:

- Environment, Health & Safety



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- Scope
- Schedule
- Cost
- Risk
- Quality
- Stakeholder Management
- Communications & Reporting
- Vendor oversight

#### Planning and Controls Lead

The Project Controls Lead is accountable to:

- Ensure project conforms to NR Program Governance, supported by routine quality checks and self assessments
- Liaising between functions and project including centers of excellence
- Gated Process including budget loads and baselines
- Reporting including Earned Value
- Analysis and Forecasting
- Business Planning
- Project Tools including IT tools, processes and instructions
- EPC contractor integration within OPG system

#### Procurement Lead

The Procurement Lead will be accountable to:

- Be the single point of contact with the EPC contractor for all procurement related matters
- Hold the Contractor accountable to complete procurement activities in accordance with the correct QA requirements, procedures and programs
- Coordinate OPG conducted audits and attend as required
- Arrange for OPG participation in and oversee contractor audits of sub-contractors as required
- Ensure oversight of EPC contractors sub-contractors procurement process
- Ensure materials and services are procured per schedule
- Ensure and coordinate resolution of any Non-Conformances

#### Engineering Lead

The Engineering Lead will be responsible for:

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- Ensuring that the ECC process required is defined, understood, reflected in the schedule and implemented per process
- Provide resources and context to perform adequate document reviews within the contractual time frame allotted
- Ensuring resources and context to perform adequate oversight of EPC contractors to ensure project objectives for cost, scope, schedule, and quality are met
- Attend COMS reviews and ensure OPEX is embedded in the Engineering deliverables
- Ensure scope is defined, understood and managed per the applicable scope management governance
- Ensure all risks associated with Modifications are identified in RADAR per appropriate governance; mitigating actions are prepared tracked monthly and updated as required
- Identify, coordinate and solicit all stakeholder inputs to engineering deliverables reviews

#### Project Submittals

Accountabilities regarding project submissions for OPG staff are outlined below. The main responsible groups are Darlington Control Documents Management group, Document SPOC and document reviewers.

#### NR Records and Document Management

- Accountability for support on project submissions to the project team resides with the Darlington Control Documents Management group

#### Records and Document Management

- Handles day-to-day transactional responsibilities, including being the medium between the project team and EPC contractors for transaction of submissions related to VenDM.

#### Document SPOC

- The document SPOC can be the Project Leads or other person delegated responsibility for coordinating documents reviews. The Project Lead is accountable to ensure the document is reviewed by the appropriate stakeholders and for ensuring the review is completed within the specified time.

#### Reviewers

- Reviewers of project submissions, as designated by the Project Lead via review workflows, are responsible for their review of a project submission per the indicated timeline on the workflow.

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## Appendix E: Refurbishment Outage and Project Management Summary

R1 for Gate 3a

### Refurbishment Outage and PM Summary

	Breaker Open	Breaker Close		PM Start	PM Fin
1st Unit	15-Oct-16	22-Sep-19		30-Jun-15	10-Apr-20
2nd Unit	10-Oct-19	16-Sep-22		10-Apr-18	4-Apr-23
3rd Unit	16-Mar-21	21-Feb-24		16-Sep-19	10-Sep-24
4th Unit	4-Oct-22	10-Sep-25		6-Apr-21	28-Mar-26

Unit		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1st Unit	Work Window		Oct			Sep							
	PM Window	Jun					Apr						
2nd Unit	Work Window					Oct			Sep				
	PM Window			Apr						Apr			
3rd Unit	Work Window							Mar			Feb		
	PM Window				Sep						Sep		
4th Unit	Work Window								Oct			Sep	
	PM Window						Apr						Mar

#### MA-13 Milestones

PO24 to PO-18	Mod Pkgs issued
PO-25	Rev A schedule issued
PO-24	Assessing Start
PO-24 to PO-12	Design Mod Docs issued
PO-18 to PO-8	WP assessing complete
PO-18 to PO 8.5	Holds removed
PO-18 to PO-3	Materials on site or dispositioned
PO-12 to PO-9	Major contracts awarded

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**Nuclear Refurbishment – Milestone  
Definition Framework**

**N-MAN-00120-10001-SCH-06-R001**  
2016-02-09

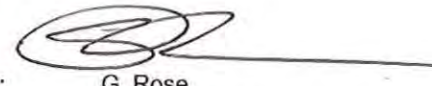
Order Number: N/A  
Other Reference Number:

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**Revision Summary**

Revision Number	Date	Comments
R000	2012-08-02	Initial issue. Previous document number N-GUID-09701-10009.
R001	2013-04-23	Revise Doc to include the AIP Scorecard & Elevated Tier 3 milestone instructions
R002	2013-11-27	Revised to update section 4.0.- Approval Process ; Part B – Milestone Completion – Final Signature and Milestone Recovery Plan form – Final Signatures
R003	2015-12-18	Revised to incorporate the Approval Process for the Readiness to Execute Plan (RTE) Milestones – Tier 4, 5. Update Recovery / Mitigation plan Process and Form (D-FORM-10763)
R004	2016-02-09	Revised to incorporate CNO Milestones (section 2.7) and the Approval level of the forms: D-FORM-10762 and D-FORM-10763

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### 1.0 DIRECTION

#### 1.1 Objective

The objective of this Manual is to outline the purpose and provide instructions on the management of Milestone definitions for Nuclear Refurbishment, within the Darlington (DN) Refurbishment Program.

The success of the Refurbishment program is highly dependent on timely completion of deliverables and achievement of milestones.

All phases will be controlled by Program Milestones (Tier 1,2,3). Adherence to milestone timelines and definitions is essential to ensure a successful Refurbishment. Each project will also have Milestones (Tier 4 and 5)

#### 1.2 Purpose

This Guide will standardize the framework for developing Darlington Refurbishment Milestone definitions.

The purpose of this Guide is to provide Darlington Nuclear Refurbishment staff and support organizations with knowledge of:

- Milestone Tier Structure
- Milestone Numbering Nomenclature
- Common Milestone Definition Template
- Milestone Completion Progress Monitoring
- Quality Requirements for Milestone Deliverables
- Milestone Closeout and Document Retention Requirements

#### 1.3 Intended Audience

The Darlington Refurbishment Program as documented in the DN Refurbishment Program Integrated Master Schedule NK38-PLAN-00300-10000, including all projects within the program which includes ASIC funded projects scheduled in the Refurbishment Outage.

All Milestones will be identified with a Milestone Tier Structure in accordance with Section 3.1 below.



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## 2.0 MILESTONE DEFINITION REQUIREMENTS

### 2.1 Tier 1, 2 & 3 Requirements

All Tier 1, 2 and 3 milestones require an approval milestones definition form.

Tier 1, 2 & 3 are at the NR Program Level and represents Key Program Control Milestones

Each project/ functional schedule, as a minimum, shall have the following program reportable (elevated Tier 3) milestones

- i. Detailed design complete
- ii. Scope Health progress to 20
- iii. Request for proposal
- iv. Contract (s) award
- v. Long Lead Material Identified
- vi. Commissioning Start
- vii. Available for Service
- viii. Any project or functional specific milestone that has important consequences for the Program i.e. EDM for Refueling

### 2.2 Tier 4 & 5 Requirements

Tier 4 and Tier 5 Milestones are at a Project/ Functional Bundle level and requirements will be identified at the project level following the Task Instruction: DNG Refurb— Standard Projects Milestone List, N-MAN-00120-10001-SCH-02. A sample of Standard Milestones Listing completed with associated Milestone Tier coding Structure is shown in Appendix “B”

### 2.3 NR AIP Milestones and Scorecard Requirements

NR AIP Milestone is referring to Nuclear Refurbishment Program AIP level milestones.

A Milestone Definition Template (D-FORM-10762) is required for each identified NR AIP Milestone as outlined in the NR AIP Scorecard list.

NR AIP Milestones should be identified at least as Tier 3 reportable milestones.

### 2.4 CNO Milestones

The CNO Milestones are presented to the Chief Nuclear Officer and they shall be identified as Tier 3 reportable milestones. A Milestone Definition Template (D-FORM-10762) is required for each identified CNO Milestone.

The Approval Process Diagram (4.2) shall be followed.

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## NUCLEAR REFURBISHMENT – MILESTONE DEFINITION FRAMEWORK

### 2.5 Milestone Schedules Structure

The Project/ Functional Bundles Milestones Schedules structure (including milestone P6 coding process) will be followed as described in the “DR Program P6 Schedulers User Guide” N-MAN-00120-10002-SCH-08

### 2.6 Readiness to Execute Plan Milestones (RTE)

Readiness to Execute Plan is in support of tracking all processes, tools, and deliverables to ensure readiness for execution phase.

The RTE plan consists of a series of significant milestones leading up to the start of the DNRU2 Outage. These milestones are mainly Tier 4 and Tier 5 with some being Tier 1, 2 or 3. Due to their importance, RTE T4 & 5 milestones will be controlled with slightly more rigor than other T4 & 5 milestones.

RTE Tier 1, 2, 3 milestones follow the same processes as other Tier 1, 2, 3 milestones.

The Approval Process Diagram (4.3 – Approval Process Diagram for RTE Milestones) should be followed for Tier 4 and Tier 5 only.

## 3.0 PROCESS

### 3.1 Milestone Tier Structure

There will be Milestones at the Program level and Gates/Projects Milestones (per Gated Process N-MAN-00120-10001-GRB & N-MAN-00120-10001-SCH-02) at the Project level.

The relationship between Program Milestones and the Gated Process is shown in Appendix A.

Milestone Reporting Tier Structure is required to identify Key Program Control Milestones and to easily identify the level in the Organization that the Milestone is reportable to and the Approval Level required for any deviation to the Milestone

Tier	Reportable To	Definition	Example
1	• EVP Nuclear Refurbishment	• Commitments to the Board or decisions at Board Level	• RQE Release Quality Estimate • Unit Start/Finish Dates
2	• SVP Nuclear Refurbishment	• Critical to the Program ** Normally documented in	• CNSC Approval of ISR

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		Phased Program BCS's per Release Strategy **	
3	• SVP Direct Reports	• Manage the health of the program and keep it on track	• All Projects Scope Freeze/Detailed Eng. Finished
4	• VP Refurbishment Execution (or delegate)	• Project Gates (checkpoints of project preparation progress at which funding is released for next phase) • Pre Install Activities	• G0 Project Scope Approval • G3 Definition Phase • Walkdowns Complete • ALARA Plans Complete
5	• Project Manager	• Within gated process and are specific to project life cycle	• Turbine Generator Project Charter Approved (CHR) • Management Plans Completed • Project Long Lead Materials

## 3.2 Milestone Numbering Nomenclature

### 3.2.1 PIMS Milestones

The Activity ID from the Program Schedule (PIMS) will be assigned as the Major Milestone number.

Same Activity ID will be used to identify the specific record number when filling D-FORM-10762 –Program Milestone Definition, or D-FORM-10763- Program Milestone Recovery Plan.

The Schedule Activity ID coding is as follow:

Activity ID Coding	Code Description
RG	Regulatory Key Dates
RL	Program Release Dates
CP	Campus Plan Dates
RP	Unit 0 Outage Preparation Key Dates
OP	Unit "" Outage Preparation Key Dates
U""	Unit "" Outage Key Dates
CL	Program Close Out Key Dates

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### 3.2.2 Elevated Tier 3 Milestones

The Activity ID from the Project/ Functional Bundles Schedule will be assigned as the Major Milestone number.

The Project/ Functional Bundles Schedules Activity ID coding structure will be followed as described in the “DR Program P6 Schedulers User Guide”. N-MAN-00120-10002-SCH-08.

### 3.2.3 NR AIP Milestones

The Activity ID from the Program/Project will be assigned as the NR AIP Major Milestone number.

### 3.2.4 NR AIP Scorecards

If the NR AIP Scorecard Measure is a combination of more than one schedule Activity IDs, or has an arbitrary background other than the schedule, the AIP scorecard nomenclature will illustrate the AIP measure description.

## 3.3 Milestone Definition Template

The Milestone Definition Template (D-FORM-10762) is required for Tier 1, Tier 2, & Tier 3 Milestones only except for RTE Milestones. Included on the template will be the requirements for the Milestone Completion signoff. Instruction on how to fill in D-FORM-10762 is shown in Appendix E.

## 3.4 Milestone Completion Progress Monitoring

Timely and quality completion of milestones is critical for executing Darlington Refurbishment on schedule.

In order to ensure quality and timely completion of Milestones, the following formal monitoring process is required to manage/control/review/report completion progress of all Tier 1,2 &3 milestones.

All Tier 4 & 5 milestones will be managed by the individual project manager through the normal project management process. The project management process will interface with this process when it impacts a Tier 1,2 or 3 milestone.

### 3.4.1 Milestone Definition Signoff

The Milestone owners will signoff agreement to the definition of the milestone.

The signoff will be included on the Milestone Definition template D-FORM-10762 Part “A”.

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### 3.4.2 Milestone Success Plan Presentation

Prior to the Milestone due date the Milestone owner will present, at the monthly program review meeting, their plan specifying how they will satisfy the requirement for a quality and timely completion of the Milestone.

The milestone success plan presentation should be done 3, 6 or 9 months prior to Milestone TCD date. (Refer to D- FORM-10762 Part “A”)

A template for the Success Plan Presentation is shown in Appendix “C”

### 3.4.3 Milestone Recovery and Mitigation Plans Requirements

Recovery or mitigation plans are required whenever the variance from plan is significant enough that completing a milestone within the committed timeframe and with quality, is at risk. The distinction between a recovery plan and mitigation plan is below.

Recovery Plan:	Detailed plan that supports full recovery of the milestone within the committed time frame.
Mitigation Plan:	Detailed plan that identifies how commitments within milestone will be achieved, however outside of the committed time frame. I.e. milestone will be missed.

Milestones identified as Tier 1, 2, or 3 require recovery or mitigation plans documented within D-FORM-10763. Instruction on how to fill in D-FORM-10763 is shown in Appendix F.

Where milestone recovery is not possible, and a mitigation plan has been initiated, a change in the milestone date may be required. Changes to Tier 1, 2, or 3 milestones commitments are required to follow the Change Control process and mitigation plan should be attached.

#### 3.4.3.1 Recovery and mitigation plans shall address the following:

- Original milestone completion date
- Target date by which full recovery will be completed
- Description of why the Milestone became challenged
- Course of action to recover the Milestone including responsible individuals and due for actions

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e. Successor milestones that are affected and the impact.

3.3.4.2 Approval of the milestone recovery and mitigation plans will be consistent with milestone tier structure approval (Section 3.1).

3.4.3.3 A summary of the milestone recovery and mitigation process is shown in Appendix D”.

### 3.4.3 Milestone Change Control Process

In the event that the timely completion of the identified Tier 1, 2 or 3 milestone is in jeopardy a Milestone Recovery Plan should be followed as described under item 3.4.3

In order to cancel a Tier 1, 2 & 3 milestone the Change Control process has to be followed as described in N-MAN-00120-10001-PC-12.

In the event that a Tier 1, 2 or 3 milestone is following the cancelation process, the milestone recovery form N-FORM -10723 shall be attached to the Change Control Form N-FORM-11252 as per N-MAN-00120-10001-PC-12.

Tier 4 & 5 milestones will be managed by the individual project manager through the normal project management process.

### 3.5 Quality Requirements for Milestone Completion and Closeout

Completion of all the Program Milestones (Tier 1 to Tier 3) must be supported by a suitable quality verification process. Depending on the type of Milestone and the deliverables associated with completion, quality verification may be comprised of any one or more of the following:

- (a) Demonstration that preparation, review and approval of supporting deliverables have been controlled by an existing managed system (e.g. OPG/OPGN/DR governance, other Quality Assurance methods or processes adopted by OPGN/DR for conducting its business)
- (b) Demonstration that preparation, review and approval of supporting deliverables have been vetted or validated through other established work processes and practices in OPGN/DR, which may take the form of internal memos, presentations to and agreements from relevant stakeholder, minutes of meetings etc.
- (c) Demonstration that the quality of supporting deliverables has undergone independent, third-party verification.

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- (d) Successful outcome from a Challenge Meeting or Challenge Process solely conducted for verifying adequate completion of a milestone against a pre-established set of expectations/success criteria agreed to between the milestone owner and the receiving stakeholder(s).

The requirement for a Challenge Meeting or Challenge Process will be embedded in each specific Milestone Definition.

A Milestone shall not be declared complete until all requirements have been successfully completed or dispositioned. Completion needs to be fully documented and needs to be auditable.

To ensure this, Milestone Closeout needs to be documented; a signed Darlington Refurbishment Signoff for Milestone Completion identifying the deliverables/documents that were completed will be presented at the monthly program review meeting.

Darlington Refurbishment Signoff for Milestone Completion signoff will be included as "Part B" on the Milestone Definition Template D-FORM-10762.

### 3.6 Milestone Completion, Closeout and Document Retention Requirements

A Milestone shall not be declared complete until all requirements have been successfully completed or dispositioned. Completion needs to be fully documented and needs to be auditable.

To ensure this, Milestone Closeout needs to be documented; a signed Darlington Refurbishment Signoff for Milestone Completion identifying the deliverables/documents that were completed will be presented at the monthly program review meeting.

If a Challenge Meeting is identified for a Milestone, this form will be presented at the Challenge Meeting.

Darlington Refurbishment Signoff for Milestone Completion signoff will be included as "Part B" on the Milestone Definition Template D-FORM-10762.

## 4.0 APPROVAL PROCESS

### 4.1 Routing and Authorization

The initiator shall complete all the section of the milestone templates form as required. Major steps on the routing and authorization process are described in the Approval Process Diagrams.

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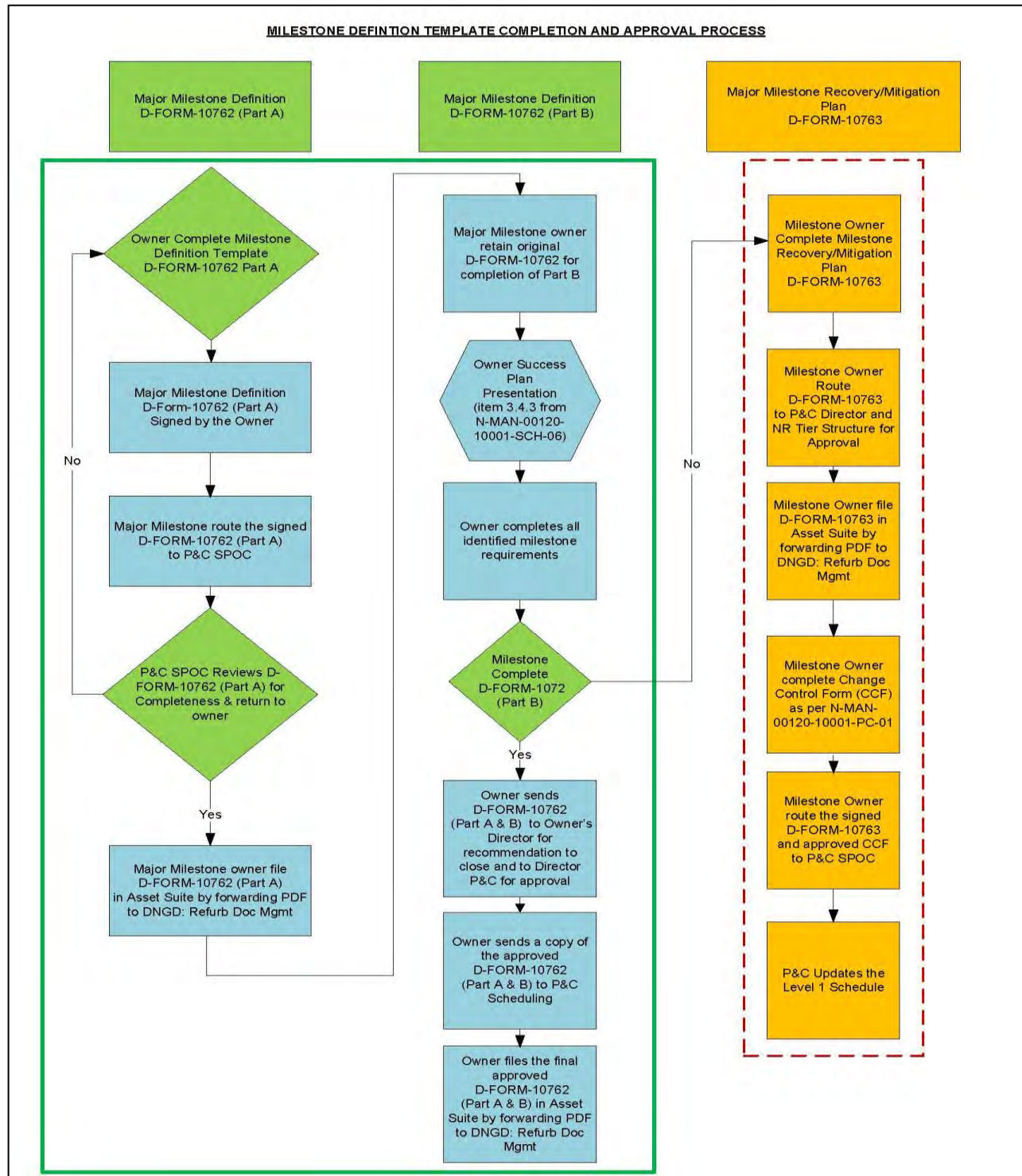
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#### 4.2 Approval Process Diagram for Tier 1, 2, 3 & AIP Milestones

For approval process the attached completion and approval process diagram should be followed.





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### 4.3 Approval Process Diagram for RTE Milestones (Tier 4, 5 only)

“RTE Milestones Definition Form and Approval Process Diagram” should be followed

#### RTE Milestone (Tier 4,5) Definition Form Completion and Approval Process

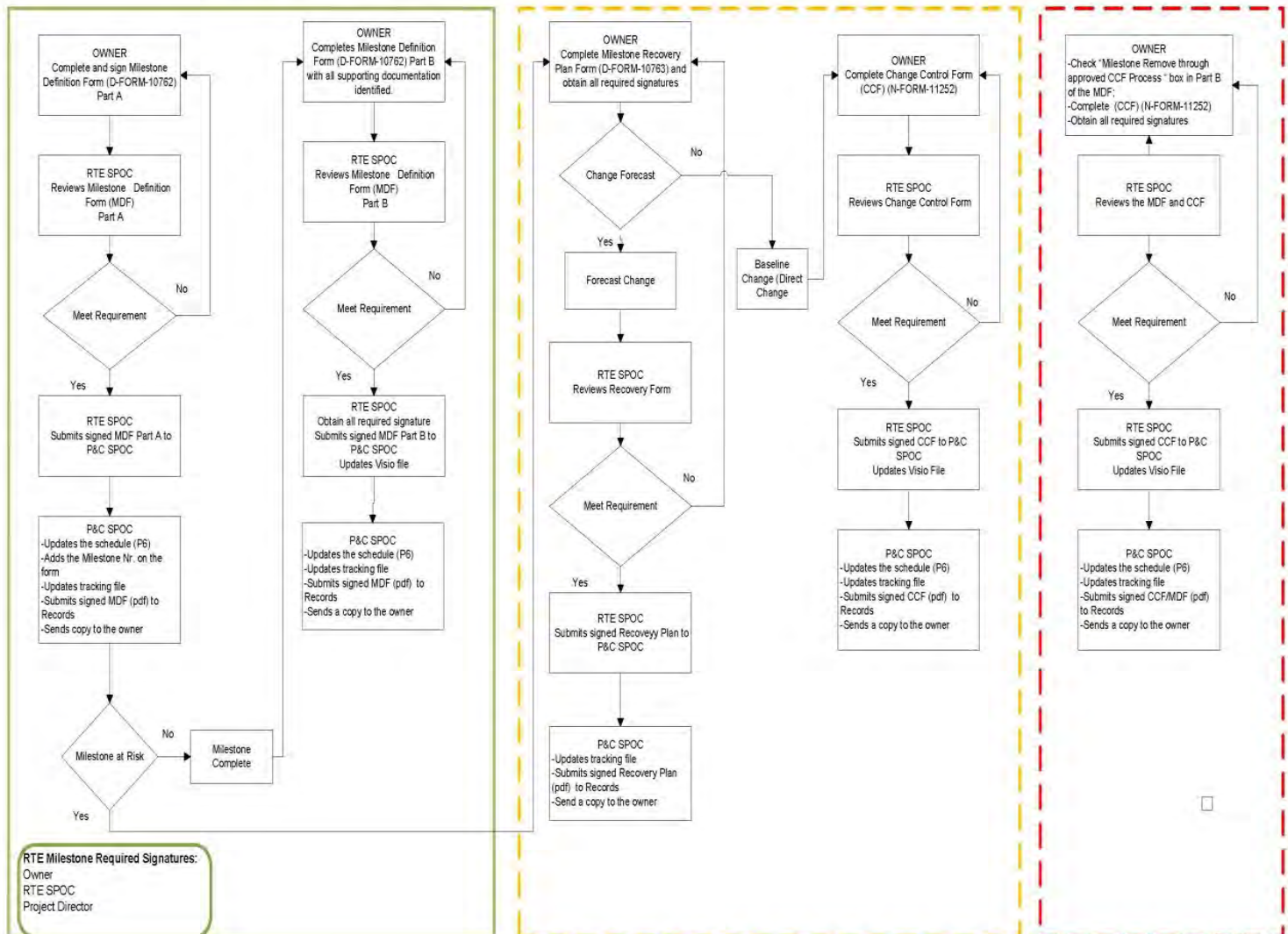
##### Milestone Definition Form (D-FORM-10762) Part A - Workflow for New Milestones

##### Milestone Definition Form (D-FORM-10762) Part B - Workflow for Completed Milestones

##### Milestone Recovery Plan (D-FORM-10763) – Workflow for Forecast change

##### Milestone Change Control Form (CCF) (N-FORM-11252) – Workflow for Change Control Process

##### Workflow for Milestone Deletion



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### 5.0 RECORDS AND REFERENCES

#### 5.1 Records

The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (ASSET SUITE Type/Sub-Type)
Darlington Refurbishment Program Milestone Definition	D-FORM-10762	N	File as a record using the following document numbering configuration: (note: Milestone number will be recorded in doc number) NK38-REF-09701-xxxxxx Retention: 10 years after Completion/Settlement RRC: NO2-0049 Each milestone definition will be linked to the associated milestone
Darlington Refurbishment Milestone Recovery / Mitigation Plan	D-FORM-10763	N	File as a record using the following document numbering configuration: (note: Milestone number will be recorded in doc number) NK38-REF-09701-R-xxxxxx Retention: 10 years after Completion/Settlement RRC: NO2-0049

#### 5.2 References

This Guide receives its authority from N-MAN-00120-10001-SCH NR Schedule Management.

- [R-1] N-MAN-00120-10001-GRB - Nuclear Projects Gated Process
- [R-2] N-MAN-00120-10001-PC-12 - Nuclear Refurbishment – Program Change Management
- [R-3] D-FORM-10762 - Darlington Refurbishment Program Milestone Definition Template
- [R-4] D-FORM-10763 - Darlington Refurbishment Program Milestone Recovery / Mitigation Plan Template

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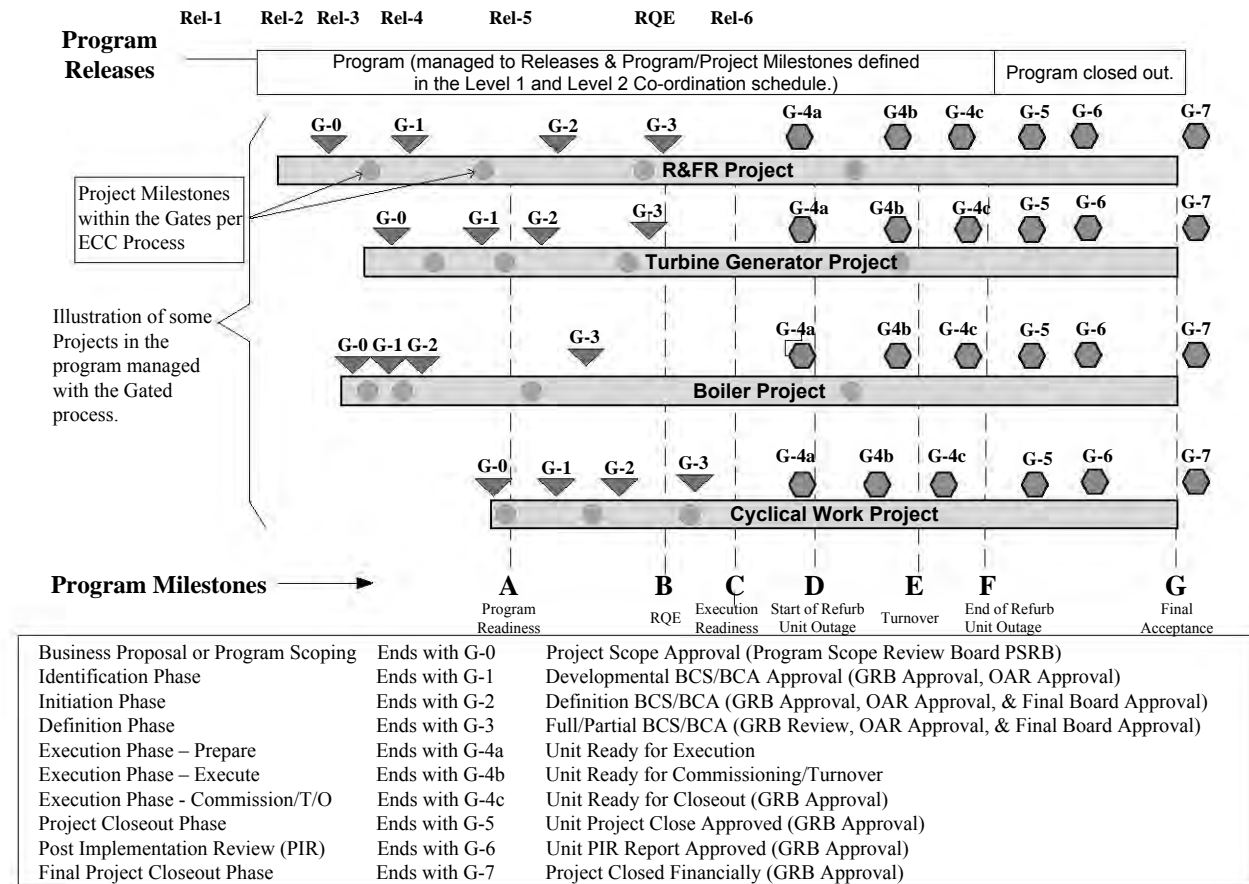
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**Appendix A: Structure of Gated Process/Program/Project Milestones**

**Darlington Refurbishment Program**





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Appendix B: Standard Milestone Listing

Darlington Refurbishment  
 Standard Milestone Codes



Standard Milestone Listing						Milestone Tier Structure					
Order	Milestone Type	Milestone Code (P6)	Notes	Milestone Title	Description and Use	Milestone Tier Structure Code	Associate Program Milestones for Reference	Milestone Completion Criteria	Responsibility	Mandatory Y/N	Project Life Cycle Phase
* 1	Finish	CDC		Conceptual Design Complete	Completion of conceptual design activities to determine alternatives/options and recommendation of a preferred alternative.	5		All conceptual studies and reports pertaining to preparation of Modification Outline have been accepted by OPG.	• Owner: Engineering • Support: Vendor/Project	N	Initiation
2	Finish	GR1		Gate G1 Approval	Gate G1 approval for Refurb projects.	4		Initiation Phase Approval (Refurb).	• Owner: Project • Support: P&C	Y	Initiation
3	Finish	GR2		Gate G2 Approval	Gate G2 approval for Refurb projects.	4		Definition Phase Approval (Refurb).	• Owner: Project • Support: P&C	Y	Definition
4	Finish	GR3		Gate G3 Approval	Gate G3 approval for Refurb projects.	4		Unitized Execution Phase Approval (Refurb).	• Owner: Project • Support: P&C	Y	Execution
5	Finish	GR4		Gate G4 Approval	Gate G4 approval for Refurb projects.	4		Unitized Project Closeout Phase Approval (Refurb).	• Owner: Project • Support: P&C	Y	Closeout
6	Finish	GR5		Gate G5 Approval	Gate G5 approval for Refurb projects.	4		Final Project Closeout Phase Approval (Refurb).	• Owner: Project • Support: P&C	Y	Closeout
7	Finish	RFP		Request For Proposal	All documentation required to initiate the contract procurement process have been issued.	3		<ul style="list-style-type: none"> <li>• Key terms and conditions have been developed and accepted by legal</li> <li>• All required Engineering documents (e.g. PDR, specs) are issued</li> <li>• Scope of work is issued</li> </ul>	• Owner: Supply Chain • Support: Project/Legal	Y	Definition
* 8	Finish	EPC	Predecessor to MS-11 **	Award Contracts / PO Issued	All EPC contracts have been awarded. Purchase Orders are adequately funded to cover the agreed upon contract value. Milestone applicable for a unit or a planned outage. Individual associated Tier 5 milestones might be identified at lower level in the schedule.	3		<ul style="list-style-type: none"> <li>• N-FORM-10029 has been approved by appropriate level of OAR and PO is issued in Passport.</li> <li>• EPC vendor has been given charging path for the services rendered to OPG.</li> </ul>	• Owner: Supply Chain • Support: Project/Legal	Y	Definition
9	Finish	DCA		Design Contracts Awarded / PO Issued	PO issued and approved in PassPort	4		• EPC vendor has been given charging path for the services rendered to OPG.	• Owner: Project • Support: Vendor	Y	Definition
10	Finish	ICA		Installation Contracts Awarded / PO Issued	PO issued and approved in PassPort	4		• EPC vendor has been given charging path for the services rendered to OPG.	• Owner: Project • Support: Vendor	Y	Initiation
11	Finish	PCA		Procurement Contracts Awarded / PO Issued	PO issued and approved in PassPort	4		• EPC vendor has been given charging path for the services rendered to OPG.	• Owner: Project • Support: Vendor	Y	Definition
* 12	Finish	DES		Preliminary Design Completed	Preliminary Design is complete for review against the criteria provided in the gated Process. Design is responsible for this milestone.	5		The approved Modification Outline, the issued Design Plan, the issued Design Requirements, and the issued Design Release Plan must be attached to the Master EC record. A forecast for the required Project Design resources and the schedule for the remainder of the project has been documented.	• Owner: Engineering • Support: Vendor/Project	Y	Definition
13	Finish	LLT		Long Lead Time Material Identified	EPC contractor to provide list and description of materials that potentially have equal or greater than 24 months lead time for delivery from the time OPG approval has been granted to proceed with purchase. Milestone applicable for a unit or a planned outage. Individual associated Tier 5 milestones might be identified at lower level in the schedule.	3	U2 OP2040 U1 OP1040 U3 OP3050 & U4 OP4040	Supply Chain to identify / generate new CATID's and determines Q level for the listed materials	• Owner: Project • Support: Vendor	N	Initiation

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	14	Finish	PTI	Predecessor to MS-11 **	Work Identified in PassPort	Phase I assessment of Work Orders in Passport is complete.	4	U2 OP2015 U1 OP1015 U3 OP3015 & U4 OP4015	Vendor to identify: <ul style="list-style-type: none"> <li>• 100% of approved work orders</li> <li>• Tasks for support work groups</li> <li>• Regulatory approvals</li> <li>• Where possible, required modifications, pre/post requisite work and revisions to procedures</li> <li>• 80% of Material Requisitions</li> </ul>	<ul style="list-style-type: none"> <li>• Owner: Project</li> <li>• Support: Vendor</li> </ul>	Y	Definition / Execution
*	15	Finish	WPI	Predecessor to MS-20 **	Work Plans Issued	Contractor work plan has been authorized by OPG for use.	5		<ul style="list-style-type: none"> <li>• All required signatures have been obtained</li> <li>• User classification is identified</li> <li>• Process for intent and non-intent changes is identified</li> </ul>	<ul style="list-style-type: none"> <li>• Owner: Project</li> <li>• Support: Vendor</li> </ul>	Y	Execution
*	16	Finish	PTA	Predecessor to MS-23 **	Work Package Assessment Completed and PassPort Tasks set to Ready	Vendor has obtained OPG construction Manager Acceptance on Field Installation Work Packages	4	U2 OP2070 U1 OP1070 U3 OP3070 & U4 OP4070	<ul style="list-style-type: none"> <li>• Entered additional work order tasks in passport post phase I as required</li> <li>• Submitted their requests (PC1's) to Operations for premitry needs</li> <li>• Obtained approval for Status Control Tags where possible</li> <li>• Inspection and Test Plans have been authorized by ANI for use</li> </ul>	<ul style="list-style-type: none"> <li>• Owner: Construction</li> <li>• Support: Vendor/Project/Ops</li> </ul>	Y	Execution
*	17	Finish	ECP		Design Complete	Detailed design normally an Engineering Change Package (ECP) or Vendor equivalent release is complete, approved, and issued. This includes drawings and regulatory approvals. The release may include a single unit, multiple units, or other packages of work as approved in the Engineering Change modification outline. This milestone date should be aligned with the Engineering Department Key Milestone. Milestone applicable for a unit or a planned outage. Individual associated Tier 5 milestones might be identified at lower level in the schedule.	3	U0 RP130 U2 OP2055 U1 OP1055 U3 OP3055 & U4 OP4055	All documentation required to authorize the Design Engineering Change (including updates to the AEL (Major Equipment List /Bill of Material), spare parts list, and catalogue ids) has been issued. Note: this may be on a "unit by unit" basis. A forecast for the required Project Design resources and the schedule for the remainder of the project has been documented. Note: In order to commit to this milestone date, Design requires confirmation of both major equipment Purchase Orders being issued to vendors and the vendor schedule.	<ul style="list-style-type: none"> <li>• Owner: Engineering</li> <li>• Support: Vendor/Project</li> </ul>	Y	Definition
*	18	Finish	MED		Material / Equipment Available	Equipment/Materials are available for Just in Time delivery	5		Delivery dates and staging locations have been reviewed and accepted by OPG Construction Manager in accordance with agreed upon warehousing strategy.	<ul style="list-style-type: none"> <li>• Owner: Construction</li> <li>• Support: Vendor/Project</li> </ul>	Y	Execution
*	19	Start	SOI		Start of Installation	Milestone to track the start of installation or Construction which includes Removal. Milestone applicable for a unit or a planned outage. Individual associated Tier 5 milestones might be identified at lower level in the schedule.	4		PassPort Installation Tasks have been set to Working.	<ul style="list-style-type: none"> <li>• Owner: Construction</li> <li>• Support: Vendor/Project</li> </ul>	Y	Execution
*	20	Finish	FOI		Finish of Installation	Milestone to track the Finish of installation or Construction which includes Removal.	4		PassPort Installation Tasks have been set to Finished.	<ul style="list-style-type: none"> <li>• Owner: Construction</li> <li>• Support: Vendor/Project</li> </ul>	Y	Execution
*	21	Start	CMS		Commissioning Start	Milestone required for commissioning start.Milestone applicable for a unit or a planned outage. Individual associated Tier 5 milestones might be identified at lower level in the schedule.	3		PassPort Commissioning Tasks have been set to Working.	<ul style="list-style-type: none"> <li>• Owner: Construction</li> <li>• Support: Vendor/Project/O&amp;M</li> </ul>	Y	Comm/RTS
*	22	Start	CMF		Commissioning Finished	Milestone required for commissioning finished	4		PassPort Commissioning Tasks have been set to Finished.	<ul style="list-style-type: none"> <li>• Owner: Construction</li> <li>• Support: Vendor/Project/O&amp;M</li> </ul>	Y	Comm/RTS
*	23	Finish	AFS		Available for Service and/or Ready For Service Completed	System Modification has been turned over to Operations and is available for service. For Maintenance type projects where Available For Service does not apply, the Ready For Service should be used. Milestone applicable for a unit or a planned outage. Individual associated Tier 5 milestones might be identified at lower level in the schedule.	3		AFS Acceptance: A meeting is held for AFS. If acceptance is received at this meeting, then AFS Acceptance has been met. If the meeting is held and AFS is NOT accepted, then the milestone is still active. If the meeting is moved, and AFS is accepted when the meeting is held then AFS Acceptance has been met.  Design M/S DCS (AFS Date - 2W): Support as required prior to and during outage, DCS Approved and Commissioning Results accepted, FCs complete and AFS attended.	<ul style="list-style-type: none"> <li>• Owner: Construction</li> <li>• Support: Vendor/Project/O&amp;M</li> </ul>	Y	Execution

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*	24	Finish	DCO		EC Close-out Completed	Verification that Design EC is closed-out within the 6 months of the AFS. (Design close out of the project.)	5		All support to issue final drawings/documents and close PassPort Design ECs. All action tracking items are set to complete with the exceptions noted in governance.	• Owner: Engineering • Support: Vendor/Project	Y	Closeout
	25	Finish	PCO		Close Out Completed	Milestone to identify the completion of close out activities, or to close out a specific unit. (Financial close out of the project.)	4		Project Close-out activities are complete and Project Closure Report routed for approvals.	• Owner: Project • Support: Vendor/Construction	Y	Closeout
*	26	Finish	MOE		MOE Requirement Met	Milestone for tracking Ministry of the Environment requirements. Include action tracking number in activity description.	5		Action Tracking item is complete and closed.	• Owner: Project • Support: Engineering/Ops/Vendor	N	Definition / Execution
*	27	Finish	MOL		MOL Requirement Met	Milestone for tracking Ministry of Labour requirements (e.g. Notice of Project, Project JHSC). Include action tracking number in activity description.	5		Action Tracking item is complete and closed.	• Owner: Project • Support: NR O&M H&S/Construction/Vendor	N	Definition / Execution
*	28	Finish	PMM		Project or Functional Manager Milestone	User defined Milestone for Project or Functional Team specific tracking. Use this as an interim milestone to track specific progress not already identified in this listing.	5		Project or Functional Team met the intended criteria of PMM specific Milestones.	• Owner: Project	N	Any phase is applicable
*	29	Finish	RGC		CNSC Regulatory Commitment Met	Milestone for tracking Reg C's. Include Action Tracking number in activity description.	4		Documents have been received to confirm completion. Action Tracking item is closed in PassPort.	• Owner: Reg Affairs • Support:ProjectEngineering /Vendor	N	Definition / Execution
*	30	Finish	RGM		CNSC Management Commitment Met	Milestone for tracking Reg M's. Include Action Tracking number in activity description.	4		Documents have been received to confirm completion. Action Tracking item is closed in PassPort.	• Owner: Reg Affairs • Support:ProjectEngineering /Vendor	N	Definition / Execution
	31	Finish	PCM		Plan Complete Milestone	Plan Complete Milestone. This milestone will identify the forecast completion of the entire plan.	4		Project Closure Report has been approved.	• Owner: Project • Support:Vendor	Y	Closeout
*	32	Finish	INC		Inspections Complete	Milestone for tracking when inspection(s) are complete.	5		Inspections complete and signed documents have been issued.	• Owner: Project • Support:Vendor	Y	Any phase is applicable
	33	Finish	IPC		Installation of Pre-requisite work complete	Installation of pre-requisite work, outage tools, equipment and Facilities completed prior to refurb.	5		All Pre-requisite Work, outage tools, equipment and Facilities associated with the project is now complete and signed off.	• Owner: Construction • Support: Vendor/Project	N	Definition
	34	Finish	PCI		Procedure change requirements identified	Procedures requiring update/ changes are identified.	5		TPAR's for Operation and Maintenance producers have been approved and submitted to Document Control for implementation. Responsible group to initiate an AR to track the rollout of the revised procedure.	• Owner: Project • Support:Vendor	N	Definition
	35	Finish	PRI		Procedures Issued	Procedures requiring update/ changes issued.	5		Signed documents have been issued in Passport. The AR for rollout of the revised procedure(s) has been signed off by the responsible manager.	• Owner: Project • Support:Vendor/O&M/Engineering	N	Definition
	36	Finish	PMU		PM (Preventive Maintenance) updated	All PM are now reviewed /updated	5		All Preventive Maintenance Work associated with the project has been identified and required revisions have been incorporated in Passport	• Owner: Engineering • Support: Vendor/Project/O&M/Engineering	N	Definition



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	37	Finish	TRI		Training Material Issued	All project specific training materials have been issued by the vendor	5		Vendor to demonstrate that all project specific training materials have been verified by a qualified individual(s) and ready for use in accordance with agreed upon training plan.	• Owner: Project • Support:Vendor/Training	N	Definition
	38	Finish	TRC		Training Completed	All project specific training have been delivered in accordance with the agreed upon training plan	5		Vendor to provide training records for all trained staff and obtain approval to process staff credit in OPG's Training Information Management System	• Owner: Project • Support:Vendor/Training	N	Definition
	39	Finish	RGA		Regulatory Approvals Obtained	Milestone to address commitments that we need to meet, but not for having necessary approvals in place.	4	RG120	Documents have been received to confirm completion.	• Owner: Project • Support:Vendor/Reg Affairs	N	Definition
	40	Finish	RVA	Predecessor to MS-03 **	Revision 'A' schedule support	Vendor leve1 has been submitted for outage REV “A” schedule issuance	4	U2 OP2010 U1 OP1010 U3 OP3010 & U4 OP4010	The duration of execution windows, work calendar and shift structure has been mutually agreed between Project Manager and vendor. Level 1 schedule has been signed off and submitted to the outage team for integration.	• Owner: Project • Support:Vendor	Y	Definition
	41	Finish	RVB	Predecessor to MS-19 **	Revision 'B' schedule support	Vendor level 2 for non-critical path work has been submitted for outage REV “B” schedule issuance. For refurbishment critical path work, vendor must submit level 3 schedule.	4	U2 OP2050 U1 OP1050 U3 OP3040 & U4 OP4050	Major components of execution window for non-critical path work have been identified and signed off by Project Manager and vendor	• Owner: Project • Support:Vendor	Y	Definition
	42	Finish	RVC	Predecessor to MS-28 **	Revision 'C' schedule support	Vendor must submit a fully resource loaded level 3 in support of Refurbishment integrated schedule issuance	4	U2 OP2080 U1 OP1080 U3 OP3080 & U4 OP4080	Full level 3 schedule has been issued. Reporting structures and communication plan with all major stakeholders have been approved.	• Owner: Project • Support:Vendor	Y	Definition
	43	Finish	RVO		Rev 0 schedule issued	Vendor to submit a base line execution schedule	4	U2 OP2110 U1 OP1110 U3 OP3110 & U4 OP4110	Execution schedule has been approved by project manager	• Owner: Project • Support: Vendor	Y	Definition
	44	Finish	LLC		Lessons Learned Compiled	Project team to develop a comprehensive list of lessons learned through SCR's, logs, etc	5		Project Manager to initiate a C3 SCR to capture key lessons learned from the previous outage and get concurrence from the Evaluation Organizations that are in the best position to disposition the generated actions.	• Owner: Project • Support:Vendor/Engineerin g/Construction	Y	Definition
	45	Finish	POA		Phase 1 Assessment Complete	Phase I assessment of Work Orders in Passport is complete.	5		EPC vendor to identify: • 100% of approved work orders • Tasks for support work groups • Regulatory approvals • Where possible, required modifications, pre/post requisite work and revisions to procedures • 80% of Material Requisitions	• Owner: Project • Support:Vendor	Y	Definition
	46	Finish	WDC		Walk Downs Complete	All Project Bundle walkdowns are now complete.	5		All task coded to the vendor/Project have been accepted or rejected in walkdown toolkit prior to start of execution window	• Owner: Construction • Support: Vendor/Project	Y	Definition
	47	Finish	S20		Scope Health Progress to 20	Work is known at the system or project level but not component. Milestone applicable for all packages issued. Individual associated Tier 5 milestones might be identified at lower level in the schedule.	3	OP1000	Definition Phase complete. Solution defined at system or project level. Plan to implement solution is defined. System or project scope is defined.	• Owner: Project • Support:Vendor	Y	Definition
	48	Finish	SOW	For Functional Work	Scope of Work Document Complete	This milestone will identify the Scope of Work document is complete.	5		Scope of Work Document (s) (including Preliminary) complete and issued.	• Owner: Project	N	Definition
	49	Finish	DRC	For Functional Work	Design Requirement Complete	This milestone will identify Design Requirement complete.	5		Design Requirement are complete and signed documents have been issued.	• Owner: Project	N	Definition
*	50	Finish	CBA		Cost Benefit Analysis Complete	This milestone will identify the completion of the Cost Benefit Analysis in order to start the ECR or start the process to cancel the DSR. This is required for Value Enhancing DSR's only.	5		Cost Benefit Analysis complete and issued.	• Owner: Project	N	Definition

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Appendix B: (Continued)

Darlington Refurbishment  
 Standard Milestone Codes



51	Start	SGS		Segment Start (Program)	Milestone required for start of a segment. The segment is a part of a schedule that has a natural logic which marks the start of a large number of windows /activities. The intend of creating a segment is to minimize the number of activities that are carried over from one phase to another.	3	OP2300S1, OP2200S1, OP2060S1, OP2230S1 ,OP2350S1, OP2330S1, OP2260S1/ OP2060S3OP2300S2,OP2200S2,OP2060S2,OP2	All activities that lead to start a segment should be completed	• Owner: Construction • Support: Vendor/Project	Y	Execution
52	Finish	SGF		Segment Finish (Program)	Milestone required for finish of a segment. The segment is a part of a schedule that has a natural logic which marks the finish of a large number of activities. The intend of creating a segment is to minimize the number of activities that are carried over from one phase to another.	3	OP2300S1, OP2200S1, OP2060S1, OP2230S1 ,OP2350S1, OP2330S1, OP2260S1/ OP2060S3OP2300S2,OP2200S2,OP2060S2,OP230S2A,OP2350S2A,OP	All activities that are part of a segment have to be completed.	• Owner: Construction • Support: Vendor/Project	Y	Execution
53	Start	WNS		Execution Window Start (Program)	Milestone required for start of execution window. This window will allow the schedule to be sorted and viewed by any combinations of these elements.	3		All activities that are scheduled to start in a specific window should be completed	• Owner: Construction • Support: Vendor/Project	Y	Execution
54	Finish	WNF		Execution Window Finish (Program)	Milestone required to finish execution window. This window will allow the schedule to be sorted and viewed by any combinations of these elements.	3		Actvities that are scheduled to finish in a specific window to be completed.	• Owner: Construction • Support: Vendor/Project	Y	Execution
55	Start	SYS		System Released for RTS	Milestone required to start testing for systems or modifications	3		Systems CCD (construction completion declaration )packages completed and accepted.	• Owner: Construction • Support: Vendor/Project	Y	Execution
56	Finish	SYF		System Released for Operation	Milestone required for system to be ready for operations	3		Systems SAFS packages completed and accepted.	• Owner: Construction • Support: Vendor/Project	Y	Closeout
57	Finish	CCD		Construction Completion Declaration	Milestones required for confirmation that construction and installation activities are sufficiently complete and it is safe to proceed with modification commississioning and restart testing on affected SSCs.	3		All documentation required for CCD (field changes, non-conformance reports, marked up drawings, etc) have been completed . The package will be accepted by the Nuclear Refurbishment Project Manager and sent to Return To Service Manager.	• Owner: Construction • Support: Vendor/Project	Y	Execution
58	Finish	GR	Review MS ID if it makes sense. There is currently no ties to PMSSC	Gate Approval (1,2,4,5)	Gate G1 approval for Refurb projects.	4	N/A	Initiation Phase Approval (Refurb).,Definition Phase Approval (Refurb).,Unitized Project Closeout Phase Approval (Refurb).,Final Project Closeout Phase Approval (Refurb).			
59	Finish	FOT		TMOD installed	Milestone to track the Finish of installation or Construction which includes Removal.	5	NA	PassPort Installation Tasks have been set to Finished.	• Owner: Construction • Support: Vendor/Project	Y	Execution
60	Finish	RQE		Rel.5/6/RQE: U2 Outage Release	ROE Milestone represents an OPG Management Decision Gate for the Darlington Nuclear Refurbishment Program (DNRP) within the Release Strategy and signifies the completion of the detailed planning and establishes a program level scope, cost, and schedule baseline for the DNRP (all four units). The output of this phase will also be used to enable Execution Phase funding for Unit 2. The OPG Management Decision Gate will be based on the completion of a number of definition phase planning deliverables, compiled into a Program level "ROE Package". The summary of these deliverables will be documented in a DNRP Business Case Summary (BCS) for the entire Refurbishment program including a release of funds for Unit 2.	1	N/A	The manner in which the ROE milestone will be managed is documented in the ROE Project Management Plan (NK38-NR-PLAN-09701-10004). The ROE deliverables will incorporate a number of products completed during the definition phase of the program.	• Owner: Project • Support: Vendor	Y	Definition



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Appendix B: (Continued)

Darlington Refurbishment  
 Standard Milestone Codes



61	Finish	HRF		Program Health Review Finished	Program Health Review Finished: - External review of governance related to ROE is completed and action plan to address findings in place. - External review of ROE development progress completed and action plan in place to address findings.	3	N/A	Contracts with 3rd party reviewers awarded. Reports generated and action plans developed.			
62	Finish	RVO		Outage Level 1 Revision 0 Issued (Control Version)	The Revision '0' schedule shall include the following: • A detailed NR outage schedule incorporating the following aspects: • Level I schedule overview identifying the key components of the finalized Critical Path, major projects and programs (PIMS C). • Level II schedule overview identifying the system windows with durations (PGGS G) . • Each level III logic has been completed by the EPG vendor and approved by the NR Project Manager for all NR outage project scope. • A level III logic has been tied and resource levelled for all cyclical outage scope by the NR Planning & Controls Work Management department. • The NR Planning & Controls Work Management department has integrated each EPC vendors' and cyclical outage schedules. • Resources levelling for all NR functional support (i.e. NR Operations, Radiation Protection) is complete. • Each schedule clearly identifies RTS/QCHP window and logic sequencing if required.	3	N/A	• Milestone Success Plan Presentation prior to due date: 0 3 Months 06 Months 09 Months • Identify reference to any process, letters, documents, transmittals in support of milestone completion. The Revision 0 NR outage schedule has been reviewed and approved by the listed supporting managers, including an independent review, The approved schedule incorporates feedback by the Stratum IVN managers, the NR Outage Execution Team and NR Reactor Safety Engineering based on review of the Revision C schedule, fin al schedule integration meetings and the issued Reactor Safety Assessment. Any revisions to the schedule require the plan to be reapproved by all stakeholders. Document this milestone completion by attaching the following Revision 0 schedule components to the milestone sign-off sheet: (a) Revision 0 Level 1 Logic (b) Revision 0 Level 2 Window Logic Overview (c) Revision 0 Level 3 Critical Path logic (d) Schedule development final work down curve at Revision 0.	• Owner: Project • Support: Vendor	Y	Definition
63	Finish	CRR		Cyclical Scope/Cost/Duration Reconciliation Review	The Director, Work Management with supporting managers and functional groups should conduct a Cyclical Scope/CosVDuration Reconciliation Review meeting prior to RQE submission and OMS scope freeze date. The desired outcome of this meeting is to have completed a review of desired cyclical maintenance work in DNRU2 outage and reconciled it against budget, duration and Outage Goals. The review will: - Recommend scope cuts as required to remain within maintenance budget constraints and/or - Provide an estimate of the additional funding required to complete the maintenance work required to achieve the high-level maintenance goals established for the refurbishment outage. Recommendations from the Scope/CosVDuration reconciliation review will be reviewed by the USRB and forwarded to the PSRB as required.	3	N/A	• The Work Control Team Leaders, Supporting Managers, Operations and System Engineering have completed a full review of OMS Approved scope for the outage and concurred. • Recommend scope that should not be or cannot be completed. • Identify and justify work that must be completed that will be in excess of maintenance budget goals. • Identify any work that will be approved for scope that is on the Materials at Risk List with appropriate justification and or mitigation strategy. • Document and issue the minutes of meeting from the Cyclical Scope/Cost/Duration Reconciliation Review meetings. • Submit recommendations from the meeting to USRB for decisions and action • Document this M/S completion by attaching a copy of the final issued minutes from the Scope/Cost/Duration Reconciliation and any approved scope that is on the Materials at Risk List with appropriate justification and or a mitigation strategy.			
64	Finish	MTS		Window Materials Staged and Tools on Site		4	N/A				
65	Finish	DOC		Window Documentation Ready	Supporting documentation includes Work Plans, Operations and Maintenance Procedures and ALARA Plans. All supporting documentation that is required to complete final assessments as per N-PROC-MA-0002 must be issued and approved at this time. This includes all Risk Mitigation Plans and recall strategies that support shut down safety that have been identified by RO-13. Risk Mitigation Plans and recall strategies that support shut down safety identified after RO-13 will be required to be completed by PO-08 (Risk Mitigation Plans Prepared MIS; OP2210). Where reviews are required, draft version of support documents will be available at least one month prior to the MIS due date. Review comments should be fed back to the author with sufficient time to Disposition the comments.	4	N/A	All required Outage Support Documentation has been approved and issued for the purpose of Work Planning to proceed as per N PROC-MA-0002. Document this MIS completion by attaching a copy of the Documents WDC and a list of all documents issued.			

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Appendix B: (Continued)

Darlington Refurbishment  
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66	Finish	DEC		Segment # Dose Estimate Complete	Dose estimate complete	3	N/A				
67	Finish	OPS		Segment # Detailed Outage Segment Permitry Level 1 Plan Complete	Detailed outage segment permitry L1 plan complete	3	N/A				
68	Finish	MST		Window ### Materials Staged and Tools on Site	Materials staged and tools on site	4	N/A				
69	Finish	WPP		Segment # Work Permits Prepared and Reviewed and Challenge Meetings Held by Operations	Work permits to be prepared and reviewed	3	N/A				
70	Finish	RSM		Segment # Reactor Safety Challenge Meeting	Reactor safety challenge meeting	3	N/A				
71	Start	CBO		Circuit Breaker Open	Start of Execution	1	N/A				
72	Finish	RTS		Return to Service Commissioning & Testing Complete	All testing and commisioning work completed	3	N/A		• Owner: Construction • Support: Vendor/Project	Y	Closeout
73	Finish	CBC		Circuit Breaker Close	End of Execution	3	N/A		• Owner: Construction • Support: Vendor/Project	Y	Closeout
74	Finish	CFC		Class 3 Frag-nets		4	OP2050				
75	Finish	CCT		Construction Check and Test Requirements		4			• Owner: Construction • Support:		Closeout



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Appendix C: Milestone Success Plan Presentation

## Milestone Success Plan Presentation

Milestone No:

Milestone Description:

Milestone TCD:

### Progress Status:

- Describe how the requirement for a quality completion of the Milestone is satisfied.
- Is the milestone completion date at risk of being delayed?

YES/NO	Comments

• Safety • Human Performance • Reliability • Value for Money

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**Appendix D: DNG Refurb – Program & Project Milestones Recovery / Mitigation Process**

**DNG Refurb – Program & Project Milestones Recovery and Mitigation Process**

The following provides summary instructions on the process of documenting and managing the recovery and mitigation plans for program and project milestones that are at risk.

**Program Milestones – Tier 1, 2, or 3**

**Process Description:**

- In the event that the timely and quality completion of a tier 1,2, or 3 milestone is in jeopardy, a milestone recovery or mitigation plan using D-FORM-10763 is required
- In the event that the milestone recovery is not possible, and a mitigation plan has been initiated, a change in the milestone date may be required. Changes to Tier 1, 2, or 3 milestones commitments are required to follow the Change Control process and mitigation plan should be attached.

**Accountability:**

Who	What	When
Milestone Owner	Follow the Program Milestone Recovery and Mitigation Plan Requirements as per N-MAN-00120-10001-SCH 06 using D-FORM-10763 form.	Completion of the Major Milestone in jeopardy
CSA	Support Milestone Owner in Developing Milestone Recovery and Mitigation Plan and associated Change Control Form (if required)	Completion of the Major Milestone is in jeopardy and when the milestone date is not recoverable

**Process**

- Milestone Owner complete Milestone Recovery and Mitigation Plan D-FORM-10763
- Milestone Owner Route D-FORM-10763 to P&C Director and obtain approval
- Milestone Owner file D-FORM-10763 in passport by forwarding PDF to DNG Doc Mgmt
- If milestone is not recoverable, Milestone Owner may be required to complete Change Control Form (CCF) as per N-MAN-00120-10001-PC-12
- Milestone Owner route the signed D-FORM-10763 and approved CCF to P&C Scheduling Department
- P&C updates the PIMS Schedule

**Application**

- All Program Milestones – Tier 1, 2, or 3

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**Appendix D: (Continued)**

*Project Milestones – Tier 4 or 5*

**Process Description:**

- Project milestone changes will be managed by strictly following the NR Change Control Process outlined on N-MAN-00120-10001-PC-12 "Cost & Schedule Change Control" Procedure.
- Project milestone owners may be requested by senior management to document milestone recovery and mitigation plans using D-FORM.

**Accountability:**

Who	What	When
Project Manager	Follow the NR Change Control Process outlined on N-MAN-00120-10001-PC-12	Completion of the Project Milestone is in jeopardy
CSA	Support Project Managers in completing Change Control Form	Completion of the Project Milestone is in jeopardy

**Process**

As per N-MAN-00120-10001-PC-12

- Project Manager completes Change Control Form (N-FORM-11252).
- Route the approved Change Control Form to P&C SPOC.
- Project assigned CSA updates the Project Schedule.

**Application**

- All project Milestones – Tier 4 or 5

**References**

- DN Refurbishment Program Integrated Master Schedule (PIMS) NK38-PLAN-00300-10000.
- Nuclear Refurbishment Cost and Schedule Change Control N-MAN-00120-10001-PC-12.
- NR Schedule Management N-MAN-00120-10001-SCH.
- DNG Refurbishment Standard Project Milestone List N-MAN-00120-10001-SCH 02.


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**Appendix E: Instruction to Fill Out D-FORM-10762 (Milestone Definition Form)**

	Records File Information:	Internal Use Only D-FORM-10762-R008*									
	<b>Darlington Refurbishment Program Milestone Definition Template</b>										
<p>Record Number: NK38-REF-09701- (1)</p>											
<p>Milestone Number: (2)</p>											
<p>Milestone Title: (3)</p>											
<p><b>Part A - Milestone Definition</b></p>											
<table border="1"> <tr> <td>Milestone Type: Program (4)</td> <td>Tier Structure: (5)</td> <td>Unit: All (6)</td> </tr> <tr> <td>Milestone Owner: (7)</td> <td>Signature: (8)</td> <td>Date: (9)</td> </tr> <tr> <td>Milestone TCD: (10)</td> <td colspan="2">Milestone Success Plan Presentation Date: (11)</td> </tr> </table>	Milestone Type: Program (4)	Tier Structure: (5)	Unit: All (6)	Milestone Owner: (7)	Signature: (8)	Date: (9)	Milestone TCD: (10)	Milestone Success Plan Presentation Date: (11)		<p><b>Milestone Definition:</b> Describe the milestone and include any supporting governance. Identify any supporting departments/Directors, if applicable.</p> <p>(12)</p>	
Milestone Type: Program (4)	Tier Structure: (5)	Unit: All (6)									
Milestone Owner: (7)	Signature: (8)	Date: (9)									
Milestone TCD: (10)	Milestone Success Plan Presentation Date: (11)										
<p>*Associated with N-MAN-00120-10001-SCH-06, Nuclear Refurbishment Program Milestone Definition Framework N-TMP-10056-R010 (Microsoft® 2007) Page 1 of 3</p>											

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**Appendix E: (Continued)**

Internal Use Only D-FORM-10762-R008	
<b>Darlington Refurbishment Program Milestone Definition Template</b>	
<p><b>Requirements to Satisfy the Milestone (Reference N-MAN-00120-10001-SCH-06):</b></p> <ul style="list-style-type: none"> <li>Identify reference to any process, letters, documents, transmittals in support of milestone completion.</li> <li>Indicate how your department will meet <u>each</u> of the requirements of the milestone. Provide details, progress status, work down curves, challenges, etc. Use separate sheets as required.</li> </ul> <div style="border: 1px solid black; border-radius: 50%; width: 40px; height: 40px; text-align: center; line-height: 40px; margin-left: 20px;">13</div>	
<p><b>Performance Indicator:</b>  Identify the performance indicators (metrics, WDC, etc) to indicate progress.</p> <div style="border: 1px solid black; border-radius: 50%; width: 40px; height: 40px; text-align: center; line-height: 40px; margin-left: 20px;">14</div>	
Milestone Predecessor(s):	Milestone Number : <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; text-align: center; line-height: 30px;">15</div> Or N/A <input type="checkbox"/>
Milestone Successor(s):	Milestone Number : <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; text-align: center; line-height: 30px;">16</div> Or N/A <input type="checkbox"/>
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Internal Use Only D-FORM-10762-R008																	
<b>Darlington Refurbishment Program Milestone Definition Template</b>																	
<b>Part B - Milestone Completion</b>																	
<p><b>Completion Status – please select one:</b> <span style="border: 1px solid black; border-radius: 50%; padding: 2px 5px;">17</span></p> <p> <input type="checkbox"/> Milestone met on or before target      Target Date      Completion Date  <input type="checkbox"/> Milestone met based on associated recovery plan      Recovery Date      Completion Date  <input type="checkbox"/> Milestone removed through approved CCF process         </p> <p><i>Please attach Recovery Plan, D-FORM-10763, and/or Change Control Form, N-FORM-11252, if applicable.</i></p> <p><b>Describe how you met this milestone and list all the deliverables/documents.</b>  <i>Indicate how your department met each of the requirements of the Milestone Definition. Provide details, PASSPORT Documents, signed letters etc. Indicate Challenge Process used.</i></p> <p><span style="border: 1px solid black; border-radius: 50%; padding: 2px 5px;">18</span></p>																	
<p><b>Final Signatures</b></p> <table border="1"> <tr> <td><span style="border: 1px solid black; border-radius: 50%; padding: 2px 5px;">19</span></td> <td>Approval Level</td> <td>Signature</td> <td>Date Signed</td> </tr> <tr> <td></td> <td>Issued by – Owner</td> <td></td> <td></td> </tr> <tr> <td></td> <td>Recommended to Close By Owner's Director</td> <td></td> <td></td> </tr> <tr> <td></td> <td>Approved by – Director, Planning &amp; Controls</td> <td></td> <td></td> </tr> </table>		<span style="border: 1px solid black; border-radius: 50%; padding: 2px 5px;">19</span>	Approval Level	Signature	Date Signed		Issued by – Owner				Recommended to Close By Owner's Director				Approved by – Director, Planning & Controls		
<span style="border: 1px solid black; border-radius: 50%; padding: 2px 5px;">19</span>	Approval Level	Signature	Date Signed														
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*\*Please refer to N-MAN-00120-10001-SCH-06, Nuclear Refurbishment – Milestone Definition Framework*


ID	Section	What is this?
1	Record Number	The standard record number begins with NK38-ref-09701-xxxxxx- this cannot change. The xxxxxx portion of the record number shall be the Activity ID assigned in the P6 Schedule.
2	Milestone Number	This shall be the Activity ID assigned in the P6 Schedule
3	Milestone Title	This shall be the Activity Name from the P6 Schedule
4	Milestone Type	Milestone Type shall be identified as either Program or AIP Scorecard
5	Tier Structure	This is the milestone tier, as determined in the Milestone Tier Structure Process (Section 3.1 of the manual): Tier 1 – Reportable to EVP Nuclear Refurbishment Tier 2 – Reportable to SVP Nuclear Refurbishment Tier 3 – Reportable to SVP Direct Report
6	Unit	This is the unit the Milestone Definition Form Relates to. The form defaults to "All". If the form only relates to one unit – please specify
7	Milestone Owner	Please specify the individual and their position
8	Signature	Requires Milestone Owner's signature
9	Date	The date the Milestone Definition Form was signed
10	Milestone TCD	This is the milestone completion date, as established in the P6 Schedule by BL Project Finish
11	Milestone Success Plan Presentation Due Date	This will be the Milestone TCD date minus 3, 6, or 9 months. For example, a milestone with a TCD of November 1, 2013, would have a presentation date of August 1, 2013 if three months were subtracted. See section 3.4.2 of the manual.
12	Milestone Definition	Describe the milestone and include any supporting governance. Identify any supporting departments/directors, if applicable.
13	Milestone Requirements	Identify reference to any process, letters, documents, transmittals in support of milestone completion.
14	Performance Indicator	Identify the performance indicators (metrics, WDC, etc) to indicate progress.
15	Milestone Predecessor (s)	List any milestone predecessors, if applicable. Ensure to use proper P6 Activity IDs from P6.
16	Milestone Successor (s)	List any milestone successors, if applicable. Ensure to use proper P6 Activity IDs from P6.
17	Milestone Completion	Check off one Status: <b>G</b> – Shows that the milestone was completed on time as indicated by the initial TCD; <b>R</b> – Shows that the milestone was completed on time based on a recovery plan; <b>N</b> – Shows that the milestone was removed through the approved CCF process.
18	Milestone Deliverable Met	Indicated how your department met each of the requirements of the Milestone Definition. Provide details, PASSPORT Documents, signed letters, etc. Indicate Challenge Process used.
19	Final Signatures	This form shall be signed by the Owner of the Milestone; Shall be Recommended to Close by the Owner's Director, and Final approved by the Director, Planning and Controls

*Note: This form can also be used for NR AIP Scorecard Definition requirements. For details, please contact P&C Scheduling Departments.*

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Appendix F: Instruction to Fill Out D-FORM-10763 (Recovery / Mitigation Plan)

	Records File Information: Sent to Records for file	Internal Use Only D-FORM-10763-R008*																
	<b>Darlington Refurbishment Program Milestone Recovery/Mitigation Plan Template</b>																	
<p>Record Number: NK38-REF-09701 -R- (1)</p>																		
<p>Recovery / Mitigation Plan for Milestone Number: (2)</p>																		
<p>Milestone Title: (3)</p>																		
<p>To: Director, Planning &amp; Controls</p>	<p>From: (4) (Milestone Owner)</p>	<p>Date: (5)</p>																
<p>Original Milestone Completion Date: (6)</p>	<p>Date which Milestone will be Complete: (7) Recovery date: Mitigation date:</p>																	
<p>Cause of Milestone Challenge: (8)</p>																		
<p>Course of Action to Recover the Milestone: Include responsible individuals and due dates. (9)</p>																		
<p>Determine Effect on Successor Milestones: Quantify impact of all successor milestones. (10)</p>																		
<p><b>Final Signatures</b></p> <table border="1"> <thead> <tr> <th>(11)</th> <th>Approval Level</th> <th>Signature</th> <th>Date Signed</th> </tr> </thead> <tbody> <tr> <td></td> <td>Issued by - Owner</td> <td></td> <td></td> </tr> <tr> <td></td> <td>Recommended to Close By Owner's Director</td> <td></td> <td></td> </tr> <tr> <td></td> <td>Approved by – Director, Planning &amp; Controls</td> <td></td> <td></td> </tr> </tbody> </table>			(11)	Approval Level	Signature	Date Signed		Issued by - Owner				Recommended to Close By Owner's Director				Approved by – Director, Planning & Controls		
(11)	Approval Level	Signature	Date Signed															
	Issued by - Owner																	
	Recommended to Close By Owner's Director																	
	Approved by – Director, Planning & Controls																	
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*\*Please refer to N-MAN-00120-10001-SCH-06, Nuclear Refurbishment – Milestone Definition Framework*

ID	Section	What is this?
1	Record Number	The standard record number begins with NK38-ref-09701-xxxxxx- this cannot change. The xxxxxx portion of the record number shall be the Activity ID assigned in the P6 Schedule.  Note: The form defaults to include an "R", this differentiates the recovery plan from the milestone definition form.
2	Recovery Plan for Milestone Number	This shall be the Activity ID assigned in the P6 Schedule
3	Milestone title	This shall be the Activity Name from the P6 Schedule
4	From	Milestone Owner as identified in the initial Milestone Definition form.  Please specify the individual and their position.
5	Date	The date the recovery plans was drawn up.
6	Original Milestone Complete Date	This is the milestone completion date, as identified in the Milestone Definition Form (this is also established in P6 schedule by BL Project Finish.)
7	Milestone Recovery / Mitigation Date	Recovery Date on or before original date. Mitigation Date after original date.
8	Cause of Milestone Challenge	Identify the reason(s) why the milestone due date has been impacted
9	Course of Action to Recover the Milestone	Identify the path forward to complete with a list of actions to recover the milestone. Include responsible individuals and due dates.
10	Effect on Successor Milestone	Quantify the impact of all successor milestones
11	Final Signatures	This form shall be signed by the Owner of the Milestone; Shall be Recommended to be Closed by Owner's Director , and Final approved by the Director, Planning and Controls



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**NUCLEAR CONTRACT MANAGEMENT MANUAL**

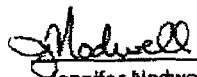
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**Nuclear Contract Management Manual**

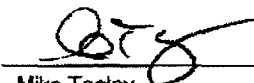
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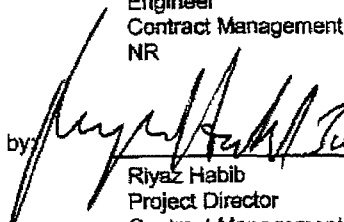
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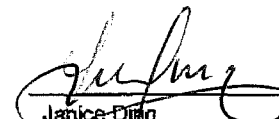
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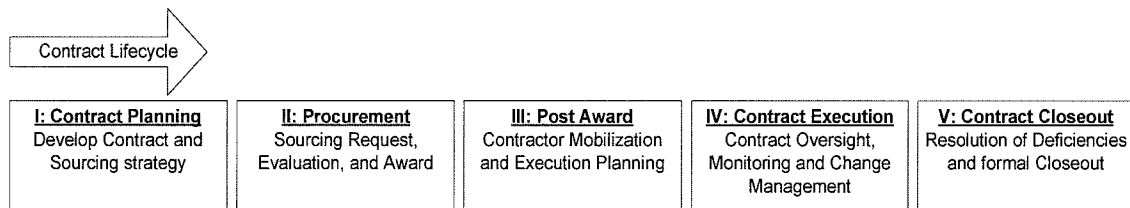
Revision Number	Date	Comments
R000	2012-11-21	Initial issue
R001	2014-05-27	Updated to re-order layout and include additional references.

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### 1.0 PURPOSE

The purpose of this document is to provide guidance for the implementation of the five stages in the contracting process for projects as set out in N-STD-AS-0029, Contract Management Standard, and illustrated in Figure 1. This manual is intended for Project Managers and employees involved in contract management activities.



**Figure 1: Contract Management Stages**

### 2.0 DEFINITION

A contract is an agreement between two or more parties based on an agreed allocation of rights, obligations, responsibilities, and risks. Contracts are based on the concept of offer and acceptance which may be enforced by a court.

Contracts may take a number of forms and OPG expects its contracts to be in the form of written documents that clearly spell out the terms and conditions for each party. The execution of work and work practices should be consistent with the agreed contract terms and conditions.

Contract management is the process that enables parties to a contract to meet their obligations in order to deliver the objectives required from the contract. It involves active monitoring, managing issues proactively as they arise, and anticipating future issues. Contract management incorporates oversight of Supplier personnel to ensure they meet all safety, quality, cost, schedule, and performance requirements. Contract management also involves building a good working relationship between OPG and the Supplier.

Contract management occurs throughout the contract lifecycle. Good contract management:

- Ensures sufficient time for planning
- Ensures achievement of value for money, and continuous improvement
- Supports effective risk management
- Ensures delivery of goods and services in accordance with the contract
- Establishes effective processes and metrics for managing the contract

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- Provides clear and complete documentation to demonstrate due diligence and facilitates resolution of disputes
- Establishes effective communication to ensure no surprises for either party

Failure to implement good contract management could result in negative impacts to OPG including, but not limited to the following:

- Paying for goods and services which do not meet the standards (quality or otherwise) set out in the contract
- Higher costs
- Schedule or delivery delays
- Overcharges by Suppliers and erroneous payments
- Dissatisfaction between the contracting parties
- Safety and regulatory impacts

OPG-POL-0013, Code of Business Conduct Policy, must be adhered to during all stages of contract management.

### **3.0 COMMERCIAL PRINCIPLES**

A set of commercial principles has been laid out for relationships with third parties and will form the basis of the individual contracting strategies. These principles are an integral part of OPG's ability to demonstrate prudence in our contracting activities. They are:

- 1. Accountability:** OPG must comply with applicable provincial and regulatory directives regarding commercial relationships. This can be achieved through the development of effective contracting strategies and clearly defined authority, responsibility, and accountability structures for planning and executing all contracts.
- 2. Value for Money:** OPG must create value by conducting business in a cost effective manner. Value for money is based not only on the minimum purchase price (economy) but also on the maximum efficiency and effectiveness of the purchase, taking into account OPG internal costs and risks, including operational risks (near and long-term). Value for money is achieved by effectively balancing the trade-off between cost, quality, and risk. Value for money is also achieved by packaging work in a manner that facilitates competition between Suppliers.
- 3. Fairness & Transparency:** OPG must operate in an open and transparent manner. Regular communication by OPG with key internal and external stakeholders including government bodies and officials, federal and provincial



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regulators, industry peer groups and community leaders is part of being an open and transparent company.

4. **Risk Transfer/Sharing:** Allocation of risk to the appropriate party best able to manage the risk will minimize the costs and potential issues associated with managing that risk. Decisions regarding risk allocation and risk premiums are an integral part of a contracting strategy and should be based on comprehensive analysis.

## **4.0 CONTRACT STAGES**

### **4.1 Stage I: Contract Planning**

In the contract planning stage the development of a contracting strategy is a key tool designed to analyze the type of work required. The contracting strategy establishes the procurement approach, the type of contract and pricing model, and the style and type of management to be adopted for the subsequent service delivery, relationship management and contract administration. The selection of a contracting and sourcing strategy is supported by adequate inputs and analysis taking into consideration the commercial principles detailed in Section 3.

A comprehensive contracting strategy takes into consideration factors such as the nature and scope of the work, the Supplier marketplace, and potential longer term or broader commercial arrangements and results in a recommendation of the most suitable sourcing approach, contract structure and pricing mechanism. The depth of analysis and documentation required for each contracting strategy should be based on a graded, risk-based approach taking into consideration project value and any political or regulatory considerations.

N-REF-00150-0497673, Contracting Strategy Template, may be used to document accepted contracting strategy for a project.

### **4.2 Stage II: Procurement**

The procurement stage of the contract management life cycle includes the process for sourcing and awarding of contracts for materials and services based on the contracting strategy in accordance with OPG-PROC-0058, Procurement Activities, and OPG-PROC-0060, Requisitioning Items and Services.

Key activities include development of procurement documentation (i.e. expressions of interest, requests for proposals), development of evaluation and selection criteria, development of proposed contract documents, evaluation of proposals, negotiation plans, contract negotiations, and the contract award process. Roles and accountabilities of stakeholders involved in procurement are documented in OPG-PROC-0058 and the partnership agreement established between Supply Chain and Nuclear Projects.

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For large contracts, it is recommended that the Project Manager and Contract Manager be selected and involved with procurement activities including contract negotiations.

### 4.3 Stage III: Post Award

Post award is the period between the award of the contract and the start of its implementation. A significant factor for success is achieving a smooth transfer of knowledge from the team that was involved in the planning and procurement phases to the team that will be engaged with the management and execution of the contract. There should be discussions between OPG and the Supplier in order to ensure that all parties involved have a common understanding about the goals and the expectations of the project, the performance requirements, and administrative procedures to be implemented to ensure adherence to the terms of the contract. Time and effort must be spent on determining how the obligations of both OPG and the Supplier should be carried out effectively and efficiently. The Contract Management Plan (CMP) documents how OPG will adherence to the contractual obligations.

In large, multi-year contracts, a Contract Manager should be assigned for the duration of the contract. The Contract Manager is engaged exclusively with the management of the contract in support of the Project Manager.

#### 4.3.1 Contract Management Plan

The CMP is an internal OPG document which outlines OPG's approach to managing key contractual terms and risks. It contains information about OPG's risk tolerances, mitigation plans, and the specific individuals in OPG who will manage the aspects of the contract. It identifies systems and processes to ensure that the Supplier complies with the terms and conditions during the performance of the contract.

The CMP should not be distributed beyond key project team members and specifically, not to a Supplier as the information it contains could put OPG at a commercial disadvantage by providing opportunities for a Supplier to exploit potential weaknesses in OPG's contract management controls or provide them with negotiation advantages.

Each contract may have a unique CMP based on the nature of the work and the negotiated terms and conditions. The CMP is developed using a risk-based graded approach appropriate to the type of contract in order to facilitate effective execution of the contract. The CMP should include:

- an assessment of key roles (including succession planning for key roles)
- key contractual milestones and deliverables
- process for development and changes to schedules
- invoicing and payment
- project securities

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- key contractual terms and conditions
- a roll-out plan for communicating key contract terms to stakeholders including the project team
- contract management work plan
- business relationship management including management of communication, issues, claims, disputes, and default
- contract change management
- notice
- contractually related risks and work management plan
- lessons learned
- roles and accountabilities matrix (N-REF-00150-0497675, Contract Management Roles & Accountabilities Matrix, may be used)

The CMP should also contain details on how OPG's contractual obligations to Suppliers are to be managed. The CMP may be a collection of documents containing the relevant information to support effective contract management.

The CMP is usually an attachment to the Project Management Plan (PMP) or may be a separate document. The template, N-REF-00150-0497674, Contract Management Plan Template, may be used. It should be reviewed anytime the project or contract risk profiles change, when contract changes or amendments are executed, and no less than annually.

### 4.3.2 Contract Manager

The Contract Manager will manage the interpretation and clarification of the contract terms and conditions to ensure all obligations and compliance with the contract are being met. Management should consider rotating individuals assigned to this role every three years for multi-year contracts. This is to ensure sufficient succession planning is in place, a questioning attitude is maintained in our business relationships, and ensure OPG can demonstrate arms-length relationships with Suppliers.

The Contract Manager will be responsible for but not limited to the following:

- Fully comprehend the commercial and contractual terms and conditions
- Confirm and periodically verify that the original signed contract and amendments are in place
- Facilitate the development, periodic review, and updates to the CMP

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- Identify high risk terms and conditions within the contract and ensure mitigation programs are in place
- Resolve highly complex contractual/commercial issues that involve high risk through team integration
- Identify business wide and cross-project issues and develop appropriate strategies
- Participate in project review meetings to support the project team on commercial and contractual matters
- Coordinate resolution of insurance claims and contractual disputes
- Coordinate development and implementation of management procedures, systems and processes to facilitate effective management of the contract
- Review applicable OPG procedures and supporting systems from a commercial perspective to improve efficiencies
- Ensure documents exchanged with the Supplier related to the execution of the contract are maintained should contractual issues or disputes arise between OPG and the Supplier
- Maintain communication with the Supplier to ensure the ongoing relationship between the parties continues
- Support closure of the contract

### 4.3.3 Contractor Set-up, Training and Orientation

The Project Manager will identify the relevant stakeholders across OPG and liaise with the key contacts to ensure the requirements for contractor set-up, training, and orientation are understood and managed. Compliance with respective governance ensures OPG is protected in the areas of site access (security clearance, parking, control room access, computer usage, etc.), communication and reporting protocols (e-mails, Tempus, SCR, Safety/Environmental, etc), specific training requirements and accountabilities, establishing the construction island, methods of control of hazardous energies, site walk-downs, etc.

## 4.4 Stage IV: Contract Execution

The contract execution phase of the contract management lifecycle includes a range of activities in the following key areas:

- Service delivery management
- Relationship management
- Contract administration

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All three areas must be integrated, balanced, and managed successfully for OPG to achieve the intended value of the contract. Business risk can never be fully transferred to the Supplier but through successful service delivery management, relationship management, and contract administration these risks can be effectively mitigated.

In this phase, the Contract Manager and project team will execute the contract management activities as outlined in the CMP.

### 4.4.1 Service Delivery Management

OPG must monitor whether the goods or services are being delivered in accordance with the specification as contracted (i.e. price, schedule, quantity and quality) and to the agreed standards.

For most contracts, contractual milestones are aligned with key project activities and deliverables, and have associated payments to the Supplier. This aligns the business interest of the Supplier (receiving payment) with those of OPG (progressing the project). Sufficient written documentation is necessary to support achievement of milestone or services for payment to the Supplier.

### 4.4.2 Relationship Management

Managing the relationship and long-term success requires a proactive approach and commitment to representing OPG's best interests. The key factors vital in making the business relationship successful include:

- Openness and effective ongoing communications
- A joint approach to managing issues
- Mutual trust with verification

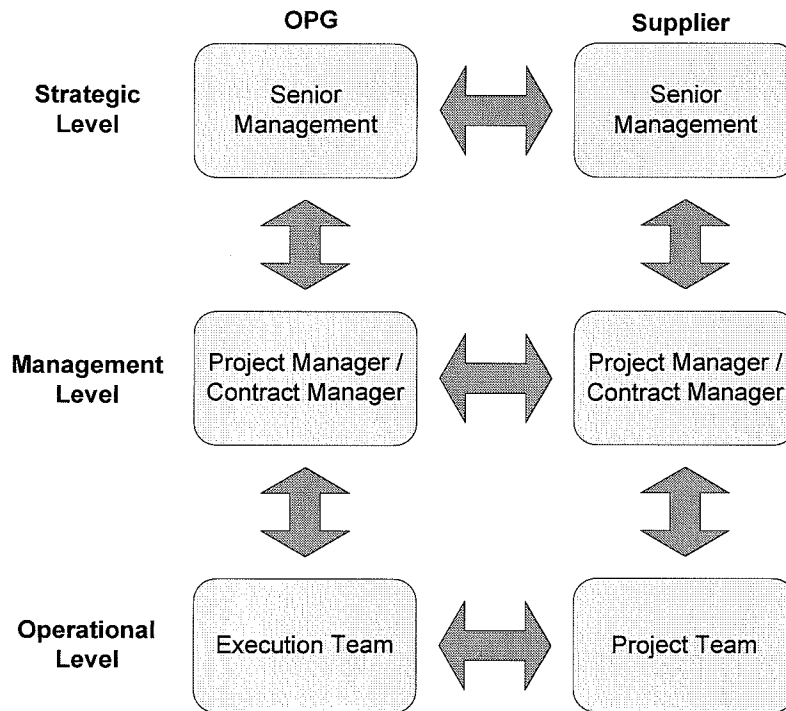
Effective communication is critical in managing a relationship to ensure no surprises. A communication protocol should be documented in the CMP along with the key contacts for both parties. There should be regular meetings to serve as a forum to identify and address specific areas or issues of concern. Depending on the nature and complexity of the contract, a Steering Committee may be formally established or a more informal approach to maintaining the overall business relationship may be taken. An example of a communication protocol is illustrated in Figure 2.

Procedures for handling potential disputes and business issues should also be established and agreed to upfront, with clear reporting and escalation procedures to maintain a business focus for the relationship. The purpose of this is to recognize problems early and get quick and effective resolution.

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**Figure 2: Communication Protocol Example**

### 4.4.3 Contract Administration

The key objectives for effective contract administration are:

- Establish clear administrative processes to ensure adherence to contract terms
- Ensure the contract documentation remains current and reflects the business arrangement as the relationship develops and evolves
- Ensure changes are controlled in accordance with contractual terms
- Ensure effective processes are in place for invoicing, cost monitoring, payment procedures, management reporting

### 4.5 Stage V: Contract Closeout

The contract closeout phase includes:

- Ensuring all products and services have been delivered and accepted
- Ensuring all issues, disputes, and / or claims that arose during the execution of the contract have been resolved
- Ensuring warranty and rework issues are addressed

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- Ensuring all lien issues are resolved
- Ensuring Project Securities (Letters of Credit, Parental Indemnities, Bonds, etc) are no longer required and returned
- Ensuring that all required documentation is received (e.g. intellectual property, drawings, specifications, training materials, etc.)
- Ensuring the return of any OPG assets used by the Supplier during execution and confirm assets are in expected condition
- Ensuring that all contractually required payments have been processed
- Recommending to Project Manager that contract has been completed and can be closed

## 5.0 REFERENCES

N-REF-00150-0497673, Contracting Strategy Template

N-REF-00150-0497674, Contract Management Plan Template

N-REF-00150-0497675, Contract Management Roles & Accountabilities Matrix

N-STD-AS-0029, Contract Management Standard

OPG-POL-0013, Code of Business Conduct Policy

OPG-PROC-0058, Procurement Activities

OPG-PROC-0060, Requisitioning Items and Services

Supply Chain and Nuclear Projects Partnership Agreement



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## Nuclear Charter

### TITLE

**NUCLEAR MANAGEMENT SYSTEM**

### AUTHORIZATION

OWNER: Glenn Jager  
Chief Nuclear Officer

APPROVAL FOR ISSUE: Robin Manley  
Director, Nuclear Regulatory Affairs

AUTHORIZATION AUTHORITY: Tom Mitchell  
President and CEO

COMPLIANCE DATE: Immediate

### PURPOSE

This Charter and referenced supporting documents establish the Nuclear Management System for Ontario Power Generation Nuclear (OPGN) which hereafter is referred to as Nuclear. This Charter communicates Chief Nuclear Officer (CNO) expectations regarding implementation of the Nuclear Management System, which fulfills requirements of Canadian Standards Association (CSA) N285 N286-05 and N286-12 standards (the reason for stating both CSA N286-05 and CSA N286-12 is that CSA N286-12 takes over from CSA N286-05 when invoked by facilities relicensing; OPGN is demonstrating it meets the requirements to both Standards regardless of when the licences are updated), International Organization for Standardization (ISO) 14000 series of standards, and American Society of Mechanical Engineers (ASME) NCA 4000. The Nuclear governing document framework is described in this document under Appendix A, Governing Document Framework. This Charter and the supporting documents identified in N-LIST-08130-10023, CSA N286-05 to OPGN Governance Cross Matrix, demonstrate compliance with CSA N286-05.

### SCOPE

This Charter is applicable to all aspects of the Nuclear business as defined within this document and

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includes all equipment, systems, and activities. It provides overall direction regarding administration of Nuclear and establishes requirements to which employees shall comply. The Nuclear Management System Charter takes its authority from the Corporate Safe Operations Policy (OPG-POL-0032) and the Nuclear Safety Policy (N-POL-0001). Nuclear programs that take authority from other Corporate policies are identified within the programs of this Charter and Appendix A. While these other programs do not take authority from this Charter, they are part of the Nuclear Management System and the CNO is accountable for their effectiveness. Activities affecting the safe operation of Nuclear plants satisfy applicable requirements of the CSA N285, N286-05 and N286-12 standards.

This Charter does not apply to maintenance and engineering of Nuclear facilities outside the inner security fence (protected area), unless those facilities directly impact the Nuclear Station within the protected area or involve Decommissioning and Nuclear Waste Management Division (DNWMD). Interfaces between Nuclear and other lines of the business are described herein. This Charter does not apply to activities associated with the Darlington New Nuclear Project.

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### 1.0 DIRECTION

#### Chief Nuclear Officer's Statement of Policy

As required by the OPG Nuclear Safety Policy, I am accountable to the President and Chief Executive Officer (CEO) and the Board of Directors of Ontario Power Generation (OPG) to establish and implement an overall *Nuclear Management System* that fosters Nuclear safety as the overriding priority.

The Nuclear Safety Policy (N-POL-0001) applies from the initial conception of a Nuclear project, through procurement and design, construction and installation, commissioning, operations and decommissioning. This explicitly includes the two most challenging phases of a Nuclear facility – the initial operation and commissioning phase and the period of operation leading up to the end of service. The Nuclear Safety Policy applies to every person in OPG Nuclear and every person or entity that supplies a product or service to OPG Nuclear. It is through our employees and our *Nuclear Management System* that we assure compliance with the policy by all groups that can have an impact on Nuclear Safety.

I am accountable for the effectiveness of the overall *Nuclear Management System* in ensuring our Nuclear facilities are operated and maintained using sound Nuclear safety and defense-in-depth practices to ensure radiological risks to workers, the public, and environment are as low as reasonably achievable, and in keeping with the Nuclear Safety Policy, and the best practices of the international Nuclear community. I ensure that a foundation of leadership exists and hold my direct reports and other supporting organizations accountable for implementation of and adherence with this *Nuclear Management System*.

I am accountable for the Nuclear vision, mission, cornerstones, values, behaviours and priorities that capture how our goal of safe, reliable, low-cost product delivery is accomplished to ethical and behavioral standards. These principles are developed in conjunction with my management team with input from people across the organization. The messages are communicated and reinforced by me personally, as well as all levels of management in the organization.

**Vision:** People Powering the Future.

**Mission:** To be Ontario's low cost electricity generator of choice.

**Cornerstones:** Safety, Reliability, Value for Money, and *Human Performance*.

**Values:** Safety, Integrity, Excellence, People and Citizenship.

**Behaviours:** Say It, Do It; Think Top and Bottom Line; Simplify It; Integrate and Collaborate; Tell It As It Is.

**Priorities:** Developed annually to focus on major program requirements based on ongoing internal and external business developments, known challenges and improvement opportunities identified through benchmarking.

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Every employee in our organization is responsible and shall be held accountable for complying with expectations in this document and programs referenced in this document, and shall ensure their actions are deliberate and consistent with protecting the health and safety of the public and the environment. All employees shall accept the unique and grave responsibility inherent in using Nuclear technology and shall adhere to radiation safety practices and precautions defined within the Nuclear governance framework. In this regard, this Charter has been written to communicate, to Nuclear generating and support organization employees, and contractors, my expectations for conducting our business.

Where Nuclear generating and support organizations have delegated responsibility for work to contractors, line management shall take all reasonable cost effective steps to ensure that the terms and conditions in the contract are enforced and in particular, that contractors comply with all applicable laws, codes and regulations.

This document, in conjunction with the referenced policies, programs, standards and other controlled documents, establishes the overall *Nuclear Management System* that assures that systems, equipment and activities are of the required quality throughout the life of our Nuclear facilities. Applicable portions of the *Nuclear Management System* shall be in place before undertaking activities covered by this Charter. The *Nuclear Management System* described in this document further assures that Safety-Related Systems, Structures, Components (SSC) and Nuclear fuel are designed, procured, fabricated, installed, operated, and maintained in accordance with applicable regulations, standards, and fuel performance limits, using rigorous processes to ensure all work activities are planned and controlled to maintain plant configuration and condition within the design basis. Changes that could impact on Nuclear safety shall be assessed and implemented in a controlled manner.

*Nuclear Management System* deficiencies or deviations from the requirements of this Charter shall be managed through the Nuclear Corrective Action Program.

Activities may be performed by a support organization or a contractor using their quality program, providing the quality program is approved by the Nuclear organization and appropriate interfaces are established. Support organizations and contractors who do not have a quality program approved by the Nuclear organization shall follow this *Nuclear Management System*.

The Director, Nuclear Regulatory Affairs and Stakeholder Relations is responsible for interpreting the requirements of this Nuclear Charter and its supporting documents.

Chief Nuclear Officer

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### 1.1 Human and Business Performance

The future success of Nuclear lies with our most important asset, our employees. Nuclear must prove itself as a fair and equitable employer of choice. Our organizational pattern, and placement of staff within the pattern, shall meet the needs of the business. Organizational interfaces shall be clearly identified, communicated, and controlled. Employees shall be trained to qualification levels demanded of their role, and shall understand what is expected of them and how they contribute to the success of the business. Effective communication of clearly defined expectations is essential for success. Success is measured by comparing actual results against the defined expectations. Employees shall be given multiple avenues to have their concerns heard in a non-threatening and unbiased fashion and to see them through to resolution; and, when requested, the confidentiality of the employee shall be maintained to the maximum extent possible.

Human and Business Performance establishes overall requirements for sustaining and improving performance. This is accomplished by the following:

- (a) Establishing and implementing a managed system consisting of governing documents communicating essential elements of Nuclear business.
- (b) Reinforcing individual accountability for performance and implementing various self-verification and independent oversight techniques.
- (c) Identifying, documenting, evaluating, and correcting in a timely manner, conditions adverse to quality.
- (d) Using internal and industry Operating Experience (OPEX) to improve human, plant and equipment performance and design, procurement, construction, commissioning, and operating requirements and practices.
- (e) Providing information to the people who need it through the managed systems that establish how necessary information is identified, targeted to required users, maintained current, and communicated effectively.

The Human and Business Performance programs described below are designed to ensure these business objectives are met.

#### 1.1.1 N-PROG-AS-0001, Managed Systems

The Managed Systems Program establishes a business framework that consists of "Plan", "Do", "Check", "Act/Adjust" elements that are common to all Nuclear Management System programs and supporting activities. The elements collectively ensure:

- (a) Management system principles of CSA N286-05, Management System Requirements for Nuclear Power Plants and CSA N286-12, Management System Requirements for Nuclear Facilities, are consistently and effectively applied to all activities defined in N-CHAR-AS-0002, Nuclear Management System.
- (b) Nuclear Management System processes and their supporting technologies are

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standardized to the greatest extent possible.

- (c) *Nuclear Management System* review is performed by the Fleetview process on programs within the *Nuclear Management System*, as well as Nuclear programs that take authority from corporate policies other than the Charter, for their overall effectiveness and opportunities for improvement. The Program Owners present their programs to the Nuclear Executive Committee comprising the CNO and his direct reports as well as other senior representatives of key OPG organizations such as Nuclear Oversight, Environment, Supply Chain, etc. in accordance with a schedule that ensures all programs are reviewed at least annually. Each program is systematically reviewed using the key areas of program oversight and leadership, program execution performance indicators, and status of initiatives developed to close any gaps in performance or leadership. This review provides an opportunity for interface and challenge by the Nuclear senior leadership team to the Program owner in meeting Nuclear Management System requirements.
- (d) The controls used by the CNO to fulfill the accountability to implement and maintain an effective management system complying with the requirements of CSA N286-05 and CSA N286-12 include:
  - i) A defined organizational structure to own and execute programs in the Nuclear Management System. This includes organizations reporting directly to the CNO as well as Interfacing Organizations which work in partnership with Nuclear to ensure the integrity of the Nuclear Management System is maintained in accordance with the expectations of the CNO. For Interfacing Organizations, Program Authority is retained within the Nuclear organization.
  - ii) Where OPG business units supporting Nuclear develop their own management system, OPG-PROC-0001 (Process Administrative Governance Documents) requires a review for any new program document that supports activities in N-CHAR-AS-0002. Any changes to a Nuclear Management System program as a result of implementing a new business unit management system will be assessed by the designated Nuclear Management System Program Authority against the CSA N286 criteria on behalf of the Nuclear Executive Committee and CNO. This ensures compliance with the generic management system requirements of CSA N286-05 and N286-12. Until such time as other business units develop, obtain approval, and implement separate management systems, the Nuclear Management System will continue to apply to all non-Nuclear Program Owners and staff executing work on behalf of Nuclear.
  - iii) The Fleetview process described in 1.1.1 c).
  - iv) Proactive CNO engagement of Nuclear and all other lines of business that support Nuclear, in the Nuclear Business Planning process (see 1.1.3).

#### 1.1.1.1 Nuclear Organization

N-STD-AS-0020, Nuclear Management System Organization, defines the Nuclear organization and general accountabilities that are applicable to the CSA N286-05 and N286-12 standards. Included are organizations that report to Senior or Executive Vice-Presidents

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outside of Nuclear but support the Nuclear line of business. This Standard defines the relationships and interfaces that have been established to ensure effective control of activities that are performed to support the Nuclear line of business. Further details of these supporting organizations and the Nuclear organizations are located in Asset Suite and SAP™.

This standard is owned and implemented by People and Culture under OPG Business Model, OPG-POL-0033.

### 1.1.2 N-PROG-AS-0006, Records and Document Control

This program establishes processes for management of Nuclear records and documents throughout their life cycle, regardless of their media. The program lays out requirements for managed system activities related to records and documents and establishes uniform, efficient processes for management, maintenance, and final disposition of records and documents throughout Nuclear.

All documents which support the implementation of a Nuclear Management System are considered Governance. Creation of all Governance, policies, charters, programs, procedures and processes established through any new Management Systems is controlled through procedures and standards.

Revision control and communication is established through an Approved Information Management System (e.g. Asset Suite).

This program is owned and implemented by the Business and Administrative Services organization, under OPG Business Model, OPG-POL-0033.

### 1.1.3 OPG-PROG-0001, Information Management

This program establishes a set of standards and procedures for the management of OPG's information throughout its life-cycle, regardless of media, including electronic systems such as e-mail, SharePoint, and the Intranet to ensure consistent and appropriate use. It describes requirements for a managed system of activities related to information. The program establishes uniform and efficient processes for management, maintenance, and final disposition of records and documents throughout OPG. It establishes the overall OPG process for governance including electronic filing, approval, distribution, and maintenance of the OPG Governance Framework.

Procedures under this program establish a consistent process across OPG including the establishment of a hierarchy of authority for documents, only one owner for the document, controlled release of the document for revision, controlled review of the document by stakeholders and individuals affected by the change, and the controlled approval and authorization of the document before it is issued as a Governing document.

This program is owned and implemented by the Business and Administrative Services organization, under OPG Business Model, OPG-POL-0033.



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#### 1.1.4 N-PROG-AS-0005, Business Planning

This program establishes the business planning framework across Nuclear Business Units to ensure compliance with Corporate management strategies and business direction, and to create a structure for undertaking business planning activities. Business planning is a tool that directs the organization's resources to meet strategic goals aligned with the company's objectives and support safe and efficient business plan execution. The business planning program ensures organizational alignment and defines desired results in sufficient detail to support accountability, and ensures constraints, the availability of resources, and business risks are adequately addressed.

#### 1.1.5 N-PROG-AS-0002, Human Performance

The human performance program establishes a systematic framework for human performance management. The program is specifically designed to achieve higher levels of Nuclear and industrial safety, higher unit reliability, and reduced operating costs through event-free operation. The goals of the program are to continually reduce human performance events and errors in pursuit of global recognition as an event-free operator and universal application of event prevention tools.

This program addresses human performance management and improvement by improving human performance through individual behaviours (all employees and contractors), organizational process, and management and leadership behaviours.

A key element of the program is outlined in N-STD-RA-0014, Second Party Verification, which specifies the requirement for verification to confirm a specific task or activity satisfies established requirements in all functional areas of Nuclear (e.g., operations, maintenance, engineering, procurement, construction, commissioning).

#### 1.1.6 N-PROG-RA-0003, Corrective Action

This program establishes the processes to ensure deficiencies, non-conformances, weaknesses with a process, document, service, or conditions that adversely impact, or may adversely impact plant operations, personnel, nuclear safety, the environment or equipment and component reliability, are promptly identified and corrected.

For those deficiencies considered significant, or repetitive in nature, these processes ensure appropriate levels of management are notified, causes identified and actions taken to preclude recurrence, and actions taken to address the identified issues are verified to be complete and effective.

This program also provides the processes to ensure in-house and external OPEX is evaluated, distributed to appropriate personnel, and applied to implement actions that improve plant safety and reliability.

An effective self-assessment and benchmarking process is also implemented by this program to promote continuous improvement. Current performance is compared to management expectations, industry standards of excellence, OPEX, and regulatory requirements to identify areas needing improvement. Self-assessment results are promptly identified, communicated to affected groups or individuals, and resolved.

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#### 1.1.7 N-PROG-RA-0010, Independent Assessment

This program provides independent assessment (internal and external) processes to perform a comprehensive and critical evaluation of all activities affecting Nuclear facilities. This program ensures the Nuclear Management System under N-CHAR-AS-0002, is reviewed with sufficient frequency to confirm its continuing effectiveness. The program is comprised of the following processes:

- (a) Internal independent assessments by Nuclear Oversight that provide critical and unbiased oversight function, have organizational freedom and authority to remain independent. Results are identified, reported and communicated to a level of management having sufficient breadth of responsibility to resolve the identified deficiencies.
- (b) External independent assessments that are provided by a Nuclear Safety Review Board (NSRB) and the Nuclear Oversight Committee of the Board of Directors. NSRB provides a broad, systematic, and independent overview of Nuclear safety in our Nuclear facilities by reviewing various safety activities, organizations, programs, procedures, requirements, and results with respect to effectiveness, significance of occurrences, and trends that may affect Nuclear safety and environmental matters. NSRB reports to the CNO, the President and CEO, and reports annually to the Nuclear Oversight Committee. The Nuclear Oversight Committee of the Board of Directors is responsible for performing the duties set out in their Charter to enable the Board to fulfill its oversight responsibilities.

This Program is owned and implemented on behalf of the CNO by the Assurance organization, under OPG Business Model, OPG-POL-0033.

#### 1.1.8 N-PROG-TR-0005, Training

This program describes the Training Program for regular staff, contractors, temporary personnel, and other staff assigned work at Nuclear ("Nuclear staff"). The program provides the structure, processes, and tools for defining, developing, implementing, documenting, assessing, and improving the training required to ensure Nuclear staff have the appropriate knowledge, skill, and qualifications for safe and efficient plant operation. Training governing documents:

- (a) Formalize training standards and processes.
- (b) Provide a process for analysis, design, development, delivery, and evaluation of quality training.
- (c) Identify requirements for qualifying staff to meet performance expectations.
- (d) Identify means by which qualifications are tracked and maintained.

This program is owned and implemented by the People and Culture organization, under OPG Business Model, OPG-POL-0033

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### 1.2 Operate Plant

Safety is an integral part of every operational decision. Activities related to the operation of Systems, Structures, and Components (SSC) are accomplished by qualified personnel in accordance with approved procedures that are maintained consistent with facility design and licensing bases. Operating configuration of each facility is controlled to ensure authorized staff retains an understanding of the status of each generating unit and its supporting services.

The Operations programs described below are designed to ensure these business objectives are met.

#### 1.2.1 N-PROG-OP-0001, Nuclear Operations

This program implements a series of standards and procedures to ensure safety of the public, environment, plant personnel, and plant equipment. This program establishes safe, uniform, and efficient operating practices and processes within Nuclear facilities that provide Nuclear professionals the ability to ensure Nuclear facilities are operated in such a manner as to ensure compliance with Power Reactor Operating Licence (PROL), Operating Policies and Principles (OP&P), and other applicable regulations and standards.

The Nuclear Operations format is based on operations-related functional areas as defined in the World Association of Nuclear Operators (WANO) Performance Objectives and Criteria. These functional areas are:

##### Operations Fundamentals

- Monitor Closely
- Control Precisely
- Conservative Bias
- Effective Teamwork
- Understand Sciences, Engineering Principles and Plant Design

##### Conduct of Operations

- Operations Management and Leadership
- Control Room Activities
- Administrative Controls
- Operations Staffing

Communication standards are established to ensure accurate transfer of information, ensuring communications are clear, concise, and complete to reduce operating and human errors. This includes operation and maintenance of the plant during normal, abnormal, and transient conditions, pre- and post-job briefings, operating logs, and main control room turnover.

This program also addresses procedures and standards for self-checking, reactivity management, operability testing, and infrequently performed tests and evolutions. Controls are put in place to ensure technical procedures are written consistent with plant design and licensing bases.

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### 1.2.2 N-PROG-AS-0008, Heavy Water Management

This program establishes overall requirements for effective and efficient heavy water management within Nuclear, through focus on strategic planning, asset management, and logistics and integration.

The program's governing principles requires it to contribute to meeting Operating Policies and Principles limits, emission limits, and other relevant regulatory limits, and to minimize employee and public dose.

## 1.3 Maintain Plant

Maintenance programs are structured to ensure Nuclear facility Systems, Structures, and Components (SSC) are maintained within parameters established in the design basis, and equipment malfunctions or deficiencies are corrected in a timely manner and rarely recur. This includes controlling release of systems and equipment for maintenance, subsequent testing and eventual return to service.

The Maintenance programs described below are designed to ensure these business objectives are met.

### 1.3.1 N-PROG-MA-0004, Conduct of Maintenance

This program implements the processes established to ensure safety of the public, site personnel, protection of the environment, and availability of plant equipment for safe and reliable operation through effective implementation and control of maintenance activities. This program also provides the requirements for managing identification and execution of preventive maintenance and repetitive task work activities using the predefined process in support of operations, maintenance, and testing of Nuclear generating station equipment and facilities.

This program ensures system instrumentation is maintained in a condition to ensure operation within specified limits, and measuring and testing equipment is of proper range, type, condition, and accuracy. To ensure accuracy within limits, adjustment, maintenance, and calibration are performed with equipment having a known relationship to nationally recognized standards. The scope of this program includes the calibration of plant equipment, issue, use, calibration, maintenance, and storage of measuring and testing equipment, and tool identification and issue.

The objectives listed above are primarily achieved by instituting effective maintenance processes, high standards, compliance with procedures, sufficient resources, monitoring and assessing performance, and holding personnel accountable for their performance.

### 1.3.2 N-PROG-MA-0019, Production Work Management

This program ensures maintenance, modification, and testing activities are identified, prioritized, planned, scheduled, and executed in a manner protecting plant operational integrity, while making the most efficient use possible of available resources. Where possible, corrective maintenance and modification activities are performed during windows when

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affected equipment has been removed from service to perform predefined (repetitive) maintenance work.

This program is highly integrated with Materials Management, Procurement Engineering, Design Management, and Equipment Reliability programs. By defining a common plant priority scheme and management reporting mechanisms, the program ensures necessary resources are focused on problems related to plant condition, thereby minimizing maintenance backlogs.

This program ensures maintenance history is kept in a format allowing for long-term trending as necessary for the Equipment Reliability and Component and Equipment Surveillance programs.

This program also implements requirements of the Conventional Safety and Radiation Protection (RP) programs to ensure a proactive approach to safety is built into task planning.

### 1.3.3 N-PROG-MM-0001, Materials Management

This program ensures equipment, components, materials, and services meet appropriate and applicable design and quality requirements through review and approval of suppliers' quality programs, and audits or in-process surveillance of the suppliers' activities.

Equipment, components, materials, and services are purchased to required specifications and codes. Equipment, components, materials, and tools are controlled through proper identification, receipt, inspection, handling, storage, issuance, and shipping to ensure quality of equipment and components is preserved and that only accepted items are used. An annual inventory certification is performed in accordance with Corporate requirements and usage patterns are analyzed to ensure that spare parts will be available to meet normal operating and outage requirements.

This program is integrated with N-PROG-MP-0011, Procurement Engineering, to ensure materials meet end-use design requirements and N-PROG-MA-0019, Production Work Management, to ensure materials are available when needed.

Nuclear fuel supply processes ensure Nuclear fuel meets appropriate and applicable design and quality requirements. Processes are also in place to ensure the required quantity of Nuclear fuel is purchased from qualified and secure sources. Nuclear fuel materials are controlled through proper identification, handling, storage, issuance, and delivery to stations to ensure quality is preserved and regulatory control requirements are met.

This program is owned and implemented by Supply Chain Division of the Business and Administrative Services organization, under OPG Business Model, OPG-POL-0033.

## 1.4 Engineering

Engineering contributes to safe, reliable, and competitive operation of Nuclear by:

- (a) Ensuring effective plant system performance monitoring and system condition reporting, equipment performance trending, and effective troubleshooting.

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- (b) Providing corrective action when necessary to restore systems or equipment to optimum performance.
- (c) Maintaining plant configuration consistent with design and licensing basis.
- (d) Supporting operations and maintenance organizations in ensuring plants are operated consistent with the Safe Operating Envelope (SOE), Nuclear Waste Management Safety and Design Envelope, design basis, and licensing basis.
- (e) Performing Integrated Aging Management activities, including Life Cycle Plans and condition assessments, to understand the condition and maintain the health of critical SSC as the plants age.

Engineering programs described below are designed to ensure the engineering business objectives are met. The business objectives fall into two major categories, Protect the Asset and Control the Design. Engineering programs establish overall requirements for the engineering function.

#### 1.4.1 Protect the Asset

Plant reliability is achieved by putting in place business processes that:

- (a) Determine the condition of SSC.
- (b) Predict expected failure.
- (c) React to the results in a timely manner.

Surveillance programs are defined to implement effective system performance monitoring and system condition reporting, equipment performance trend reporting, and effective troubleshooting.

These processes are applied to equipment important to Nuclear safety and power generation to ensure systems and equipment perform consistent with their design requirements. These programs establish requirements for preventative maintenance, inspection, test, surveillance, and monitoring necessary to ensure systems and equipment perform in accordance with their design basis and at levels optimal to meet needs of the business.

Tracking and trending of system and equipment performance, internal and external shared OPEX, and lessons learned from root cause analysis of critical equipment failures are used to determine any changes to design, maintenance or operating practices necessary to achieve target reliability.

##### 1.4.1.1 N-PROG-MP-0007, Conduct of Engineering

This program implements a series of standards, procedures and instructions for performing engineering in a consistent manner across Nuclear. The program establishes the following practices for engineering:

- (a) Ensure plant configuration is maintained in accordance with design and licensing basis, and operated within the SOE and Nuclear Waste Management Safety and Design Envelope.

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- (b) Ensure essential plant equipment performs safely and reliably.
- (c) Comply with all relevant legal, statutory, and regulatory requirements.
- (d) Encourage continuous improvement in the conduct of engineering targeted at achieving safe, reliable, and competitive operation of Nuclear power generating stations.

This program establishes expectations for engineering management and leadership, and expectations on the safety culture required to ensure Nuclear safety is considered an overriding priority.

To ensure plant configuration is controlled to maintain conformance between design basis, licence basis, the SOE, and Nuclear Waste Management Safety and Design Envelope, this program defines requirements for the engineering programs to ensure they work in concert as an integrated change control process.

### 1.4.1.2 N-PROG-MA-0017, Component and Equipment Surveillance

It is essential that component and equipment performance support the safe, reliable, and economic operation at Nuclear facilities. This program fulfils this requirement by identifying defined component programs that evaluate component and equipment health by means of technical evaluations, inspection, maintenance, certification, and testing. Implementation of the program requirements provides a consistent methodology for providing component and equipment surveillance for select components at all Nuclear facilities.

There are component programs in place to ensure assumptions in the Safety Report are met and to ensure reliable component performance as credited in licensing documents. In addition, inspection and test type programs are in place to ensure mandated inspection and test activities driven by licenses and codes and standards are met.

### 1.4.1.3 N-PROG-MA-0025, Major Components

This program establishes a formal and systematic process in Nuclear for managing information related to four major component areas: Feeders, Steam Generators, Fuel Channels, and Reactor Components and Structures. This program provides a framework for integrating and reporting of the component performance, condition, and compliance with design basis documents. This hierarchy of documents, procedures, and other governance ensures the four major components perform safely and reliably, maintaining the design and licensing basis and the operational safety requirements while optimizing production and cost-effectiveness.

### 1.4.1.4 N-PROG-MA-0026, Equipment Reliability

This program defines the requirements for establishing and maintaining optimum levels of reliability for components important to Nuclear safety, production, and environmental protection. Reliable performance of components means very low numbers of component failures, degraded equipment condition is minimized, and redundancy is maintained on key systems. The program provides a framework for the following activities which ensure high levels of reliable performance of critical components:

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- (a) Identification and classification of components according to their criticality to focus activities related to these components according to their assigned criticality.
- (b) Specifying the required maintenance strategies to maintain high levels of reliability, and continuously improving the maintenance strategies based on corrective actions and maintenance feedback.
- (c) System monitoring and performance monitoring to ensure systems important to safety and production will perform their intended functions under design basis conditions and at optimum levels.
- (d) Component monitoring for components outside of established component programs.
- (e) Prompt and effective action when critical equipment fails, and to understand the technical and organizational cause to prevent a recurrence.
- (f) Oversight and direction by management on equipment reliability issues and priorities.
- (g) Management of the technical specifications for preventive maintenance requirements.
- (h) Implementation of predictive maintenance activities to detect early degradation of components.
- (i) Transfer of Equipment Reliability requirements to on-line, outage, and long range plans to ensure key actions are planned and executed.
- (j) Identification and prediction of aging and obsolescence issues on important components and embedding mitigating strategies and actions into the Business Plan.

### 1.4.1.5 N-PROG-MA-0016, Fuel

This program establishes requirements to integrate and review Nuclear fuel-related data in order to ensure fuel performs safely and reliably over the life of the stations, consistent with design and licensing bases, while optimizing reliability, production, and cost effectiveness. Fuel-related data includes any information which may impact fuel throughout its life cycle including (but not limited to) manufacturing, inspections, research, operating conditions, and fuel channel interactions. Also included is fuel channel data which may impact safety analysis, or the safety report; however, this program does **not** include responsibilities for fuel channel life cycle management and fitness for service which are covered by N-PROG-MA-0025, Major Components.

### 1.4.1.6 N-PROG-MP-0008, Integrated Aging Management

This program ensures that the condition of critical Nuclear Power Plant equipment is understood and that required activities are in place to ensure the health of these components and systems while the plant ages. This is accomplished by establishing an integrated set of processes and activities which ensure performance requirements of all critical equipment are met on an ongoing basis.



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The program also requires preparation of life cycle plans and condition assessments for critical plant equipment. These assessments supplement the ongoing engineering surveillance activities in place to monitor and optimize system performance. From these assessments, actions are established to ensure equipment performance requirements are met during station life.

### 1.4.1.7 N-PROG-OP-0004, Chemistry

This program specifies processes, overall requirements, and staff accountabilities to ensure effective control of plant chemistry during operational and lay-up conditions, control of laboratory methods, sampling and analyses, process chemicals, chemistry control performance monitoring, and reporting. These activities are performed in order to ensure critical plant equipment performs safely and reliably over the life of the stations.

### 1.4.1.8 N-PROG-MA-0013, Welding

This program establishes controlled processes and standardized welding practices to safely and efficiently make sound welds meeting structural integrity, code, and licensing requirements in accordance with qualified procedures and using qualified personnel. This program also covers welding on components not governed by codes and standards.

### 1.4.1.9 N-PROG-RA-0016, Risk and Reliability Program

This program provides organizational accountabilities, interfaces, and key program elements to ensure risks from Nuclear accidents are identified, monitored, and controlled across Nuclear. Probabilistic Risk Assessment (PRA) is used as a means to assess and manage the magnitude of radiological risks to the public from accidents due to operation of Nuclear reactors, and applied in a consistent manner across Nuclear. Operational reliability monitoring and reporting ensures risks during operation are monitored and managed.

This program consists of safety goals, station-specific PRAs, associated risk models, unavailability models of systems important to safety and software applications, and Nuclear governing documents.

### 1.4.1.10 N-PROG-MP-0014, Reactor Safety Program

This program defines organizational responsibilities and key program elements for the management of issues related to Nuclear Safety Analysis, in particular generic action items, and the following major components of safe operation:

- Safety Analysis Basis (Safety Report and Analysis of Record)
- SOE
- Beyond Design Basis Accident Management.

This program and implementing procedures and standards govern management of issues related to Nuclear Safety Analysis and their impact on safe operation.

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### 1.4.2 Control the Design

Design changes shall be controlled to ensure plant configuration is maintained in conformance with design and licensing bases and code requirements, and remains within the SOE, Nuclear Waste Management Safety and Design Envelope and associated analyzed conditions.

#### 1.4.2.1 N-PROG-MP-0001, Engineering Change Control

This program defines a systematic process and methodology for controlling design modifications to plant SSCs, including software and engineered tools, which meets CSA N286-05, N286-12 and N285-08 Standards. The program also ensures that Non-identical Component Replacements (NICRs) and Item Equivalency Evaluations (IEE) comply with applicable codes, standards and regulations. The risk-based Engineering Change Control (ECC) process systematically controls design changes from inception to design package completion ensuring they are planned, designed, installed, commissioned, and placed in service within the SOE, Nuclear Waste Management Safety and Design Envelope, design bases, and plant licensing conditions. For all modifications, the ECC process defines requirements such as:

- (a) Regulatory approval and stakeholder reviews.
- (b) Constructability, Operability, Maintainability and Safety walk-down.
- (c) Design completion.
- (d) Management approvals.

ECC process utilizes a graded risk-based approach that allows for permanent and temporary modifications. The ECC process also defines a process to provide engineering control and approval of field changes if they are required, during installation and commissioning. In addition, the ECC process defines a Non-Identical Component Replacement process ensuring ECC is applied for substitution of components when equivalent items are no longer available. The general overall process for all types of changes is similar, differing only in the degree of rigour and formality. All changes are approved by the Design Authority. N-PROG-MP-0007 describes the role and how responsibilities of the Design Authority are managed.

Document-only changes that do not affect the *design basis* are managed in accordance with N-PROG-AS-0006 and the programs applicable to the engineering document being modified.

#### 1.4.2.2 N-PROG-MP-0009, Design Management

This program provides the framework for establishment of assurance that changes to plant design are controlled in a manner consistent with plant design and licensing basis. This program provides assurance that design bases, design outputs and design process documentation are prepared, reviewed, approved, and implemented in accordance with approved procedures, applicable regulatory requirements, standards, and industry practices. This program also ensures that procurement specifications for materials, systems, components, parts, and services of purchased items will perform their intended end-use design function(s).

A key element of the program specifies the requirement for verification to confirm a specific task or activity satisfies established requirements. Verification applies to all work activities in all functional areas of Nuclear (e.g., operations, maintenance, engineering, procurement,

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construction, commissioning) which requires verification activities to be identified, planned, executed, and documented. The method, extent, and timing of the verification as well as the identity of the verifier shall be recorded and the verifier should be appropriately independent.

#### 1.4.2.3 N-PROG-MP-0006, Software

This program applies to software classified as Real-Time Process Computing, Scientific, Engineering and Safety Analysis Software or Software Engineering Tools. This program identifies processes and overall requirements for classification of software and identifies governing standards for each software classification to define requirements for software development, maintenance, procurement, qualification, and retirement including security of Real-Time Process Computing critical cyber assets.

#### 1.4.2.4 N-PROG-MP-0004, Pressure Boundary

This program provides a managed process to control the quality of Pressure Boundary (PB) activities at Nuclear for performing repairs, replacements, and modifications on pressure-retaining systems and components. It reflects those requirements of the PB Quality Assurance program related to performance of PB fieldwork activities. This is to ensure Nuclear retains the PB Certificates of Authorization (C of A) necessary to perform PB activities and, remains compliant with the Nuclear Station PROL, Waste Facility Operating Licenses (WFOL), and applicable CSA Standards.

N-MAN-01913.11-10000, Pressure Boundary Program Manual, as referenced by this program, describes the system used to control the quality of PB activities at Nuclear facilities and stations. It complies with CSA N285.0, General Requirements for Pressure Retaining Systems and Components in CANDU Nuclear Power Plants, and ASME Section III, NCA-4000, Quality Assurance. PB requirements for all stages of work, from design through installation and test, are implemented through supporting Nuclear governing documents.

The Canadian Nuclear Safety Commission (CNSC) has regulatory jurisdiction over PB requirements, including approval of any deviations from those requirements. OPG maintains a formal agreement with an AIA, acceptable to the CNSC, to provide pressure boundary services of its nuclear facilities in accordance with requirements of CSA N285.0. This includes activities such as certification of QA and QC programs for acceptability, inspections, registrations and other activities as detailed in the agreement.

#### 1.4.2.5 N-PROG-RA-0006, Environmental Qualification

This program provides auditable assurance that essential credited safety-related equipment and components, required to mitigate consequences of a design basis accident, will perform its intended function when exposed to harsh environmental conditions resulting from that accident, and this capability will be maintained over the life of the stations. Implementation of these program requirements shall provide consistent methodology, programmatic controls, and interfaces for establishing and maintaining environmental qualification of equipment and components over the life of the Nuclear plants.

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### 1.4.2.6 N-PROG-MP-0005, Configuration Management

This program ensures Nuclear facilities are operated, maintained, and modified in accordance with their design and licensing bases. The program objectives:

- (a) Assure the physical plant configuration matches the documented configuration (documents or electronic data).
- (b) Ensure configuration information is accurate, consistent, and readily available.
- (c) Establish clear configuration control scope, responsibilities, authorities, and interfaces among all organizations.
- (d) Manage proposed changes effectively.

## 1.5 Manage Risk

Risk Management programs described below are designed to ensure Nuclear minimizes risk to health and safety of the public, environment, and employees, from events associated with station security, fire, industrial hazards, radiation safety, and pandemic. These programs are designed to understand risk, eliminate unnecessary risk, and ensure protective and control measures are put in place against risks that are part of the Nuclear business. These programs are typically not stand-alone programs. They are integrated with other programs to ensure risk elements identified above are managed as part of day-to-day operation of the business.

In the unlikely event of an emergency, an emergency plan has been established to classify, notify, and respond to such emergencies.

### 1.5.1 Hours of Work

The hours of work for Nuclear employees are controlled, monitored, reported, and assessed for compliance to both legislative requirements and CNSC expectations. N-PROC-HR-0002, Limits of Hours of Work, describes the controls for managing these requirements.

This procedure is owned by the People and Culture organization, under OPG Business Model, OPG-POL-0033.

### 1.5.2 Fitness-for-Duty

Fitness for duty expectations are communicated to all staff through “Human Resources Overview” training and adherence to the Corporate Safety Rules (under Common Safety Rule 1.2) and associated training.

### 1.5.3 N-PROG-RA-0012, Fire Protection

This program establishes provisions to prevent, mitigate, and respond to fires such that fire risk to Nuclear workers, public, environment, Nuclear physical assets, and power generation, is acceptably low and controlled. The PROLs require Nuclear to comply with the requirements of CSA N293-07, Fire Protection for CANDU Nuclear Power Plants, and includes codes and standards such as the National Fire Code of Canada 2005, the fire protection requirements of

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the National Building Code of Canada 2005, and applicable National Fire Protection Standards.

### 1.5.4 N-PROG-RA-0013, Radiation Protection

This program implements a series of standards and procedures for the conduct of activities within Nuclear sites, and with radioactive materials, intended to achieve and maintain high standards of RP including the following objectives:

- (a) Controlling occupational and public exposure by:
  - (1) Keeping individual doses below regulatory limits.
  - (2) Avoiding unplanned exposures.
  - (3) Keeping individual risk from lifetime radiation exposure to an acceptable level.
  - (4) Keeping collective doses As Low As Reasonably Achievable (ALARA), and taking social and economic factors into account.
- (b) Preventing the uncontrolled release of contamination or radioactive materials from Nuclear sites through the movement of people and materials.
- (c) Demonstrating the achievement of (a) and (b) through monitoring.

This program complies with the CNSC requirement for all licensees to implement an RP program that meets CSA N286-05 and N286-12 requirements for radioactive contamination control and radiation safety.

### 1.5.5 OPG-PROG-0010, Health and Safety Management System Program

The Ontario Power Generation (OPG) Health and Safety Management System program establishes the process requirements that must be implemented and maintained to ensure that health and safety risks to workers are being mitigated. It also outlines the responsibilities of the various levels of the organization to ensure these activities are carried out.

The Health and Safety Management System includes:

- Occupational conditions and factors that could affect the health and safety of workers, in all workplaces or from work-related activities under the control of OPG.
- Non-occupational health-related conditions and factors that could affect the health of OPG workers where it impacts achievement of OPG's business objectives.
- Public safety as it pertains to reporting requirements and operational risk management.
- Contractor safety

Ontario Power Generation (OPG) has established, documented and implemented this health and safety management system consistent with OPG-POL-0033, OPG Business Model. It is aligned with CSA N286-05, Clause 6.27 Workplace Safety and N286-12, Clause 4.2 Safety Culture. Implementation of this management system fulfills commitments in OPG-POL-0001, Employee Health and Safety Policy and ensures that health and safety risks are managed to

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achieve the desired objectives and identifies continuous improvement opportunities through a “Plan → Do → Check → Review” cycle of management.

This program is owned and implemented by the Corporate Health and Safety organization under the Employee Health and Safety Policy, OPG-POL-0001.

### 1.5.6 N-PROG-MA-0015, Work Protection

This program ensures establishment of standards and procedures necessary for worker safety where work on equipment requires isolation or isolation and de-energization. This program specifies continuous monitoring requirements necessary to ensure work practices used are safe, uniform, and effective. Effective implementation and control of work protection activities primarily are achieved by instituting high standards, providing a professional environment and sufficient resources, monitoring and assessing performance, and holding personnel accountable for their performance.

### 1.5.7 N-PROG-OP-0006, Environmental Management

This program ensures Nuclear activities are conducted such that their adverse impact on the natural environment is prevented or mitigated. All aspects of the program are conducted to ensure Nuclear complies with environmental regulatory and other requirements including ISO 14001 standard (Environmental Management Systems). The long-term objective is to continuously improve environmental performance.

This program is owned and implemented by the Environment organization under the Environmental Policy, OPG-POL-0021.

### 1.5.8 N-PROG-RA-0001, Consolidated Nuclear Emergency Plan

This program implements and maintains Nuclear’s emergency response capability to protect the public, employees, and environment in the event of a nuclear emergency. Appropriate planning measures are established to adequately respond to postulated abnormal situations, including preparation of emergency operating procedures, event classification, notification requirements, event mitigation, personnel protective actions (on-site and off-site), designation of emergency facilities, and public information requirements.

### 1.5.9 N-PROG-RA-0018, Nuclear Pandemic Plan

This program provides direction and instruction to deal with high staff absenteeism and other circumstances that may arise out of a pandemic illness. Primary aim of the Nuclear Pandemic Plan is to outline concepts, structures, roles, and processes required for Nuclear to ensure safety of employees, assets, and the public, and maintain normal plant operations consistent with the current business plan, in the event of a pandemic.

The overriding principle in this plan is that Nuclear plants shall be maintained in a safe state; maintaining the continuity of generating power only if it can be done safely.

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### 1.5.10 Nuclear Regulatory Affairs

Nuclear is committed to protecting the safety of the public, our workers, and the environment, to maintaining national security, and to meeting the international obligations to which Canada has agreed. These commitments are in keeping with the requirements of the Nuclear Safety and Control Act, the Regulations made under that Act, and the licences, permits, and certificates issued by the CNSC pursuant to the Act.

#### 1.5.10.1 N-PROG-RA-0002, Conduct of Regulatory Affairs

This program includes broad guidelines for evaluating impact of licence and permit applications and amendments, providing regulatory and legislative interpretations, and monitoring emerging legislative, regulatory, and industry trends. Successful interface with regulatory agencies is critical in meeting Nuclear's overall objective. Communication with regulatory agencies must be open, honest and forthright. The program defines a set of processes to ensure these expectations are met in an effective and efficient manner.

#### 1.5.11 N-PROG-RA-0015, Nuclear Safeguards

This program puts special controls in place to ensure Nuclear complies with Canada's commitment to the Nuclear Non-proliferation Treaty consistent with International Atomic Energy Agency (IAEA) requirements for storage and handling of Nuclear fuel throughout its life cycle. The program includes the following:

- (a) Communication protocol between the IAEA, CNSC, and Nuclear.
- (b) Obligations to meet applicable regulatory requirements and requirements of associated safeguards procedures.
- (c) Reporting to meet applicable regulatory requirements and requirements of safeguards agreements.

#### 1.5.12 N-PROG-RA-0011, Nuclear Security

Physical plant security is provided to minimize risk to the public, employees, environment, and the business, from sabotage, theft, or other criminal acts. This program supports the need to protect Nuclear assets by:

- (a) Establishing an enhanced state of security readiness as a result of potential terrorism and commitments to the CNSC.
- (b) Maximizing the response capability to contain, mitigate, and terminate a security event that has either occurred or is in progress.
- (c) Minimizing the adverse impact on legitimate plant staff or operations.

This program establishes proactive "best-in-business" security processes and conforms to the goals and objectives of the Corporation, and to legislative requirements such as Security Regulations.

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### 1.6 Provide Services

#### 1.6.1 Inspection and Maintenance Services

Inspection and Maintenance Services (IMS) is a provider of inspection, specialized maintenance, project management, and technical services to Nuclear and non-Nuclear facilities.

##### 1.6.1.1 I-PROG-AS-0001, Conduct of Inspection and Maintenance Services

This program describes the managed system applied by IMS to provide inspection, specialized maintenance, project management, and technical services to Nuclear and non-Nuclear facilities in OPG. The program ensures quality in IMS and enable IMS to provide products and services in a safe, innovative, responsive, and cost effective manner in accordance with regulatory requirements, owner or customer-specified requirements, and industry standards.

The managed system consists of this program document and interfacing OPG and Nuclear governance, the IMS organization structure, IMS Executive and management teams, and IMS infrastructures consisting of equipment, facilities, processes, and procedures.

#### 1.6.2 Commercial Services

##### 1.6.2.1 N-PROG-AS-0009, Isotope Sales

This program outlines basic conditions for the sale of isotope products and services, including managing, controlling, and documenting activities associated with the sale of any Nuclear isotope-related product or service, in compliance with the Nuclear Safety and Control Act, Nuclear policies, federal non-proliferation regulations, and all other relevant regulations.

#### 1.6.3 N-PROG-AS-0007, Project Management

This program identifies project management processes of planning, organizing, and managing resources to ensure the safe, consistent, effective execution and completion of projects across Nuclear. The program also ensures that safety and quality shall be the overriding priority and will not be compromised for cost or schedule. Projects are widely used in Nuclear for engineering and non-engineering purposes.

### 1.7 Manage Waste

DNWMD is responsible for the life cycle management of radioactive waste for OPG-owned facilities and has direct responsibility for transportation, processing, interim storage, and eventual final disposition of radioactive waste.

DNWMD is also responsible for the management system applicable to the decommissioning of Ontario Power Generation (OPG) owned nuclear facilities and management oversight of the radioactive waste repositories for both low and intermediate level waste and the adaptive phase management deep geologic repository for high level waste.

Work performed inside DNWMD licensed facilities is performed in accordance with DNWMD governing procedures as well as Nuclear governance described in this Charter. When



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DNWMD performs activities within the bounds of other CNSC licensed facilities, DNWMD complies with the licensee's governing procedures.

### 1.7.1 W-PROG-WM-0001, Nuclear Waste Management Program

This program establishes the overall managed system for Nuclear waste management, and decommissioning and incorporates, directly or by reference, the controls necessary to meet the requirements of the CSA N286-05 and N286-12 Standards, ISO 14001:2004, and DNWMD facilities and activities.

This program describes controls for training, work planning and control, regulatory affairs, records and document management, corrective actions, program assessment, and waste acceptance criteria as they pertain to waste management.

### 1.7.2 W-PROG-WM-0002, Radioactive Material Transportation

This program describes controls that ensure safe, compliant, and efficient radioactive material transportation. In addition, it includes verification that the Transportation Emergency Response Plan is appropriately established to provide corporate emergency response for radioactive material transportation incidents.

### 1.7.3 W-PROG-WM-0003, Decommissioning Program

This program describes controls for the decommissioning of OPG owned Nuclear facilities and provides assurance that work will be planned and controlled in accordance with requirements of CSA N286-05, N286-12 and N294-09, Decommissioning of Facilities Containing Nuclear Substances.

## 1.8 Interfaces

Nuclear interface with other OPG line of business is described below.

### 1.8.1 00216-CHAR-0001, Deep Geological Repository Project, Management System

This management system is applicable to Ontario Power Generation's Low and Intermediate Level Waste (L&ILW) Deep Geologic Repository (DGR) Project for the regulatory approval, design, procurement and construction of the project and the turnover to DNWMD L&ILW organization for ongoing operations. It provides assurance that the L&ILW DGR is designed, procured, constructed, commissioned and turned over in accordance with the requirements of CSA Standards N286-05 as it applies to the L&ILW DGR Project. This management system integrates the requirements for other management system standards for health, safety, environment, security, economics and quality and to meet the principle that safety is the paramount consideration guiding all decisions and actions.

## 2.0 DEFINITIONS AND ACRONYMS

### 2.1 Definitions

**Condition Assessment** is a technical or engineering assessment of the current physical condition of a generating facility and its associated structures. It includes a detailed

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assessment of all major SSC, and an estimate of the remaining expected service life for the facility and its key components. The condition assessment may also identify future investment requirements for repair, rehabilitation, modification, or replacement to carry the facility and its associated structures to their planned end of life. The rationale for each investment is identified and potential problem areas are highlighted in order that they can be properly monitored.

**Human Performance** is a series of behaviours executed to accomplish specific task objectives or achieve specific results.

**Nuclear Management System** is the principles, the required supporting actions, and the supporting documentation to support safe and reliable nuclear plants, as defined by CSA N286-05 and N286-12. Paragraphs 0.1 and 0.2. of N286-05 state “safe and reliable nuclear power plants require commitment, and adherence to a set of management system principles and, consistent with these principles, the implementation of a planned and systematic pattern of actions that achieves the expected results”. Paragraph 0.2 of N286-12 states “The management system brings together in a planned and integrated manner the process necessary to satisfy the requirements that must be met to achieve business success and sustainability”. The Nuclear Management System is represented by a governance framework supported by this Nuclear Charter and further ensures that Nuclear Safety is the overriding priority at OPG Nuclear.

## 2.2 Abbreviations and Acronyms

<b>ALARA</b>	As Low As Reasonably Achievable
<b>ASME</b>	American Society of Mechanical Engineers
<b>CEO</b>	Chief Executive Officer
<b>CNO</b>	Chief Nuclear Officer
<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>C of A</b>	Certificate of Authorization
<b>CSA</b>	Canadian Standards Association
<b>DGR</b>	Deep Geologic Repository
<b>DNWMD</b>	Decommissioning and Nuclear Waste Management Division
<b>ECC</b>	Engineering Change Control
<b>IEE</b>	Item Equivalency Evaluation
<b>ISO</b>	International Organization for Standardization
<b>L&amp;ILW</b>	Low and Intermediate Level Waste
<b>NICR</b>	Non-identical Component Replacement
<b>NSRB</b>	Nuclear Safety Review Board
<b>OPEX</b>	Operating Experience
<b>OPG</b>	Ontario Power Generation
<b>OP&amp;P</b>	Operating Policies and Principles
<b>OPGN</b>	Ontario Power Generation Nuclear
<b>PB</b>	Pressure Boundary
<b>PRA</b>	Probabilistic Risk Assessment
<b>PROL</b>	Power Reactor Operating Licence
<b>RP</b>	Radiation Protection
<b>SOE</b>	Safe Operating Envelope
<b>SSC</b>	Systems, Structures, and Components
<b>TSSA</b>	Technical Standards and Safety Authority

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**WFOL** Waste Facility Operating Licence  
**WANO** World Association of Nuclear Operators

### 3.0 REFERENCES

00216-CHAR-0001, Deep Geologic Repository Project, Management System  
ASME Section III, Boiler and Pressure Vessel Code  
ASME Section III, NCA-4000, Quality Assurance  
CSA N285.0, General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants.  
CSA N286-05, Management System Requirements for Nuclear Power Plants  
CSA N286-12, Management System Requirements for Nuclear Facilities  
CSA N286.7-99, Quality Assurance of Analytical, Scientific, and Design Computer Programs  
CSA N293-07, Fire Protection for CANDU Nuclear Power Plants  
CSA N294-09, Decommissioning of Facilities Containing Nuclear Substances  
I-PROG-AS-0001, Conduct of Inspection and Maintenance Services  
ISO 14001:2004, Environmental Management Systems – Requirements With Guidance for Use  
N-LIST-08130-10023, CSA N286-05 to OPGN Governance Cross Matrix  
N-MAN-01913.11-10000, Pressure Boundary Program Manual  
N-POL-0001, Nuclear Safety Policy  
N-PROC-HR-0002, Limits of Hours of Work  
N-PROG-AS-0001, Managed Systems  
N-PROG-AS-0002, Human Performance  
N-PROG-AS-0005, Business Planning  
N-PROG-AS-0006, Records and Document Control  
N-PROG-AS-0007, Project Management  
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N-PROG-AS-0009, Isotope Sales  
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N-PROG-MA-0015, Work Protection  
N-PROG-MA-0016, Fuel  
N-PROG-MA-0017, Component and Equipment Surveillance  
N-PROG-MA-0019, Production Work Management  
N-PROG-MA-0024, Conduct of Nuclear East Facilities Maintenance and Engineering  
N-PROG-MA-0025, Major Components  
N-PROG-MA-0026, Equipment Reliability  
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N-PROG-MP-0001, Engineering Change Control  
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N-PROG-MP-0008, Integrated Aging Management  
N-PROG-MP-0009, Design Management  
N-PROG-MP-0014, Reactor Safety Program  
N-PROG-OP-0001, Nuclear Operations

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 N-PROG-RA-0006, Environmental Qualification  
 N-PROG-RA-0010, Independent Assessment  
 N-PROG-RA-0011, Nuclear Security  
 N-PROG-RA-0012, Fire Protection  
 N-PROG-RA-0013, Radiation Protection  
 N-PROG-RA-0015, Nuclear Safeguards  
 N-PROG-RA-0016, Risk and Reliability Program  
 N-PROG-RA-0018, Nuclear Pandemic Plan  
 N-PROG-TR-0005, Training  
 N-STD-AS-0020, Nuclear Management System Organization  
 N-STD-RA-0014, Second Party Verification  
 National Building Code of Canada 2005  
 National Fire Code of Canada 2005  
 NK38-PLAN-00960-10001, Preliminary Decommissioning Plan – Darlington Nuclear  
 Generating Station  
 Nuclear Non-Proliferation Agreement  
 Nuclear Safety and Control Act  
 OPG-POL-0001, Employee Health and Safety Policy  
 OPG-POL-0021, Environmental Policy  
 OPG-POL-0032, Safe Operations Policy  
 OPG-POL-0033, OPG Business Model  
 P-PLAN-00960-00001, Preliminary Decommissioning Plan Pickering Nuclear Generating  
 Stations A and B  
 W-PROG-WM-0001, Nuclear Waste Management Program  
 W-PROG-WM-0002, Radioactive Material Transportation  
 W-PROG-WM-0003, Decommissioning Program

## 4.0 REVISION SUMMARY

- Included throughout the document that the Nuclear Management System fulfills the requirement of both CSA N286-05 and CSA N286-12.
- Changes have been made throughout to address questions raised by CNSC in their letter of Nov 18 2013 on CNSC Review of the OPG Business Model, N-CORR-00531-06349, and OPG response N-CORR-00531-06485.
- Section 1.0: The role of providing interpretation of the requirements of the Nuclear Charter and its supporting documents is transferred from the Director Nuclear Oversight to the Director, Nuclear Regulatory Affairs and Stakeholder Relations, to enable clear distinction between operational roles and oversight roles.
- Section 1.0: Added OPG Behaviours, to go along with Vision, Mission, Cornerstones and Values.

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- Section 1.0: Clarified the meaning of an “approved” quality system for organizations that support nuclear.
- Section 1.1.1: Per DCR 1259370, the program description has been updated for alignment with N-PROG-AS-0001-R016. In addition, details have been provided to clarify how the CNO exercises control over Nuclear programs and maintains an effective management system compliant with CSA N286.
- Section 1.1.1.1: Identified that the Nuclear Organization standard, N-STD-AS-0020 is owned and implemented by the People and Culture Organization.
- Section 1.1.2: Clarified the role of governance within the Nuclear Management System
- Section 1.1.3: New section is added on OPG-PROG-0001 Information Management as discussed in N-CORR-00531-06485.
- Section 1.1.7: Identified that the Independent Assessment Program , N-PROG-RA-0010 is owned and implemented on behalf of the CNO by the Finance Organization.
- Section 1.1.8: Identified that the Training Program , N-PROG-TR-0005 is owned and implemented by the People and Culture Organization.
- Section 1.2.1: The functional areas for Nuclear Operations have been updated to reflect the latest version of the WANO PO&C's.
- Section 1.3.3: Identified that the Materials Management Program , N-PROG-MM-0001 is owned and implemented by the Supply Chain Division of the Business and Administrative Services Organization.
- Section 1.4.1.10: Per DCR 1289430, the major component description “Severe Accident Management” has been changed to “Beyond Design Basis Accident Management”
- Section 1.4.2.4: Per DCR 1260200 was revised for consistency with Licence Condition 6.2 in the Darlington PROL 13.00/2014.
- Section 1.4.2.6: Per DCR 0129921, the Procurement Engineering Program document has been superseded and thus removed from this Charter. The Procurement Engineering program requirements have been included in the Design Management and Engineering Change Control programs.
- Section 1.5.1: Identified that the procedure on the Limit of Hours of Work, N-PROC-HR-0002, is owned by the People and Culture Organization.
- Section 1.5.4: Per DCR 0129228, the error with respect to indentation was corrected and the program description is now consistent with information in N-PROG-RA-0013.
- Section 1.5.5: The Conventional Safety Program, N-PROG-HR-0004, has been replaced with the Health and Safety Management System Program, OPG-PROG-0010.

## Nuclear Charter

Internal Use Only		
Document Number: N-CHAR-AS-0002		Revision: R018
Usage Classification: Information	Sheet Number: N/A	Page: 31 of 32

Title:

### NUCLEAR MANAGEMENT SYSTEM

- Section 1.7: has been revised to more succinctly describe the responsibility of the Decommissioning and Nuclear Waste Management Division (DNWMD).
- Section 1.8.1: Per DCR 0129494, N-PROG-MA-0024 Conduct of Nuclear East Facilities Maintenance and Engineering, is superseded by OPG-PROG-0032. Also, this program has been removed from N-CHAR-AS-0002 - the approval to remove was granted by the Nuclear Management System Review Board at its Feb. 20, 2014 meeting. The minutes of the meeting is documented in file N-MNTS-08100-T5.
- Section 2.1: Updated the definition of the Nuclear Management System to indicate that it is now also consistent with CSA N286-12, paragraph 02 "The management system brings together in a planned and integrated manner the process necessary to satisfy the requirements that must be met to achieve business success and sustainability".
- Section 2.1: Deleted unnecessary and not fully comprehensive definition of "event".
- Section 3.0: Added CSA N286-12 as a reference. Also, N-PROG-MP-0011 was removed as reference.
- Appendix A:
  - Combined the two Governing Document Framework tables into one.
  - N-PROG-MA-0024 Conduct of Nuclear East Facilities Maintenance and Engineering was removed.
  - N-PROG-MP-0011, Procurement Engineering, was removed.
  - The Conventional Safety Program, N-PROG-HR-0004, has been replaced with the Health and Safety Management System Program, OPG-PROG-0010.

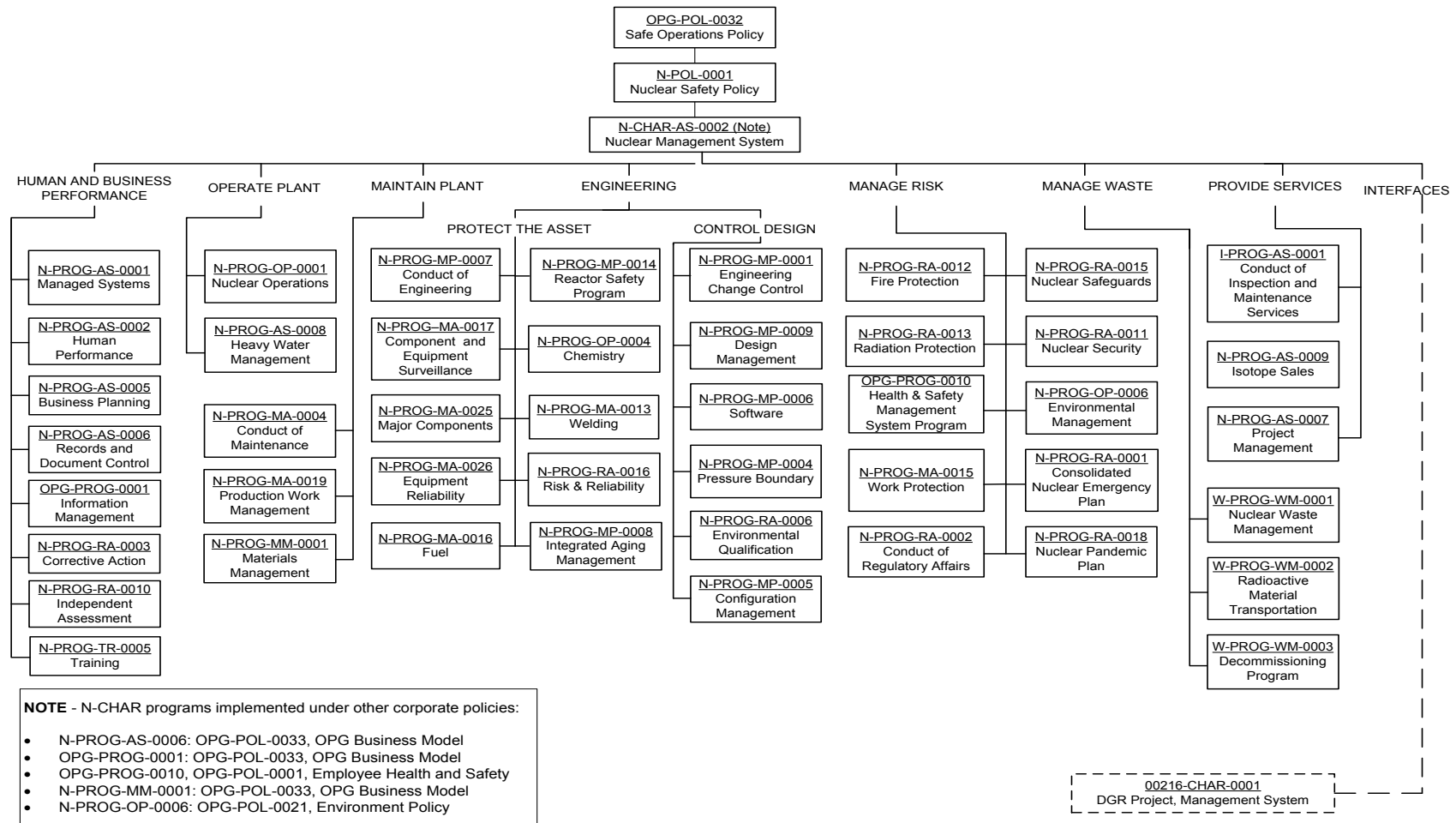
## Nuclear Charter

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**NUCLEAR MANAGEMENT SYSTEM**

## Appendix A: Governing Document Framework



**NOTE** - N-CHAR programs implemented under other corporate policies:

- N-PROG-AS-0006: OPG-POL-0033, OPG Business Model
- OPG-PROG-0001: OPG-POL-0033, OPG Business Model
- OPG-PROG-0010, OPG-POL-0001, Employee Health and Safety
- N-PROG-MM-0001: OPG-POL-0033, OPG Business Model
- N-PROG-OP-0006: OPG-POL-0021, Environment Policy



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Sheet Number:	Revision:
N/A	R001

Title:

**NUCLEAR REFURBISHMENT - GATE REVIEW BOARD - TERMS OF REFERENCE**

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**Nuclear Refurbishment - Gate Review  
Board - Terms Of Reference**

**NK38-PLAN-09701-10006-R001**  
2014-09-08

Order Number: N/A  
Other Reference Number:

**Internal Use Only**

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### Revision Summary

Revision Number	Date	Comments
R001	2014-09-08	Revised to update the following: <ul style="list-style-type: none"><li>Included Finance and projects Oversight as Quorum</li><li>Added reference to Pre-Gate Readiness Review per NK38-PLAN-09701-10227</li></ul>
R000	2011-06-09	Initial issue

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## 1.0 OBJECTIVE

The Darlington Nuclear Refurbishment program will undergo an evolution of detailed planning after scope approval. During the detailed planning phase, the project will flow through the Identification Phase, Initiation phase, and the Definition Phase. The Execution Phase of the program will follow the Definition Phase and will lead to the Close out phase (including Commission/Turnover and Final Project Close out).

The Gated concept is designed to control funding approval through the project phases, and to control steps of phase progression approvals for each individual project.

The Gated Process is intended to provide a standardized, comprehensive review of project scope, schedule, risk, cost and quality in order to enable the Gate Review Board (GRB) to approve the progression of project work through the next project phase(s).

The senior management team (Gate Review Board) mandates 'check-points' at each major project phase in order to ensure the project is on track in its development regarding scope, cost, quality and schedule.

A gate serves as the project budget allocation process upon GRB approval, the budgeted funds (including contingency) required for the approved scope of work and released to the project.

GRB will review the past performance of the previous gate, life cycle project viability (including impact on program viability) and the readiness for the next phase.

For each of the gates in the process, there is a Gate Progression Form that will be required for submission at each Gate Review Board meeting.

Progress through that Gate is approved by the Gate Review Board based on acceptance of the required deliverables, as documented on the Gate Progression Form, and as presented by the Project Manager at the Gate Review Board meeting.

Prior to the submission of the Gate Documents to the GRB a Pre-Gate Readiness Review is performed to ensure the quality meets the governance requirements and ensures consensus that Gate information has been satisfactorily prepared.

A Pre-Gate Readiness Review provides an assessment of the rigor and quality of the Gate Approval Package for cost, estimating, scope, risk and schedule, and ensures adequate definition, strategy, and supporting documentation is available prior to a GRB decision gate.

The Pre-Gate Readiness Review is performed per NK38-PLAN-09701-10227 Terms of Reference that describes the function and role of the Darlington Nuclear Refurbishment Program Pre-Gate Readiness Review/Alignment Meeting.

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### 1.1 Gate Review Board (GRB)

The primary focus of this document is to describe the function and role of the Darlington Nuclear Refurbishment Program Gate Review Board (hereafter referred to as the 'GRB'). The GRB shall provide review and approval of proposed strategies, options, funding, and schedule of the projects within the refurbishment program in accordance with the Nuclear Projects Gated Process (N-MAN-00120-10001). Approval of progression to the next phase is the outcome of the Gate Review Board Meetings.

The GRB will work within the governance and milestones established by the Program, including all Program level scope management deadlines.

## 2.0 GRB STRUCTURE - MEMBERSHIP AND QUORUM

### 2.1 Gate 0 (GO) Program Scope Review Board (PSRB)

Gate 0 approval will be done in accordance with the existing Program Scope Review Board. Quorum is per the Darlington Refurbishment Program - Program Scope Review Board Terms of Reference - NK38-PLAN-09701-10003.

### 2.2 Gate 1 to Gate 5 (G1 to G5) Gate Review Board (GRB)

The GRB will be comprised of the following team members:

- SVP - Nuclear Projects (Sponsor)
- Director Planning and Control (Chair)
- VP Refurbishment Engineering
- VP Refurbishment Execution
- VP Refurbishment OP's & Maintenance
- VP Nuclear Finance
- VP Nuclear Projects Oversight
- Director Commercial Strategy
- Director Supply Chain
- VP Projects and Modifications (for projects being executed by Projects and Modifications)

Quorum is Chair plus 5 team members.

The Chair will assign a GRB secretary from within the Planning and Control organization.

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In the event of the unavailability of the individual specified the Board member may delegate the meeting attendance to a knowledgeable and empowered representative. This representative must be a Stratum 4 Level or higher.

In addition to Quorum members, the accountable project sponsor and project manager are to attend the meeting to present.

### 3.0 GRB ROLES, ACCOUNTABILITIES

The GRB consists of voting members, where quorum is required in order to record a decision. The review and recommendation for progression to the next gate shall consider the project contribution in meeting the Program objectives, the technical appropriateness of the proposed alternative options, and the impact on refurbishment cost and schedule.

The gate package will be provided to the RPET members for their review one week in advance of the scheduled gate meeting. In advance of the Gate Meeting, each voting member shall review the material submitted by the Project Manager and, where required, seek clarification in advance of the meeting in order to maximize the effectiveness at the meeting. It is expected that voting members will perform a deeper review of all submittals relevant to their specific role.

Voting members will be expected to review all information relevant to their role, as provided at the Gate.

A contrarian (black hat) will be assigned at each GRB meeting to ensure an independent, challenging view is performed prior to acceptance of project progression to the next phase. This person should not be a voting member.

The GRB voting members will strive to arrive at a consensus for all requests to progress the project to the next phase.

The Director of Planning and Control shall assign a Secretary of the GRB and will ensure that all decisions and actions are recorded and followed up at each Gate Meeting.

Upon approval of gate progression by the GRB release of funds for the next phase will be controlled by the Planning and Controls organization with support from Nuclear Finance.

### 4.0 GRB PROCESS

The Gate Review Board will meet bi-weekly, as required. The GRB Chair will ensure that meetings are on the Refurbishment Master schedule and booked using Outlook.

All meeting material must be issued to the GRB meeting one week in advance; if there is no project requiring GRB approval for the upcoming meeting, it will be cancelled.

## Plan

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Meeting materials will include, for the specific project progressing through a gate, the Gate Presentation, the Gate Progression Form, and a link to all supporting material.

The status of all previous GRB actions will be monitored at each GRB meeting.

Deliverables will be prepared and submitted in accordance with approved templates as documented in the Nuclear Projects Gated Process (N-MAN-00120-10001-GRB).

The key outputs from the GRB are:

- Approval of progression to the next phase.
- Gate Progression Form Signoff.
- Documentation of the decisions with the rationale and basis so that these are available for reference purposes, if and when needed.
- Documentation of any actions taken at the gate meeting, and or status of existing actions.
- Documentation of the outcomes of the gate meeting and the next immediate steps.

### 5.0 DURATION

This GRB shall remain in this role until the completion of the Darlington Refurbishment Program.

### 6.0 DOCUMENTATION

A record of all GRB decisions and other gate related documents will be saved under the GRB SharePoint library.

### 7.0 REFERENCES

- Nuclear Projects Gated Process, N-MAN-00120-10001-GRB
- Pre-Gate Readiness Review Alignment Meeting - Terms of Reference, NK38-PLAN-09701-10227



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Title:

**NUCLEAR PROJECTS - GATED PROCESS**

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## **Nuclear Projects - Gated Process**

**N-MAN-00120-10001-GRB-R002**  
2016-03-31

Order Number: N/A  
Other Reference Number:

**Internal Use Only**

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**NUCLEAR PROJECTS - GATED PROCESS**

**Revision Summary**

Revision Number	Date	Comments
R002	2016-03-31	Revised general process to include Nuclear Operations projects. Updated phase description, outputs and submission documents.
R001	2013-04-08	Revised records table to align with revised Nuclear Refurbishment Records Retention Code. Updated phase outputs, submission documents, and Process Flowchart to include Stakeholder Challenge meetings.
R000	2012-11-28	Initial issue.

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### 1.0 DIRECTION

#### 1.1 Overview

In accordance with N-STD-AS-0028, Project Management Standard, all projects executed in Nuclear must progress through the Gated Process. This document describes the Gated Process.

As a project progresses through its development, it will progress through a project life cycle, or phases, including: initiation, development, definition, execution, and closeout.

The transition from one phase to the other is called a Gate. Project Gates are used to assess a projects readiness to proceed to the next phase and will assess and recommend funding.

The Governing bodies who will review project readiness and recommend funding are the Gate Review Board (GRB) for Nuclear Refurbishment and the Asset Investment Screening Committee (AISC) for Nuclear Operations Projects. Decisions to approve, deny or postpone gate approvals for the next project phase are recorded along with any provided direction.

This manual provides guidance on the Nuclear Projects Gated Process and complies with N-STD-AS-0028, Project Management Standard. Projects shall obtain funding in accordance with the approved OPG-STD-0017 Organizational Authority Register (OAR) and OPG-STD-0076 Developing and Documenting Business Cases standards. When a business case is required, it will be submitted at the same time as the Gate package and subsequently routed for further approvals per the OAR.

The intent of the Gated Process is to enable flexible management control and oversight of project development and recommendations of scope approval with attendant releases of funds through the project life cycle. The process ensures that projects meet a consistent expectation of quality and performance.

Gate progression approval is based on:

- Meeting previous phase requirements
- Instilling confidence that the project team will deliver quality, safety, cost, value for money, and schedule performance for the next phase(s).

#### 1.2 Gated Process

OPG Nuclear Projects Gated Process matrix is attached at Appendix B. The matrix is a tool that depicts the five phases of a project's life cycle and identifies required information (Phase Outputs and Gate Submission Documents) that drive the decisions that are made at the end of each phase.

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After identifying the business need, gap or opportunity, and project alternatives, project sponsors shall also confirm that the proposed benefits are aligned with the OPG-N strategic business objective and obtain the necessary approvals to proceed to the Initiation Phase and Initiation Funding (if required). Initiation Phase Funding is only available to Project Execution Authorities that do not have Base OM&A budget. This phase is the Identification Phase of the business proposal, and ends at Gate 0. The purpose of Gate 0 is to approve progression to the Initiation Phase. The Project Executing Authority may not be involved at this point.

A brief description of each phase is as follows.

### Initiation Phase

The objective of the Initiation Phase is to assess the project alternatives and complete conceptual design or scoping (for non-modification projects) of the preferred alternative along with cost estimate and schedule. The Project Execution Authority develops the Development Phase business case on behalf of the Project Sponsor. This assessment forms the basis for the Gate 1 decision - whether or not to approve progression to develop the project further. There will be cases in which the Project Sponsor would play the role of the Project Execution Authority during the Initiation Phase.

### Development Phase

The objective of the Development Phase is to develop the preferred alternative to a point where there is confidence that all major elements of the scope are accounted for. The Project Execution Authority establishes the project team, which goes forward with developing the Project Management Plan (PMP); refining the schedule, cost estimate, and design; and developing the Definition Phase business case. A contracting strategy is also developed during this phase. At the conclusion of this phase, Gate 2 decision approves progression to define the project.

### Definition Phase

The objective of the Definition Phase is to demonstrate readiness for execution. The definition phase includes the procurement of engineered equipment, completion of detailed engineering, preparations for construction/field work, and, detailed scoping of work (for non-modification projects). During this phase inputs to the performance baseline are refined, engineering designs are completed, and execution contracts are assembled. At the conclusion of this phase, the Gate 3 decision certifies to the Project Execution Authority that commitment to complete the project is warranted.

### Execution Phase

The objective of the Execution Phase is the completion of detailed engineering (if not completed in the definition phase) and procurement, and project construction/ installation, commissioning and the transfer of a completed product to the sponsor, business unit and/or station. The Execution Phase typically consumes most of a project's budget. At the conclusion of this phase, the Gate 4 certifies to the Governing Body that the project is complete.

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### Closeout Phase

The Closeout Phase is the last phase in the project life cycle and includes the final actions to complete all activities and formally finish and close out the project. This phase should be completed as quickly as possible after final Available for Service (AFS) in order to minimize project costs. Gate 5 normally does not require a Gate Decision meeting. Typical closeout deliverables include a de-mobilization plan and must be presented for non-standard execution strategies. In accordance with OPG-PROC-0056 Post Implementation Review, the project performance and actual business benefits are evaluated against the baseline plan and summarized in a Post Implementation Review (PIR) Plan.

Appendix A depicts the end-state of the standardized Gated Process.

Decision gates must be shown as milestones on the project schedule. There may be additional decision gates required within a project phase (e.g. G2a, G3a) depending on project risk, funding release and execution strategy, and organization process. This should be documented within the project's gate progression strategy. Sequential unit execution may also require additional gates between phases. Conversely, simpler projects may not be required to use every gate nor have a formal review and approval of every gate at the AISC or GRB.

### **1.3 Graded Approach for Gate Approvals**

The intent of the risk-based, graded approach is to match the level of effort in the Gate progression strategy with the potential impact to safety, quality, cost and schedule.

The need for more or fewer gates, combining gates and deliverables, and bringing deliverables forward or back, is part of defining the gate progression strategy following a graded, risk based approach suitable to the project. The strategy may deviate from the standard five gates illustrated in Appendix B but should be documented and approved by the Governing Body prior to implementation. The Governing Body may direct changes in a project's strategy during the project lifecycle when required.

The logic and method of implementation for the graded approach are defined in business unit level guides, manuals and Terms of Reference for AISC and GRB.

### **1.4 Pre-Gate Readiness Review**

A pre-Gate Readiness review provides an assessment of the rigor and quality of the Gate Approval Package for cost, estimating, scope, risk, schedule, etc. prior to a decision gate. The readiness to submit is documented in the applicable gate progression documentation and signed by the project manager to attest to the completeness of the package. The Terms of Reference for each Pre-Gate Readiness Review is described in NK38-PLAN-09701-10227.

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## NUCLEAR PROJECTS - GATED PROCESS

### 2.0 DEFINITIONS AND ACRONYMS

#### 2.1 Definitions

**Sponsor:** organization, department or business unit that identifies a need and initiates the creation of a project.

**Project Executing Authority:** organization, department or business unit that manages the planning, funding, risks and execution of a project.

#### 2.2 Acronyms

AFS	Available for Service
AISC	Asset Investment Steering Committee (Operations)
BCS	Business Case Summary
BOE	Basis of Estimate
CWP	Comprehensive Work Package
DRAS	Decision Record Analysis Summary
DSR	Darlington Scope Request
EA	Environmental Assessment
GRB	Gate Review Board (Nuclear Refurbishment)
ISR	Integrated Safety Report
ITP	Inspection and Test Plan
NR	Nuclear Refurbishment
NWMD	Nuclear Waste Management Division
PDRI	Project Definition Rating Index
PIR	Post Implementation Review
PMP	Project Management Plan
PSA	Purchase Service Agreement
SRB	Scope Review Board
WO	Work Order

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### 3.0 REFERENCES

#### 3.1 Performance References

N-FORM-10765, AISC Part A: Issue Characterization

N-FORM-10945, Cost Estimate and Request for Conceptual Funding

N-FORM-11390, Decision Record and Analysis Summary Form

N-FORM-11392, Funding Request Form

N-FORM-11397, Gate Progression Form

NK38-PLAN-09701-10227

N-PROC-MP-0090, Modification Process

N-STD-AS-0028, Project Management Standard

N-GUID-09701-10011, Safety Management Essentials

N-GUID-09701-10020, Nuclear Refurbishment Commissioning Process

OPG-STD-0017, Organizational Authority Register (OAR)

OPG-PROC-0056, Post Implementation Review

PMP-TMP-00001, Project Management Plan (PMP)

#### 3.2 Developmental References

N-PROC-MA-0013, Planned Outage Management

N-PROC-MA-0022, Integrated On-line Work Schedule

Project Definition Rating Index – Industrial Projects, CII Implementation Resource 113.2

Project Definition Rating Index – Building Projects, CII Implementation Resource 155-2

Project Management Body of Knowledge 4th Edition (PMBOK Guide)

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### 3.3 Records Table

The following Records may be generated by use of this document and shall be registered in the appropriate document management system in accordance with the following table:

Record Created	Associated Form or Template Number	QA Record? Y/N	Filing Information/Retention (AIMS Type/Sub-Type)
Site Project Management (PM) File	N/A	N	Site Project Management File, issued in Asset Suite by Project ID number. Retention = 6 Years after project closed per the approval of Project Closure Report, FIN-FORM-PA-005. RRC: N02-0038. NR Retention =10 Years after Completion/ Settlement. RRC:N02-0049
Project Management Plan (PMP)	PMP-TMP-0001 or N-TMP-10010 (NR)	N	Issue in Asset Suite as Controlled Document Doc Type = PLAN Doc No: N, P or D - PLAN – SCI - XXXXX File in site PM File. Retention = 6 Years after project closed per the approval of Project Closure Report, FIN-FORM-PA-005. RRC: N02-0038. NR Retention =10 Years after Completion/ Settlement. RRC:N02-0049
Gate Progression Form	N-TMP-10220	N	Issued in Asset Suite as Record. File gate approval package as single record Property # -GRB-SCI - XXXXXXXX NR Retention =10 Years after Completion/ Settlement. RRC:N02-0049
Project Charter	N-TMP-10117	N	Issued in Asset Suite as Controlled Document Doc Type = PLAN Sub Type = PCH Doc No: N, P or, D - PCH - SCI - XXXXX Filed in site PM File. Retention = 6 Years after project closed per the approval of Project Closure Report, FIN-FORM-PA-005. RRC: N02-0038. NR Retention =10 Years after Completion/ Settlement. RRC:N02-0049
Type 1 Business Case Summary	OPG-FORM-0074	N	Indexed in Asset Suite as Controlled Document Doc Type = PLAN Sub Type = BCS Doc No: N, P or, D – BCS - SCI - XXXXX Filed in site PM File, not linked in Asset Suite. Retention = 6 Years after project closed per the approval of Project Closure Report, FIN-FORM-PA-005. RRC: N02-0038. NR Retention =10 Years after Completion/ Settlement. RRC:N02-0049



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Document Number: <b>N-MAN-00120-10001</b>		Usage Classification: <b>N/A</b>
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Title:

**NUCLEAR PROJECTS - GATED PROCESS**

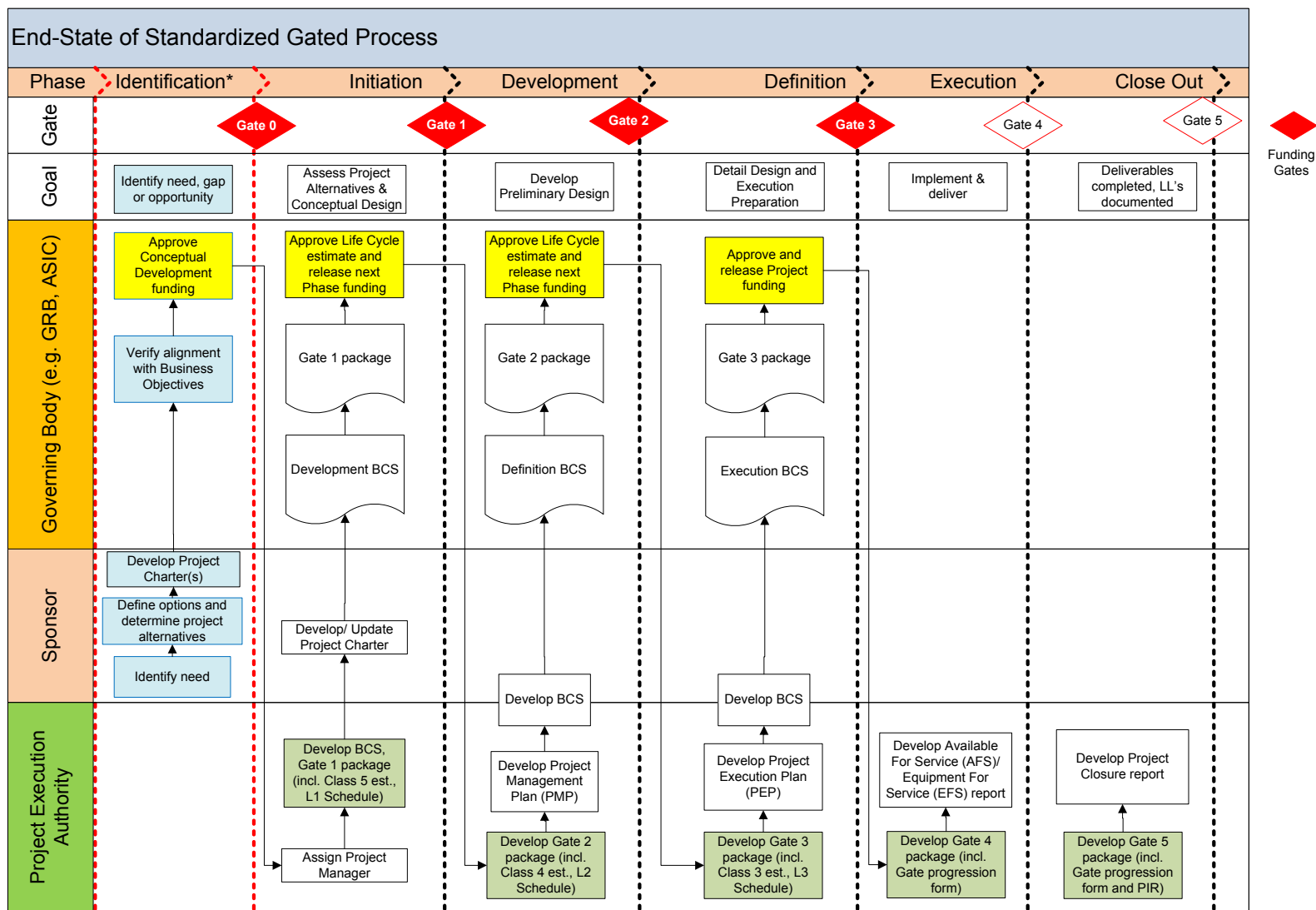
Record Created	Associated Form or Template Number	QA Record? Y/N	Filing Information/Retention (AIMS Type/Sub-Type)
Type 2 Business Case Summary	OPG-FORM-0075	N	Per OPG-FORM-0074 above.
Type 3 Business Case Summary	OPG-FORM-0076	N	Per OPG-FORM-0074 above.
Project Over-Variance Approval	OPG-FORM-0077	N	Per OPG-FORM-0074 above.
Decision Record and Analysis Summary (DRAS)	N-FORM-11390	N	Issued in Asset Suite as Record. NR Retention =10 Years after Completion/ Settlement. RRC:N02-0049
Funding Request Form	N-FORM-11392	N	Issued in Asset Suite as Record. NR Retention =10 Years after Completion/ Settlement. RRC:N02-0049
Transfer of Portfolio	N-FORM-11044	N	Filed in site PM File.
Lessons Learned Report	N-TMP-10204	N	Issued in Asset Suite as Controlled Document Doc Type = REP Sub Type = LLD Doc No: N, P or, D – LLD - SCI - XXXXX Filed in site PM File. Retention = 6 Years after project closed per the approval of Project Closure Report, FIN-FORM-PA005. RRC: N02-0038. NR Retention =10 Years after Completion/ Settlement. RRC:N02-0049
Report of Equipment InService (Capital Projects only)	FIN-FORM-PA004	N	Original held permanently by Corporate Finance. File copy in site PM File.
Project Closure Report	FIN-FORM-PA005	N	Original held permanently by Corporate Finance. File copy in site PM File.
Disposition Note	N/A	N	Filed in site PM File
Post Implementation Review (Simplified Template)	FIN-TMP-PA002	N	Issued in Asset Suite as Controlled Document Doc Type = REP, Sub Type = PIR Doc No: N, P or, D - PIR – SCI - XXXXX Filed in site PM File Retention = 6 Years after project closed per the approval of Project Closure Report, FIN-FORM-PA-005. RRC: N02-0038. NR Retention =10 Years after Completion/ Settlement. RRC:N02-0049
Other forms, reports or correspondence	N/A	N	Issued in Asset Suite as Record. Property # - Doc Type - SCI - XXXXXXXX Doc Type = REP, CORR, PLAN, MAN, REF, etc. as suitable Retention = 6 Years after project closed per the approval of Project Closure Report, FIN-FORM-PA-005. RRC: N02-0038 NR Retention =10 Years after Completion/ Settlement. RRC:N02-0049

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Appendix A:



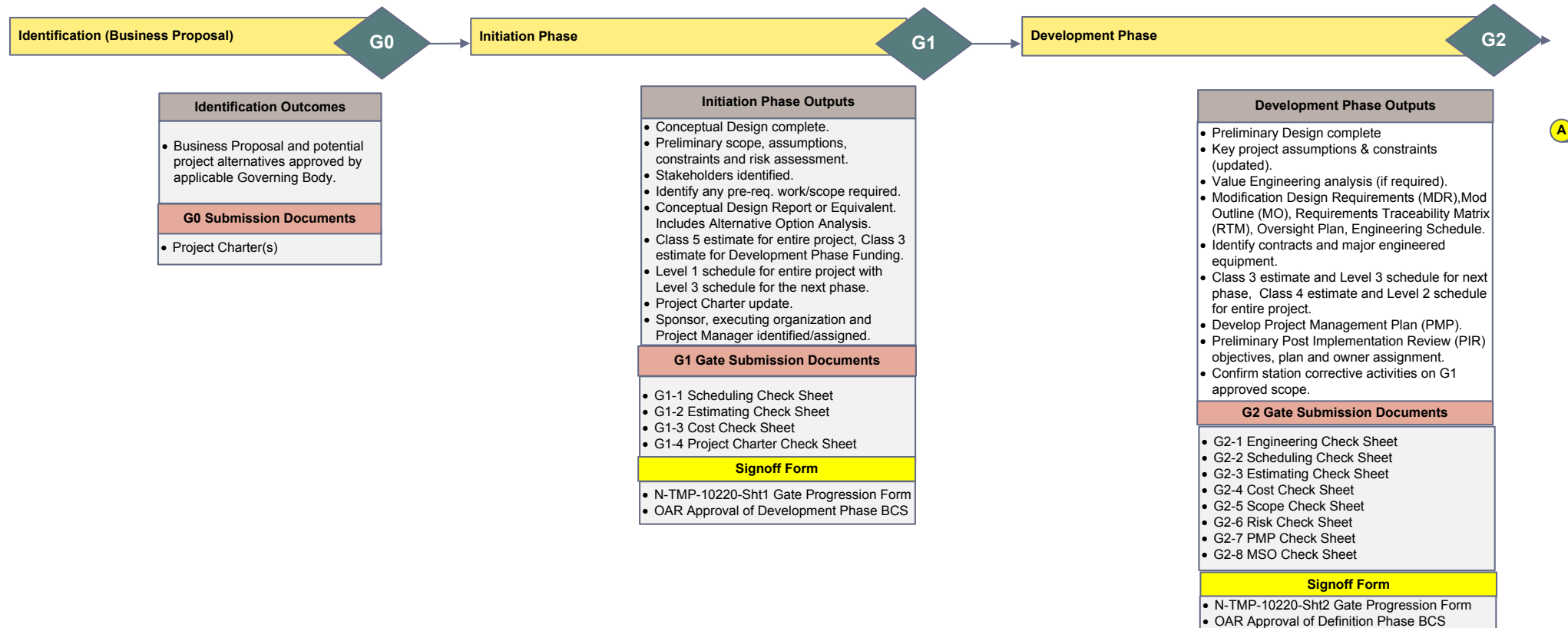
\* This phase may be applicable to non-Refurb. Projects

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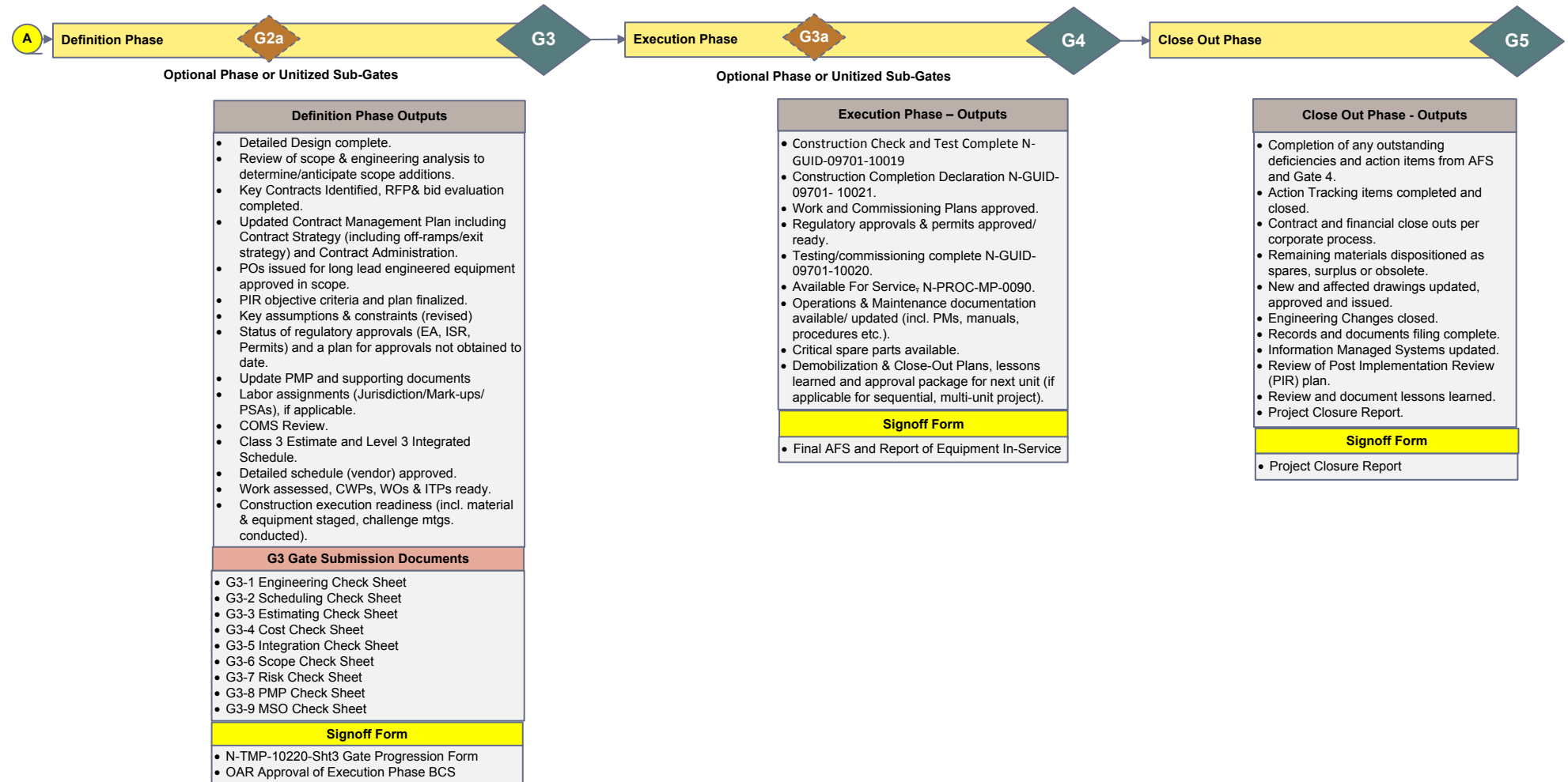
Appendix B:



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**NUCLEAR PROJECTS - RECORDS AND DOCUMENT MANAGEMENT**

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**Nuclear Projects  
Records and Document Management**

**N-MAN-00120-10001-RDM R001**  
2013-09-09

**Internal Use Only**

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## NUCLEAR PROJECTS - RECORDS AND DOCUMENT MANAGEMENT

### Revision Summary

Revision Number	Date	Comments
R001	2013-09-09	<p>General updates throughout.</p> <p>Page 4</p> <ul style="list-style-type: none"> <li>Added that staff may obtain records numbers via the automatic sequence generator.</li> </ul> <p>Page 5</p> <ul style="list-style-type: none"> <li>Provide document numbering requirements for documents that are specifically related to the Nuclear Refurbishing project.</li> <li><u>Nuclear Refurbishment Specific Documents</u> - If a technical procedure revised under N-PROC-AS-0028 then an additional document number element (NR) is required. This will ensure Darlington Operations do not inadvertently use the document on a non layup unit. E.g. NK38-<b>NR</b>-OM-33000-XXXXX.</li> </ul> <p>Page 6</p> <ul style="list-style-type: none"> <li>Added that the Electronic Document Management Systems (EDMS) is progressively replacing the Supplier Document Hub (SDH).</li> </ul>

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### 1.0 DIRECTION

This manual provides direction on records and document management pertaining to Nuclear Projects and complies with N-STD-AS-0028, Project Management Standard.

Nuclear Projects records are corporate assets and shall be stored in approved information management repositories such as "Asset Suite".

### 1.1 Overview

This manual provides direction to ensure that records in the custody or control of Nuclear Projects are managed consistently, protected and accessible throughout their life cycle.

Nuclear Projects adheres to all Nuclear and OPG governance in Information Management including records management and document control.

Information Management Services; Records and Document Management (RDM) team provides the centralized (centre-led) control function within the established processes.

Specific document numbering guidance is provided for the Nuclear Refurbishment project.

### 1.2 Registering and Processing Records and Controlled Documents

Document Owner shall adhere to the following records governance.

- OPG-PROC-0019, Records and Document Management
- N-PROC-AS-0003, Controlled Document Management
- N-PROC-AS-0042, Quality Assurance Records.

#### 1.2.1 Document Owner shall complete the following actions when registering *documents* for storage in Asset Suite.

For a controlled document email RDM via "DNGD: Refurb DM" providing the following portions of the document number and requesting the next in sequence #.

For records, obtain the next in sequence # via the automatic sequence generator url below.

<http://catou-ogappuw0h:7302/DocumentNumberGenerator/>

User name: NUMGEN

Password: DocNoGen15



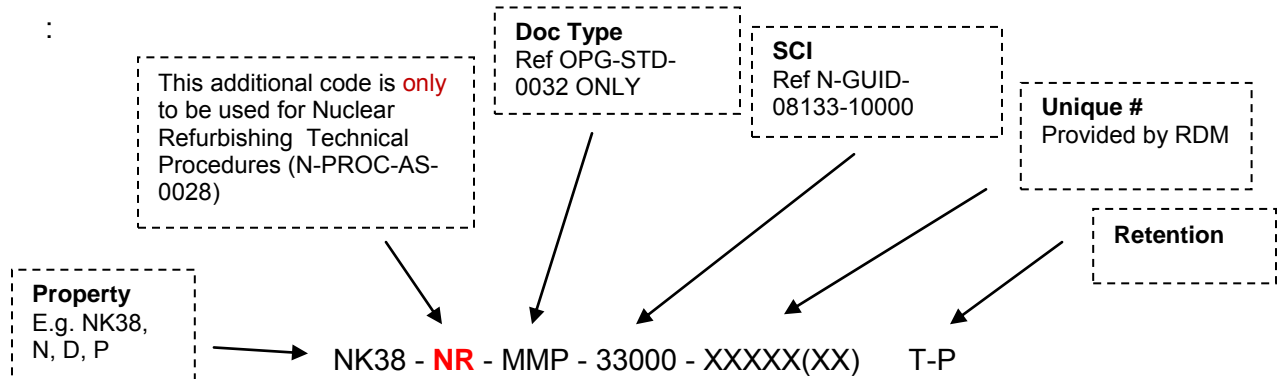
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## NUCLEAR PROJECTS - RECORDS AND DOCUMENT MANAGEMENT

Example of a document number and retention is shown below



Construction of a Nuclear Projects Document Number	
Property Number	E.g. NK38, N, D, P etc. <u>Nuclear Refurbishment Specific Documents</u> - Use NK38
Document Type	Select a Doc Type (Ref OPG-STD-0032. E.g. PROC, CORR, REP) <u>Nuclear Refurbishment Specific Documents</u> - If a technical procedure revised under N-PROC-AS-0028 then an additional document number element (NR) is required. This will ensure Darlington Operations do not inadvertently use the document on a non layup unit. E.g. NK38- <b>NR</b> -OM-33000-XXXXX E.g. Doc Types OTP, SSRT, OM, ARM, CCP, CLP, CMP, MMP, and CTP
Subject Classification Index (SCI)	Select a SCI - Ref N-GUID-08133-10000.
Sequential (unique) Index #	RDM will provide unique index numbers. XXXXXX for a controlled document XXXXXXXX for a record
Retention	Select a standard retention - Ref N-GUID-08133-10000.
Project ID #	Include Project ID # <u>Nuclear Refurbishing Specific Documents</u> - Use either a) the general NR project ID # 10-73000 or b) the specific project bundle ID #
Security Classification	Select a Security Classification – Ref OPG-STD-0030

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Nuclear Projects has a well defined project numbering system that provides a common framework for the management of project information. All project controlled documents and records must have a file number applied.

### 1.3 Working Files – OPG Internal SharePoint Team Sites for Collaboration

Interactive team sites have been created in SharePoint for collaboration of working files. A series of document libraries have been set up to provide a central storage and collaboration space for documents and information. The library structure aligns with the standard work breakdown structure for the associated project. Refer to N-MAN-00120-10001-RDM-01, Nuclear Projects SharePoint 2007 for detailed instructions when working in SharePoint team sites.

To enhance search and retrieval, where applicable, all working documents should be named according to the document number along with the revision number; e.g. N-MAN-00120-10001-RDM-R001.doc.

### 1.4 Submissions / Transmittals Between OPG and Suppliers

Post contract, all formal project documents, between OPG and suppliers shall be sent to via either the Supplier document hub or the Electronic Document Management System that is progressively replacing the SDH.

#### 1.4.1 Supplier Document Hub (SDH)

The SDH was created to electronically log, track and workflow the exchange of documents and collaboration between OPG and Suppliers. Refer to MAN-00120-10001-RDM-02, Nuclear Projects Supplier Document Hub.

All documents sent to an external party will be documented using N-FORM-10554, Document Transmittal Record as per OPG-STD-0030, Classification, Protection and Release of Information and transmitted to the supplier using SDH.

#### 1.4.2 Electronic Document Management (EDMS)

The EDMS is a Commercial off the Shelf application developed specifically to manage formal submissions between plant owners and suppliers for major construction projects. EDMS is progressively phasing out the SDH.

### 1.5 Management of Large Size Files

When a document size is too large to send via e-mail (>10 MB) the file can be saved to a Network Shared Folder for internal documents at \\corp.opg.com\opg\nucwebdocs\NuclearProjects.

#### 1.5.1 Transfer of Video Files to Records Management for Filing

This process is to be followed when video files are sent to RDM for filing (e.g. inspection files).

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- (a) Submitting organization to provide two Digital Video Discs (DVDs) to Records Management for dual storage. Refer to OPG-STD-0057, Electronic Document Management for storage and handling of DVDs
- (b) RDM will index the item in Asset Suite
- (c) One copy of the DVD will be stored in a Secure Storage Room and the second copy will be stored in a QA Vault
- (d) RDM will record the storage locations in Asset Suite.

### 1.5.2 Retrieving Video Inspection Files for Viewing

- (a) Send e-mail to appropriate Records and Document Management mailbox providing the record number of the video to be viewed
- (b) RDM will upload the video to \\corp.opg.com\opg\nucwebdocs\NuclearProjects
- (c) All staff have “read only” access to the shared drive and the ability to view the file and save to a different location
- (d) A link via SharePoint can be created to view the file
- (e) This shared drive is for short term storage of files – one year plus current
- (f) If a DVD of the file is required the individual can burn the DVD from the shared drive and delete the file.

## 1.6 E-mail Management

E-mails that are determined to be Official Records as per OPG-PROC-0093, E-Mail Management, are declared and kept to demonstrate conformance to standards or compliance with laws or to retain knowledge and information of business importance that might otherwise be inaccessible when required.

**Note:** Users **should not** store official *records* in local e-mail folders.

## 2.0 RECORDS

- 2.1 Any controlled documents which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0003, Controlled Document Management.
- 2.2 Any records which may be produced as a result of this document should be managed in accordance with OPG-PROC-0019, Records and Document Management.
- 2.3 The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.

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Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (ASSET SUITE Type/Sub-Type)
Document Transmittal Record	N-FORM-10554	N	N File in Records Management Doc Type = CORR N-DTR-SCI-XXXXXXX Retention Permanent

### 3.0 ABBREVIATIONS AND ACRONYMS

<b>EDMS</b>	Electronic Document Management System
<b>DVD</b>	Digital Video Disc
<b>NR</b>	Nuclear Refurbishment
<b>RDM</b>	Records and Document Management
<b>SDH</b>	Supplier Document Hub

### 4.0 DEFINITIONS

**Controlled Documents:** A subset of *records* and has a defined revision control process.

**Document** is recorded information that describes, specifies reports, certifies, requires, or provides annotation or results. Documents include paper copies (procedures, manuals, correspondence, etc.), electronic media (such as word processor files and computer databases), and any other sources of information used to design or operate a facility or make sound technical decisions. It includes both current and working documents and historical information. A document becomes a record when it is declared as a record by the creator, receiver, or document owner or is duly approved and authorized.

**Document Owner:** Individual responsible for the integrity (accuracy, completeness, and consistency) of a document, throughout its life cycle. Document owners can be individuals, or groups (such as a department or division in Ontario Power Generation). The accountability for the Document Owner may be delegated.

**Governing Documents:** Are a subset of *records* and comprise the NNP management system and provide assurance that the NNP will be engineered, purchased, constructed, commissioned and turned over in accordance with the requirements of Canadian Standards Association Standard N286-05 "Management system requirements for nuclear power plants" (N286-05). Governance document types include CHAR, PROG, PROC, STD, PLAN, INS and FORMs.

**Record**, also called "official record", is a document that has been declared (in an electronic system) or otherwise authenticated (i.e., signed, stamped, initialled, clearly

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identified, or endorsed electronically or otherwise). A record provides evidence of the performance of business activities and/or the achievement of results. Typically, records are kept to demonstrate conformance to standards or compliance with laws, or to retain knowledge and information of business importance when needed. The record is that version of a document designated to be maintained in an Approved Information Management System (for electronic records) or a records centre (for hard copy records). Where possible, the original signed copy of a document shall be designated as the record.

**Quality Assurance Record** is an essential record that provides evidence of licensing, design, construction, operation, maintenance, testing, and modification of nuclear facilities.

Permanent Quality Assurance Record is a *record* which meets one or more of the following criteria and is maintained for the life of an item or the facility such as the following:

- Significant value in demonstrating capability to operate safely.
- Significant value in maintaining, reworking, repairing, replacing, or modifying a structure, system, or component.
- Significant value in determining the cause of an accident or malfunction of an item or an unscheduled occurrence.
- Required to provide baseline data for periodic inspections.
- Significant value during a facility's decommissioning of a system, component, or structure.

Temporary (Non-Permanent) Quality Assurance Record is a record which provides evidence an activity has been performed in accordance with specified requirements, but does not meet the criteria for a permanent Quality Assurance record.

## 5.0 REFERENCES

N-GUID-08133-10000, Document Management Reference Guide  
N-MAN-00120-10001-RDM-01, Nuclear Projects SharePoint 2007  
N-MAN-00120-10001-RDM-02, Nuclear Projects Supplier Document Hub  
N-MAN-00120-10001-RDM-03, Nuclear Projects Supplier Document Submission  
N-PROC-AS-0003, Controlled Document Management  
N-PROC-AS-0042, Quality Assurance Records  
OPG-PROC-0019, Records and Document Management  
OPG-PROC-0093, E-Mail Management  
OPG-STD-0030, Classification, Protection and Release Information  
OPG-STD-0057, Electronic Document Management for storage and handling of DVDs



**Report**

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**NUCLEAR REFURBISHMENT – DATA MANAGEMENT PLAN**

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**Nuclear Refurbishment Data  
Management Plan (NRDMP)**

**N-MAN-00120-10001-RDM-20-R000**  
2015-06-15

**Internal Use Only**

Prepared By: \_\_\_\_\_

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Reviewed By: \_\_\_\_\_

Ryan Smith  
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Risk And Infrastructure  
Planning And Controls

Approved By: \_\_\_\_\_

Gary Rose  
Director  
Planning And Controls

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## NUCLEAR REFURBISHMENT – DATA MANAGEMENT PLAN

### 1.0 PURPOSE

#### 1.1 Data Management

Information entered into any database or software is owned by the group entering the information. Once in the database or software included the information it's considered data.

The Nuclear Refurbishment – Data Management Plan *NRDMP* describes how the program will conform to [OPG-STD-0057 OPG Standards for Electronic File Submissions](#) on archiving, dissemination and sharing data including the requirement to “share with stakeholders, within a reasonable time, the primary data, samples, physical collections and other supporting materials created or gathered.”

Once the data is converted to a product such as document, report, drawing, schedule or email, etc., the NR organization will follow OPG-PROC-0019, Records Management and other supporting records management governance and procedures.

#### 1.2 Objectives

This plan will make certain that the data produced during the period of this project will be appropriately managed to ensure its usability, access and preservation over the course of the project until closure.

**Note:** This plan is a living document and will be revised to reflect updated information as required. Areas where known revisions will be required at a future date are noted in the relevant sections.

### 2.0 ROLES AND ACCOUNTABILITIES

There are 3 main groups who accountable for Nuclear Refurbishment data management. All NR Staff and contractors are required to comply with this plan.

#### 2.1 IT Programs

Data storage, architecture and its strategy is managed by the CIO IT Program. This ensures that size of storage; classifications are current and meet the demand of the entire program.

#### 2.2 Project Manager Direction

Project managers and their delegates shall keep informed and ensure management of the software content of the day-to-day data activities. Good practice would be to establish periodic reviews of data within their project teams in line and follow the OPG Electronic, Records and Document Management activities with any products produced.

#### 2.3 Project Management Office (PMO) Role

Ensures strategy, project management governance, process, standards and historical data is archived and/or protected, are followed by performing regular assessments of data in projects and the program. These processes can feedback into the standards definition.



## Report

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### 3.0 EXPECTED PROGRAM DATA

#### 3.1 Methods

Electronic data is expected to be produced throughout the life of the program.  
Sources include:

- Documents
- Reports
- Emails
- Drawings
- Schedules
- Contractual and financial data
- Scope management data
- System and station configuration data
- Environment, health and safety data
- Productivity data (materials and hours)

The data will come in the form of raw system data as well as documents in various formats (Word, Excel, Visio, PDF, etc.). The table in appendix “A” outlines the main applications and databases that will be used by the NR Program:

#### 3.2 Data Retention

All data will be sent to records/archived and retained for the life of the program plus 10 years as per OPG-MAN-08133-0001, 01-03-01, Records Retention.

### 4.0 STAKEHOLDERS

The main stakeholders of this plan are OPG Nuclear personnel. External users are the CNSC, Ministry of Energy and OPG Board of Directors and others from time to time.

### 5.0 ACCESS, SHARING AND REUSE

The primary means of document control is the SharePoint Team sites. Hierarchical taxonomy, Metadata and in some cases WBS structure are in place to easily retrieve working documents. The secondary means is Shared folders.

Vendor data is primarily electronic and interfaces primarily via the OPG Nuclear Electronic Document Management System (EDMS) unless otherwise specified.

The EDMS is a nuclear interface with Passport, maintained by the CIO. In the Passport system data can be accessed by providing descriptive and variable/question-level search; topical browsing; data extraction and re-formatting; and on-line analysis.

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NR data will comply with all OPG data governance as per [OPG-STD-0057 OPG Standards for Electronic File Submissions](#). Compliance including good contract management processes and practices is also an expected behaviour. This document is not meant to replace or provide guidance for managing contractual disputes or preparation of evidence in any proceedings.

Terms that guide how NR Program data will be shared and reused are defined below, including when the data will be accessible, how long the data will be available (either during or after the Program), and how access can be gained.

The data will not be encumbered with intellectual property rights (including copyright, database rights, license restrictions, trade secret, patent or trademark) by any party; nor is subject to any additional legal requirements.

Application or Database	Timing of Data Availability/ Currency (phase)	Duration of Availability/ Currency	Accessibility Guidelines (users, privacy, etc.)	Archive Requirements
-------------------------	--	---------------------------------------	--	----------------------

## **6.0 STANDARDS FOR DATA, METADATA, FORMAT CONTENT INFORMATION**

Once a report or document is created, its imperative that the NR organization follows the OPG-PROC-0019, Records and Document Management.

Documentation detailing the sources, coding, and editing of all data, in sufficient detail to enable users to replicate them from original sources; and descriptive metadata for each study including a title, author, abstract, descriptive keywords, and file descriptions.

Electronic Documents will be prepared using applications/software as described in section OPG-STD-0057 OPG Standards for Electronic File Submissions.

Digital copies will be indexed into Asset Suite by OPG for permanent record as required. By exception, OPG may request hard copies be provided. For preservation and long-term access, data collection will be accompanied with proper documentation and associated metadata.

## **7.0 FREQUENCY OF STORED DATA SENT TO RECORDS**

Every department in Refurbishment will save previous months data in the approved format and sent to records within 10 days after the monthly reporting cycle.

## **8.0 CIO SUPPORT**

### **8.1 Security Recover Ability**

OPG server drives are backed up by CIO. This will allow full recovery of data in the event of catastrophic failure. All of these systems will be in place for the 10 year minimum period post-refurbishment.

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#### **8.2 Storage, Backup, Replication and Versioning**

The CIO provides automatic version (revision) control over all deposited materials and no versions of deposited material are destroyed except where such destruction is legally required. All systems providing on-line storage for the Nuclear Refurbishment Program are contained in a virtual and physical secured facility that is continually monitored. System backups are made on a daily basis.

#### **9.0 BUDGET**

The cost of preparing data and documentation will be borne by the program, and is already reflected in the business costs included in the current budget.

NR Infrastructure will support costs for the life cycle of the NR Program. This budget resides within the NR Infrastructure department over the lifetime of the project once complete the burden will be turned over to the CIO as appropriate. This includes any project or capital costs to facilitate the implementation of this plan.

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### 10.0 REFERENCES

This plan interfaces with the following supporting and parent documents that are directly applicable:

1	OPG-STD-0057	Electronic Document Management
2	OPG-PROC-0019	Records and Document Management
3	OPG-MAN-08133-0001, 01-03-01	Records Retention
4	N-PROG-AS-006	Records and Document Control
5	N-PROC-MP-0090	Modification Process

All employees of the program are expected to conform to OPG records management and document control requirements as defined within the following suite of documents.

Ref #	Document Number	Document Name
1	N-PROC-AS-0003	Controlled Document Management
2	N-PROC-AS-0042	Quality Assurance Records
3	N-PROC-MP-0078	Specification, Review, Acceptance and Use of Vendor Technical Documents
4	N-PROG-MP-0004	Pressure Boundary
5	N-MAN-00120-10001, Sht. RDM-14	EDMS Description and General User Guide
6	N-MAN-00120-0001, Sht. RDM-15	Electronic Document Management System Document Submission Process Manual
7	N-MAN-00120-0001, Sht. RDM-16	EDMS Document Review and Commenting Manual
8	N-MAN-00120-10001, Sht. RDM-17	EDMS Report Generation User Guide
9	N-ST-01161-10000	Section 3.4.2 - Drafting Presentation Standard and Practices
10	IT-STD-0001	IT Infrastructure Standards – End User
11	IT-STD-0004	Encryption
12	IT-STD-0007	IT Infrastructure Standards – Enterprise
13	OPG-FORM-0070	AIMS Criteria Checklist for Records
14	OPG-MAN-08133-0001	02-01-02, Records Media: Types and Environmental Controls
15	OPG-PROC-0019	Records and Document Management
16	OPG-PROC-0079	Form and Template Management
17	OPG-PROC-0093	E-Mail Management
18	OPG-STD-0030	Classification, Protection, and Release of Information

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19	OPG-STD-0059	Code of Business Conduct
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Appendix A: Data Management Spreadsheet

Application/ Database	Program Data Description	Data Format	Product & Storage Size	Access & Security	Responsible Department (s)	Responsible Department	Data Storage Responsibility	Plan in place	Stored	Backup	Comments
NUCLEAR REFURBURISHMENT ONLY SOFTWARE & DATABASES											
Primavera	NR will use different types of codes to organize and report on the schedule progress. The volume of projects and activities that are anticipated in P6 are significant and must be carefully managed.	PDF attachments	2mb-6mb/	By user accounts	Scheduling and Work Management	Refurb-Scheduling Dept.	Refurb Scheduling	No	Shared Drive	SQL Server	Each month schedules are converted from data to a document. These pdf's are stored in a PLEP shared drive folder managed by Refurb Scheduling. There are approx. 250 (2014) schedules not in Records.  Going forward past as well as future products must be sent records for safe keeping.
ESMII	Implement a number of enhancements to NR's module of Equipment Status Monitoring II app	Web based tool	<1mb	OPG trusted Security	Operations	Refurb-Operations	CIO	Yes	In tool	SQL Server	
TPAR	Operations and Maintenance procedure tracker.	.doc	<1mb	By user accounts	Operations	Refurb-Operations	CIO Refurb	No	NR Program SharePoint List	SharePoint Server	Parent software is managed by the CIO since its web based software. Refurb's portion is managed by P. Davies from Operations in SharePoint.
CEM	Management (CEM) computer application was developed to provide a common platform for Chemistry Laboratory information management across OPG.	Web based tool	<1mb	By user accounts	Chemistry	Refurb-Chemistry	CIO Designated Fleet Chem. Lab. FLM	Yes	CEM	SQL Server	This tool is primarily used by Chemistry; secondary users are engineering and operations.
US Cost/itwo	Web-based cost estimating solution Success Enterprise, allows Refurbishment to manage the integrated estimate through every stage of the project lifecycle; from the earliest feasibility estimate through the final detail.	.xlsx	5mb	By user accounts	Estimating	Refurb-Estimating	CIO Refurb Estimating	No	Shared Drive	SQL Server	Today the organization keeps all older products in a Shared drive. Going forward past as well as future products must be sent records for safe keeping.
Proliance	Proliance software improves capital project and facility performance, by streamlining the plan-build-operate lifecycle. Proliance is designed for Nuclear Projects managing capital planning, budgets, Actual across Nuclear Projects.	.xlsx	6mb	By user accounts	Cost &Change Management	Refurb-Cost Control	CIO Refurb Cost Management	No	Proliance	SQL Server	Data is stored in the software, some products are sent to Records. There should be a concern if the size of the software data base can capture the entire history of the Program or purchase storage add-ons now.
CCF Register	Change Control booking kept on Excel spreadsheets as working documents in the NR Program Team Site (P&C).	.xlsx	<1mb	Confidential/Records	Cost &Change Management	Refurb-Reporting and Cost	Refurb Cost Management	Yes	NR Program SharePoint Team Site	Doc's in SharePoint	Sent to records as confidential monthly.

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Application/ Database	Program Data Description	Data Format	Product & Storage Size	Access & Security	Responsible Department (s)	Responsible Department	Data Storage Responsibility	Plan in place	Stored	Backup	Comments
DSR Database	Darlington Refurbishment Program-Scope Requirements - Scope Managed Control system for only approved Refer scope.	.xlsx	<1mb	By user accounts	Cost & Change Management	Refurb-Reporting and Cost	Refurb Cost Change Management	No	Access	SQL Server	Vulnerable platform that requires a more stable environment.
Online Bi Reports	Several owners of the data but the tool housed in SharePoint web platform is shared with the entire fleet, Refer products are managed by P&C Reporting and Infrastructure Teams.	Variety of formats	>1mb	By user accounts	Reporting	Refurb-Reporting and Cost	Refurb Reporting	No	Report Builder	SQL Server	Data is always live and is not saved or sent to records for a point in time record. Vulnerable due to 2 report builders in Refurbishment.
NPDW	Proliance send details to Nuclear data warehouse, flows info to BI to MS Report Builder.	SQL Server	Varies	By user accounts	Reporting	Refurb-Reporting and Cost	Refurb Reporting	No	Report Builder	SQL Server	
9 SharePoint Team sites	Working document for all refurbishment	Variety of formats	<1mb	By user accounts	NR Infrastructure	Refurb-Risk Management	Refurb Infrastructure	Yes	SharePoint Team sites	SQL Server	The NR SharePoint Sites are managed by P&C and support/systems are managed by the CIO.
RMO	Risk Management and Oversight Tool that manages Project Management areas and oversight plan on daily interactions with the project contractors.	.xlsx	<1mb	By user accounts	NR Infrastructure	Refurb-Risk Management	Refurb Risk Management	Yes	RMO	SQL Server	The RMO is a self contained database managed by the P&C and supported by the CIO and backed it
Shared Drives	Nuclear Refurbishment has a few folders in the PLEP and DNGS servers. Only access is administered to these folders and not the content.	Variety of formats	Varies	By user accounts	NR Infrastructure	Refurb-Risk Management	Refurb	Yes	Shared Drive	Tape backup	Various groups historically kept their products before SharePoint and during the first years of SharePoint. Legacy documents were not moved to SharePoint per direction from the CIO.
IDBNR	RQE integrated database for project management (Primavera, Station Work Control, As7 and DSR) eventually will include, Scope Changes Control tool and RTS dbase)	Variety of formats	<1mb	By user accounts	RQE	Refurb-RQE Team	Refurb RQE Team	No	NR Data Mart database	SQL Server	Short term owned by RQE team. Requires a long term plan and assigned an owner in P&C.
STATION WORK MANAGEMENT SYSTEM											
OMS	NR will capture snapshot at each required milestone and document in Asset Suite Action tracking module, for all milestones, according to N-PROC-MA-00013 OUTAGE MANAGEMENT	PDF attachments	Varies	By user accounts	Work Management	CIO	CIO	Yes	Asset Suite - Action Tracking Module	SQL Server	

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Application/ Database	Program Data Description	Data Format	Product & Storage Size	Access & Security	Responsible Department (s)	Responsible Department	Data Storage Responsibility	Plan in place	Stored	Backup	Comments
<b>NIMS</b> (Assessor, Holds, Work lit and Walk down Tool kits, T+1 GUI)	<i>within Action Tacking Module NR will capture snapshot at each required milestone and document it in the Asset Suite Action tracking module, for all milestones, according to N-PROC-MA-00013 OUTAGE MANAGEMENT</i>	<i>PDF attachments</i>	Varies	<i>By user accounts</i>	<i>Work Management</i>	CIO	CIO	<b>Yes</b>	Asset Suite - Action Tracking Module	SQL Server	
<b>PLMP</b> (predictive maintenance Living Program)	<i>within Action Tacking Module NR will capture snapshot at each required milestone and document it in the Asset Suite Action tracking module, for all milestones, according to N-PROC-MA-00013 OUTAGE MANAGEMENT</i>	<i>PDF attachments</i>	Varies	<i>By user accounts</i>	<i>Engineering</i>	Eng-Eng	CIO	<b>Yes</b>		SQL Server	
<b>SCC</b>	Schedule Control Centre, website for formatting and posting of Integrated Project Schedule	<i>PDF attachments</i>	Varies	<i>Scheduler leads</i>	<i>Scheduling and Work Management</i>	Fleet-Work Management	CIO	<b>Yes</b>		SQL Server	
<b>NUCLEAR DATABASES &amp; APPLICATIONS</b>											
<b>EWMS</b>	Engineering Work Management System	Word, Excel or PDF attachments	Varies	<i>By user accounts</i>	Engineering	Fleet Engineering	CIO	<b>Yes</b>		SQL Server	
<b>EDMS</b>	Sole document exchange software between contractors and NR	Word, Excel or PDF attachments	Varies	<i>By user accounts</i>	CIO	CIO	CIO	<b>Yes</b>	EDMS	SQL Server	
<b>CORPORATE DATABASES AND APPLICATIONS</b>											
<b>Asset Suite</b>	<i>NR will capture snapshot at each required milestone and document it in the Asset Suite Action tracking module, for all milestones, according to N-PROC-MA-00013 OUTAGE MANAGEMENT</i>	<i>PDF attachments</i>	Varies	<i>By user accounts</i>	CIO	CIO	CIO	<b>Yes</b>	Asset Suite	Main Frame	
<b>Asset Suite</b>	<i>Records Module NR will capture Final Project Reports, Statement of Works, and Memos</i>	<i>PDF attachments</i>	Varies	<i>By user accounts</i>	CIO	CIO	CIO	<b>Yes</b>	Asset Suite	Main Frame	



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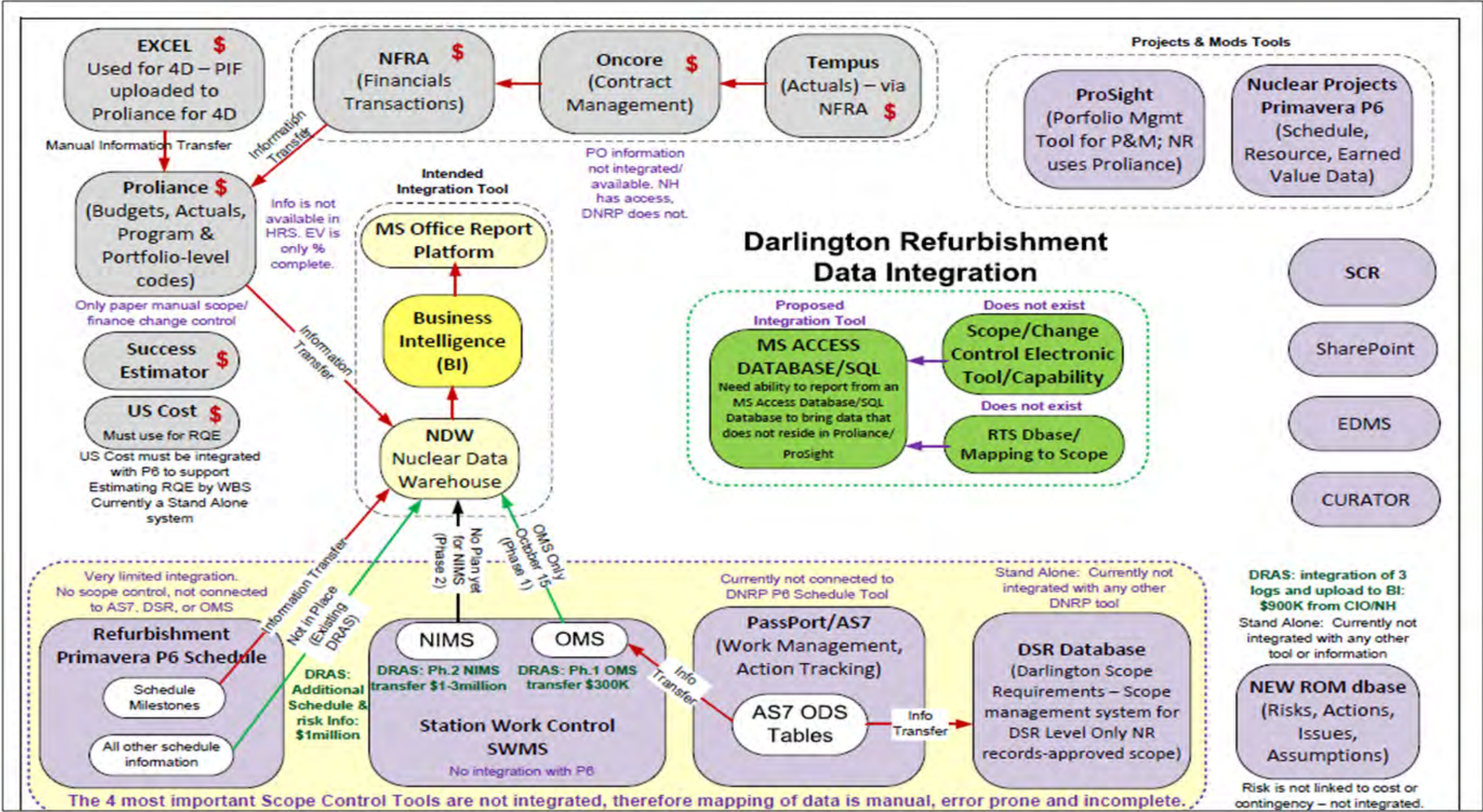
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NUCLEAR REFURBISHMENT – DATA MANAGEMENT PLAN

Application/ Database	Program Data Description	Data Format	Product & Storage Size	Access & Security	Responsible Department (s)	Responsible Department	Data Storage Responsibility	Plan in place	Stored	Backup	Comments
Curator	Data repository within Asset Suite for keeping documents	Oracle	Varies		CIO	CIO	CIO	Yes	Asset Suite	Server	
Tempus	Companywide software for payroll time keeping OPG employees	Oracle 11	Varies	By user accounts	Finance	CIO- Financial Systems	CIO	Yes	Tempus	SQL Server	
ONCORE	Companywide software for payroll time keeping of Vendor worker hours	Oracle	Varies	By user accounts	Contract Management/Finance	CIO- Finance	CIO	Yes	Oncore	SQL Server	
NFRA	Financial Database connected to SAP, Oncore, Proliance	SAP BI 7.x	Varies	By user accounts	CFO	CIO	CIO	Yes		SQL Server	
Q7	System Quality improvement application	N/A	Varies	By user accounts	N/A	CIO	N/A	Yes	N/A	SQL Server	
System IQ	System Quality improvement application	Oracle 10	Varies	By user accounts	CIO	CIO	CIO	Yes		SQL Server	
Macroview	Email tool that stores in SharePoint via Outlook	.msg	Varies to include attachments	By user accounts	NR Infrastructure	Refurb- Risk Management	Refurb Infrastructure	Yes	NR SharePoint Team site	SQL Server	
TIMS II	Corporate Training Database, documentation of employee credits and training qualifications	Oracle 10	Varies	By user accounts	Training	Refurb- Operations	CIO	Yes	Tims II	SQL Server	
SCR	Station Condition Records links to Asset Suite Action Tacking	SQL	Varies	By user accounts	Nuclear Oversight	Refurb- MSO	CIO	Yes	SCR	SQL Server	
Organizational Chart	A point in time view on works for the corporation	.xlsx	Varies	By user accounts	Human Resources	Refurb Human Resources	Refurb – HR/CIO	NO	Web software	SQL Server	OPEX from other projects including PA RTS organizational charts are necessary when looking back on how and who the organization has working for them.  Today the corporate org chart is almost never updated to reflect the current organization. There is no in house tool that captures a time on who works for refurbishment.

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Appendix B: Data Management Systems





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**NUCLEAR PROJECTS COST ESTIMATING**

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## Nuclear Projects Cost Estimating

**N-MAN-00120-10001-EST-R002**

2014-10-21

**Internal Use Only**

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## Revision Summary

Revision Number	Date	Comments
R000	2012-07-25	Initial issue.
R001	2012-11-30	Revised to be applicable for all Nuclear Projects
R002	2014-10-10	Revised to include new updates and templates

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## 1.0 DIRECTION

### 1.1 Introduction

1.1.1 Cost estimating is the process used to determine the total cost of labour, materials, equipment, professional fees, and other resources, required for the execution of a project or part of a project. Estimates are also used to evaluate changes, alternatives, and what-if scenarios to assist in decision making. An accurate cost estimate leads to a more precise project schedule and budget which forms the basis for project planning, decisions, value and performance.

1.1.2 This guide complies with N-STD-AS-0028, Project Management Standard.

1.1.3 The estimating process is mainly comprised of:

- Identifying the scope of work, project constraints and assumptions.
- Quantifying the resources required.
- Applying costs to the resources.
- Adjusting or factoring the pricing based on project environment.

1.1.4 The quality of a project estimate is directly proportional to how well the project scope has been defined. Improved scope detail leads to improved estimate accuracy.

1.1.5 An estimate is not complete without considering the project's schedule-related constraints as the time allocated to execute the project will have considerable impact to cost.

1.1.6 Project Manager accountabilities for the estimating process include:

- (a) Provide clear direction on project and estimate deliverables and requirements.
- (b) Provide the required relevant and accurate scope and supporting information to prepare a thorough estimate.
- (c) Review and understand the estimate results to ensure the estimate meets project and Gate requirements, and be able to effectively communicate the results.

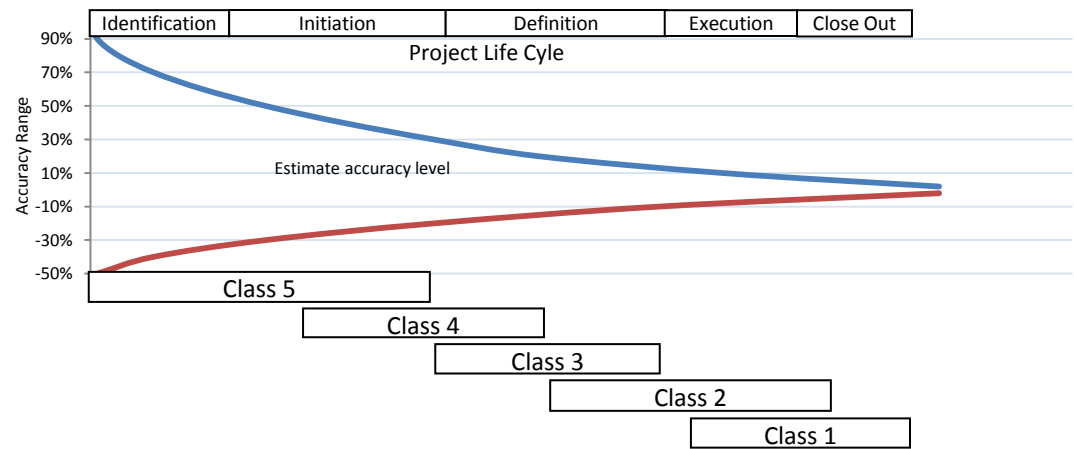
### 1.2 Estimate Classes and the Project Life Cycle

Estimating is a project planning activity that is repeated and refined for each funding release and decision gate of the project to reflect the refined scope and details. The accuracy of the total project cost estimate is expected to improve with each iteration, this is illustrated in Figure 1, Total Project Estimate Accuracy During Typical Project Lifecycle.

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Figure 1, Total Project Estimate Accuracy During Typical Project Lifecycle



Estimate accuracy is classified per the Association for the Advancement of Cost Engineering International (AACEi) standards Class 1 through 5. Class 1 is the most accurate.

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**Table 1 - AACEi Estimating Classification**

Estimate Class	Primary Characteristic	Secondary Characteristic		
	Maturity Level of Project Definition Deliverables Expressed as % of complete definition	End Usage Typical purpose of estimate	EXPECTED ACCURACY Typical variation in low and high ranges [a]	Methodology Typical estimating method
Class 5	0% to 2%	Concept screening	L: -20% to -50% H: +30% to +100%	Ratio from existing units, sales estimates, or published costs. Factored estimate based on appropriate equipment sizes, general features and dimensions <u>Examples Methods</u> Capacity Factored Parametric or Analogous Estimating Method Expert Judgment Analogy
Class 4	1% to 15%	Study or feasibility	L: -15% to -30% H: +20% to +50%	Factored estimate based on equipment sizes, soil and site data, site work, buildings, structures, piping, mechanical and electrical information. Allowances where required for non-quantifiable requirements. <u>Example Methods</u> Equipment Factored Parametric Estimating Method
Class 3	10% to 40%	Budget authorization or control	L: -10% to -20% H: +10% to +30%	Some factoring, some quantity takeoff from preliminary equipment arrangements and architectural drawings and information. Vendor quotes for major equipment. Other owner's costs included. Allowances where required. <u>Example Methods</u> Semi-Detailed Unit costs with Assembly level line items
Class 2	30% to 70%	Control or bid/tender	L: -5% to -15% H: +5% to +20%	Detailed activity-based unit-cost with forced detailed takeoff. <u>Example Methods</u> More definitive, various including, expert opinion, learning curve.
Class 1	50% to 100%	Check estimate or bid / tender	L: -3% to -10% H: +3% to +15%	Detailed activity-based unit-cost with detailed takeoff <u>Example Methods</u> Deterministic, most definitive, including expert opinion; learning curve

Note [a]:The state of process technology, availability of applicable reference cost data, and many other risks affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

Table 1 - AACEi Estimating Classification, lists the AACEi classes of estimates, their intended purpose, the level of definition and the methodology used to prepare them. Refer to Appendix A for further information regarding estimating methods.



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## NUCLEAR PROJECTS COST ESTIMATING

Estimate Class requirements for each phase/Gate per manual N-MAN-00120-10001-GRP, Nuclear Projects Gated Process, are listed in Table 2. The estimate for the work pertaining to the next immediate phase is required to be of higher accuracy than the balance of the project as the scope for the next immediate phase should be well defined and planned.

**Table 2, Typical Project Phase / Gate Estimate Requirements**

Project Phase	Business Proposal	Identification Phase	Initiation Phase	Definition Phase	Execution Phase
Gate	G0	G1	G2	G3	G4
<b>Gate Purpose</b>	Initial evaluation - Feasibility of proposed projects;  Identification Phase Funding Concurred	Identify Gap & Screen Business Need;  Initiation Phase Funding Concurred	Evaluate & Develop Alternatives, Select Preferred Alternative;  Definition Phase Funding Concurred	Develop & Define Preferred Alternative and Execution Phase Plans;  Execution Phase Funding Concurred	Implement (Install) & Deliver Preferred Alternative;  Close-out Phase Funding Concurred
<b>Estimate Class for Next Phase(s)</b>	<b>Class 3</b>	<b>Class 3</b>	<b>Class 3</b>	<b>Class 3</b> (w/o Detailed Design Complete)  <b>Class 2</b> (w/ Detailed Design Complete)	<b>Class 2</b>
<b>Estimate Class for Total Project</b>	<b>Class 5</b>	<b>Class 5</b>	<b>Class 4</b>	<b>Class 3</b>	<b>Class 2</b>
<b>Level of Project Definition</b>	Between 0 to 1% of total engineering	Between 1 to 2% of total engineering	Between 1 to 15% of total engineering	Varies from 10% to 100% of total engineering	Project definition 100% done; plus possible Engineering Field Change

1.2.1 Projects should scope and estimate projects against the Work Breakdown Structure (WBS) and/or Code of Accounts in order to allow:

- Monitoring of variance between actual costs and budget (estimate)
- Consistent format for cost reporting across projects.
- Comparison of project performance across a portfolio or program.
- To consolidate cost data for future projects.

## 2.0 BASIS OF ESTIMATE (BOE)

The BOE documents the parameters and scope used in support of developing the estimate and also includes the completed estimate details and breakdown. The BOE is generally started prior to developing the estimate and finalized once the estimate is complete. A Scope of Work (SOW) document may be used to initiate an estimate however a BOE is still required.

**Note:** The BOE may be incorporated as part of the PMP.

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As listed in detail in Appendix C: Basis of Estimate Template, Key elements of a BOE include:

- Basis of Estimate objective
- Project scope description
- Cost basis
- Assumptions
- Project duration/ milestones
- Exclusions
- Design basis
- Risks & opportunities
- Reference documents
- The completed estimate detail tables and forms

The BOE is approved by the Project Manager and is included or incorporated as part of the PMP.

A formal BOE is typically not required for estimating the cost of:

- Changes
- Alternatives analysis
- What-if scenarios
- Small or simple projects (justification for not creating a BOE must be approved by the applicable project Director and GRB or PMOC).

### 3.0 ESTIMATING PROCESS

There are four major steps in developing a new estimate. They are:

- (1) Estimate Planning
- (2) Estimate Development
- (3) Estimate Review
- (4) Estimate Approval.

These will be implemented to support each applicable decision gate of the gating process.

#### 3.1 Estimate Planning

Estimate Planning is carried out to determine the accountability, estimate class, timeline, and deliverable requirements associated with an estimate. Estimate Planning includes:

- Decide if the estimate is to be completed internally within OPG or externally by a third party estimator. As a general guideline:

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- Projects with a total value of less than \$1M would not be expected to use an external estimator except under special circumstances.
- For projects expected to cost between \$1M and \$5M, the use of a third party estimator is at management discretion.
- For projects with a total budgeted cost greater than \$5M, estimating should be delegated to a third party estimator.
- Vendor bid evaluations may include a third party estimate as an independent comparison.

Note: the above recommendation is at the Project Manager's discretion and may be reviewed and challenged at the GRB. All the estimates will be coordinated with OPG project control estimating team.

- Choose who will conduct the estimate for the various scope. Certain sections of scope may be estimated by different people or groups in relation to expertise and responsibility.
- Establish estimate completion and review dates based on scope progress and phase of project (Gate), and with concurrence of the project manager. These dates must be in accordance with the overall project and portfolio/program milestones.
- Determine the level of estimate accuracy in alignment with the phase of the project and Gate requirements. This is based on the available project scope information and engineering progress (see Table 2 guideline).
- Verify the grouping of major scope items via WBS definition and/or code of accounts.
- A unique estimate ID number may be provided by the estimating support team to track and record the estimate and revisions when applicable.

## **3.2 Estimate Developing**

Each project needs to provide to the estimator the required estimating document as listed in Appendix B, Estimate Input Checklist.

Generally, the BOE and SOW content should be frozen before the estimate requirement date to allow sufficient time to complete a thorough estimate and any required reviews prior to approval. Estimator, program or portfolio work load must be taken into consideration.

### **3.2.1 Estimate Preparation**

The estimator should:

- (1) Attain and document scope clarification and ensure there is alignment with the project management team via estimate developmental or clarification meetings.

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- (2) Prepare or update the estimate and Basis of Estimate (BOE) in parallel while clearly outlining any assumptions, exclusions or exceptions. Confirm and verify the required scope and strategy are fully reflected in the BOE. Recommended BOE template is included in Appendix C.
- (3) Prepare estimate breakdown based on approved project WBS and/or Code of Accounts. following are high level steps for cost estimate preparation:
  - I. Choose applicable estimating techniques (See Appendix A)
  - II. Quantify labour hours, and material/equipment using available document
  - III. Develop the project cost using labour rate, historical data, factors, etc
- (4) Estimates must be structured to distinguish costs by project release and phase, the template for summary table is in Appendix D
- (5) The estimate shall be structured in consideration of data migration to P6 and other project control tools.
- (6) Allowances may be required for areas of project scope which are not yet clearly defined. Allowances must be clearly identified in the BOE. E.g. an allowance for a pump may be required when the type and size of the pump required is not yet known, this should be clearly defined on section 2.3 (Procurement) of BOE. Allowances should not be confused with cost contingency nor used to reduce the effort of creating a properly detailed estimate.
- (7) Estimates may include several key benchmark ratios and factors versus historical (and sometimes estimated) values from similar projects. The key benchmark criteria shall be agreed upon between project estimator and Project Manager and documented in the BOE under applicable section. If there is a large discrepancy between the estimates and similar completed projects, it must be justified and documented in the BOE. Lessons learned on similar types of projects shall also be reviewed and incorporated.
- (8) For projects involving a similar installation strategy for multiple units or stages, the estimate for subsequent units/stages should consider factors to allow benefit of lessons from experience as repeat work moves from the first unit to the last unit.
- (9) Conduct estimate peer internal reviews.
- (10) Prepare the estimate package for formal estimate review.
- (11) Maintain a backup of the estimate calculation details for reviews or audits.

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### 3.2.2 Estimate Package

The estimate package is prepared by the project estimator or responsible vendor and as a minimum should include the following:

- The completed BOE (Appendix C) Cost estimate summary table (Appendix D)
- Detailed breakdown (incl. indirect costs, profit and overhead) by applicable WBS and/or Code of Account, and project release/phase.

**Note:** The BOE represents only overnight cost of project; cash flow, escalation and interest will be added by Scheduling/Finance and applied to the total project budget.

### 3.3 Estimate Review

A scope and quantity check review may be required for larger or more complex projects. The review should include all elements of the BOE and SOW. Estimate reviews are intended to verify technical details of the scope of work and the quantities and processes used in developing the estimate. The goal is achieve agreement and alignment on the total estimate package by all attendees.

The formality of the review should be dependent on the project size and complexity using a graded, risk based approach. More than one review may be required.

The review should include the accountable Project Manager, estimating section manger, applicable team members and stakeholders per the Project Manager's discretion.

If estimates deviate from the normal ranges in historical databases, the Project Manager and/or estimator should provide justification in the BOE or estimate package.

### 3.4 Estimate Approval

The completed estimate is included with the BOE and is approved by the accountable Project Manager.

## 4.0 ESTIMATE REVISIONS AND RECONCILIATION

Estimates shall be revised for each Gate approval package. Depending on the size of scope change or variances between a current bid and previous estimate, project may need to have a "Vendor Estimate Validation" or they may need to seek a new refresh internal/third party estimate. Project Manager needs to make a decision using Estimating Decision Guide flowchart provided in Appendix E.

Note: the recommendation provided in "Estimating Decision Guide" is at the Project Manager's discretion and may be reviewed and challenged at the GRB.

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### 4.1 Refresh Estimate

A new BOE and estimate report will be developed by internal/third party estimator following all the steps as explained in section 3.2 and then the new estimate report need to be reviewed and approved as explained in section 3.3 and 3.4.

### 4.2 Vendor Estimate Validation

Project team needs to provide submitted bid proposal and all the correspondent documents between OPG and Vendor to internal/third party estimator, they must also invite third party estimator to all bid review or challenge meetings. Internal/third party estimator will confirm the integrity of the bid by verifying estimating methods, and assessing the assumptions and making sure that the adopted ground rules are consistently applied throughout the submitted estimate/bid. They will issue a "Vendor Estimate Validation report/memo" to document their finding and recommendation.

## 5.0 ESTIMATING TOOLS

Estimating tools or databases may be used for estimating preparation and tracking. Estimating data may be stored in the applicable estimating tool or database. Further information on the estimating tools is available in the applicable estimating guides and task instructions.

## 6.0 DEFINITIONS AND ACRONYMS

### 6.1 Definitions

None

### 6.2 Abbreviations and Acronyms

<b>AACE</b>	The Association for the Advancement of Cost Engineering
<b>BOE</b>	Basis of Estimate
<b>ES MSA</b>	Extended Services Master Service Agreement
<b>GRB</b>	Gate Review Board
<b>NR</b>	Nuclear Refurbishment
<b>P&amp;M</b>	Projects and Modifications
<b>PMP</b>	Project Execution Plan
<b>SOW</b>	Scope of Work
<b>WBS</b>	Work Breakdown Structure

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## 7.0 RECORDS AND REFERENCES

### 7.1 Records

Any controlled documents which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0003, Controlled Document Management.

Any records which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0042, Records and Document Management.

- 7.1.1 The following records may be generated by use of this document and shall be registered in the appropriate document managed system in accordance with the following table. Refer to N-MAN-00120-10001-RDM, Nuclear Projects Records and Document Management, for additional details.

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention
Basis of Estimate (BOE)	N-TMP-10010 (NR)	N	May be incorporated in PMP. Issue in Asset Suite as Record. Property # - PLAN - SCI -XXXXXXX  Retention = 6 Years after project closed per the approval of Project Closure Report, FIN-FORM-PA-005. RRC: N02-0038.  Retention = T20 (NR)
Estimate Package	n/a	N	Issue in Asset Suite as Record. Property # - REP – SCI - XXXXXXXX Retention: per BOE above.

## 7.2 References

### 7.2.1 Performance References

- N-MAN-00120-10001-GRP, Nuclear Projects Gated Process
- N-MAN-00120-10001-RDM, Nuclear Projects Records and Document Management
- N-MAN-00120-10001-RISK, Nuclear Projects Risk Management Process
- N-STD-AS-0028, Project Management Standard

### 7.2.2 Developmental References

- AACE Recommended Practices and Standards:  
- Practice No. 18R-97 Cost Estimate Classification System

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- Practice No. 19R-97 Estimate Preparation Costs in the process industry
- AACE Total Cost Management Framework

- FAA Life Cycle Cost Estimating Handbook
- NASA Cost Estimating Handbook 2004
- Project Management Body of Knowledge 4<sup>th</sup> Edition (PMBOK Guide)

## **8.0 REVISION SUMMARY**

This is an update to include Decision Making Matrix, Estimate Input Checklist, Estimate & BOE Templates developed since the 2012 Revision issued



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**Appendix A - Estimating Methodology**


	<i><b>Parametric Estimating</b></i>	<i><b>Analogous Estimating</b></i>	<b>Detailed Engineering Estimating</b>
<b>General Description</b>	Uses a statistical relationship between historical data and other variables to calculate a cost estimate for a deliverable/project	Uses the actual cost/effort of a previous and similar project/data as the basis for estimating the cost of the current project.	Detailed Engineering estimates is an estimate that is built from a high level of detail based on design quantities.
<b>Example</b>	Variables can include equipment weight, size, number of components to be installed, and number of lines in a computer program.	Replacing a dryer in the reactor building; estimate based on actual cost of a dryer replacement project in the RAB.	Determining the cost of a project from contractor quotes and design bill of materials.
<b>Application</b>	Applicable to a higher level of the WBS (less detailed), provided that statistical data is available. This may be the only method available in the early phases of a project due to limited scope definition.	Applicable when there is insufficient actual cost data to use as a basis for a detailed approach, but a comparable item exists on which to base an estimate.	Applicable when detailed information, concerning labour and material resource requirements, is available. This method may be incorporated with the parametric and analogous method if some aspects of the project do not have sufficient information.
<b>Assumptions</b>	Assumes that the group of variables that affects the cost of a particular component has remained the same.	Assumes that the analogy has been evaluated as a valid comparison.	N/A
<b>Advantage</b>	May be performed relatively quickly. May be performed with limited project definition.	Allows the estimate to be broken down into a lower-level of WBS (more detail) with enhanced credibility.	Provides very detailed estimates on every aspect of the project.
<b>Disadvantage</b>	Subtle changes in relationships between cost and variables are not easily reflected in the estimate.	May be difficult to find a good analogy.	Time consuming to prepare, and requires detailed, well defined information for the project.

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## Appendix B – Estimating Input Checklist

		<b>DNGS Refurbishment - Estimate Input Checklist</b>		System Bundle: Project Name: Submitted by:		Submitted Date: Estimate Start Date: Estimate Forecasted Finish Date:																																																																															
		<table border="1"> <thead> <tr> <th colspan="2">General Project Data</th> <th colspan="2">Required Estimate Class</th> <th rowspan="2">PMT Comments</th> <th rowspan="2">Internal/Third Party Estimator Comments</th> </tr> <tr> <th></th> <th></th> <th>4</th> <th>3</th> </tr> </thead> <tbody> <tr><td>1</td><td>Estimating Deliverables in Project Schedule</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>2</td><td>Project Scope of Work Document</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>3</td><td>Project Work Breakdown Structure (Chart with all details)</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>4</td><td>List of all Work Packages in Excel</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>5</td><td>Definition of Project Phases</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>6</td><td>Project Schedule for all Phases (Level 1 <input type="checkbox"/>, Level 2 <input type="checkbox"/>, Level 3 <input type="checkbox"/>)</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>7</td><td>Project Inclusion/Exclusion</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>8</td><td>Project Assumptions</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>9</td><td>Project Constraints</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>10</td><td>Risk Register</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>11</td><td>Shifts Pattern</td><td><input checked="" type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> <tr><td>12</td><td>Contract Strategy</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td><td></td></tr> </tbody> </table>		General Project Data		Required Estimate Class		PMT Comments	Internal/Third Party Estimator Comments			4	3	1	Estimating Deliverables in Project Schedule	<input type="checkbox"/>	<input type="checkbox"/>			2	Project Scope of Work Document	<input type="checkbox"/>	<input type="checkbox"/>			3	Project Work Breakdown Structure (Chart with all details)	<input type="checkbox"/>	<input type="checkbox"/>			4	List of all Work Packages in Excel	<input type="checkbox"/>	<input type="checkbox"/>			5	Definition of Project Phases	<input type="checkbox"/>	<input type="checkbox"/>			6	Project Schedule for all Phases (Level 1 <input type="checkbox"/> , Level 2 <input type="checkbox"/> , Level 3 <input type="checkbox"/> )	<input type="checkbox"/>	<input type="checkbox"/>			7	Project Inclusion/Exclusion	<input type="checkbox"/>	<input type="checkbox"/>			8	Project Assumptions	<input type="checkbox"/>	<input type="checkbox"/>			9	Project Constraints	<input type="checkbox"/>	<input type="checkbox"/>			10	Risk Register	<input type="checkbox"/>	<input type="checkbox"/>			11	Shifts Pattern	<input checked="" type="checkbox"/>	<input type="checkbox"/>			12	Contract Strategy	<input type="checkbox"/>	<input type="checkbox"/>		
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12	Contract Strategy	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		
<b>Engineering Deliverables:</b>																																																																																					
13	Conceptual Design Report	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		
14	Modification Outline (Draft <input type="checkbox"/> , Approved <input type="checkbox"/> )	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		
15	Modification Design Requirement	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
16	Design Plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
17	Specifications & Datasheets	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
18	No Committal Budgetary Quote of Construction Work	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		
19	Number of EC's (Elec/I&C <input type="checkbox"/> , Mech <input type="checkbox"/> , Civil <input type="checkbox"/> , Other <input type="checkbox"/> )	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		
20	Number of NICR <input type="checkbox"/> , PMOD <input type="checkbox"/> , TMOD <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		
21	Design Scoping Checklist	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
22	COIR / COIR List of Deviation	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
23	Equipment List	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
24	Bill of Materials/Quantity	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
25	Spare Parts Listing	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
26	Walk Down Report/Required	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		
27	OPEX Report	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		
28	Corresponding Between Project Team and Contractor (if any)	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		
29	Maintenance Strategy	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
30	General Equipment Arrangement Drawings - Hard Copy	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
31	All Discipline Drawings (Elec/Mech/I&C/Civil) - Hard Copy	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																																																		
32	DRAS Form (if any)	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		
33	Other (if any)	<input type="checkbox"/>	<input type="checkbox"/>																																																																																		

**Note:** All projects are required to fill out this checklist when they submit their estimating service request.

This is a checklist of basic deliverables required for estimate preparation; any missing document will have a negative on the quality of the estimate.

If a document hard copy is not provided, a direct link to the document should be included under PMT comments section.

The maturity of estimate level is an approximation of the completion status of the above deliverable.

**Committed by Estimating Team for:**

Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

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### Appendix C - Basis of Estimate Template

OPG ES-MSA Agreement

Basis of Estimate

## Basis of Estimate

**Project Name:**  
**System Bundle:**

### If prepared by Vendors

Submitted by:  
Company Name:  
Submitted Date:

### If prepared by OPG internal/Third Part estimator

Prepared by:  
Reviewed by (QA):  
Concurred by (OPG Estimating Section Manager):  
Accepted by (Project Section Manager):  
Approved by (Project Manager):  
Submitted Date:

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## Appendix C (continued) - Basis of Estimate Template

OPG ES-MSA Agreement	Basis of Estimate
<b>1.0 BASIS OF ESTIMATE OBJECTIVE</b> Brief description of the project; Primary estimating Methodology based on available project information Estimate classification for each phase and the accuracy range	
<b>2.0 PROJECT SCOPE DESCRIPTION</b> High level scope of work for Phase I and Phase II	
<b>2.1 Shared cost</b> Deliverables and effort required by Project Management Office /QA office List of any special training or job consumable	
<b>2.2 Engineering</b> Type of engineering job (like to like, Mod work ...) and assumed required engineering effort for functional engineering, procumbent engineering and field engineering List of any major engineering deliverables/drawings per DSR Number of assumed master ECs per DSR Number of design ECs per the master ECs per DSR	
<b>2.3 Procurement</b> List of major Long Lead equipments per DSR List of major Non Long Lead equipment per DSR List of any equipment or material provided by OPG (out of scope material) List of spare parts	
<b>2.4 Construction</b> List of major fabricating and installing activities per DSR	
<b>3.0 COST BASIS</b> Total project estimated cost For refresh estimates, a comparison table that compares the new and previous estimates Contractor quotes Assumed shift pattern Any factors that had a significant impact on the final estimated cost Estimates key benchmark ratios versus historical (and sometimes estimated) values from similar projects	
<b>4.0 ASSUMPTIONS</b> List of assumption used in the estimate preparation	
<b>5.0 PROJECT DURATION/ MILESTONES</b> List of assumed durations for preliminary engineering, detail engineering, installation, commissioning and close out phases per DSR Phase I/II milestones/constraints per DSR	
<b>6.0 EXCLUSIONS</b> General or project specific exclusions List of any labour cost not included in the projects and assumed captured on other level of project	
<b>7.0 DESIGN BASIS</b> Percentage of design complete to meet above estimate classification Assumptions made with respect to missing data	
<b>8.0 RISKS &amp; OPPORTUNITIES</b> List of major risks or opportunities which could change the final estimated cost	
<b>9.0 REFERENCE DOCUMENTS</b>	
<b>Attachment:</b> ES-MSA Estimate Table (summary and detail)	

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**Appendix D – Estimate Summary Table Template**

Estimate categories	Phase 1 U2		Phase 2 U2		Phase 3 U2		U1		U3		U4	
Estimate Classification (AACE standard):												
Estimate Range:	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
<b>Engineering/Installation cost (All DSR)</b>												
1 Preliminary Engineering (Mod Work Only) (Tier 1)		-										
2 Preliminary Engineering (Mod Work Only) (Tier 2)		-										
3 Detailed Design - Tier 1 Subcon (Mod Work Only)		-					-		-		-	
4 Sub Contracted Engineering / PE - (Tier 2) (Mod Work Only)		-					-		-		-	
5 Work Planning and Assessing		-		-			-		-		-	
6 Equipment (Long Lead and Non Long Lead)		-		-			-		-		-	
7 Materials (Long Lead and Non Long Lead)		-		-			-		-		-	
8 Mobilization, Work Staging				-			-		-		-	
9 Construction - Direct Performed				-			-		-		-	
10 Construction Indirects				-			-		-		-	
11 Construction by Tier 1 Sub Con				-			-		-		-	
12 Construction by Tier 2 Sub Con				-			-		-		-	
13 Engineering Support - Construction (Tier 1)				-			-		-		-	
14 Engineering Support - Construction (Tier 2)				-			-		-		-	
15 Commissioning/AFS Support						-	-		-		-	
16 Engineering Support - Comm/AFS (Tier 1)						-	-		-		-	
17 Engineering Support - Comm/AFS (Tier 2)						-	-		-		-	
18 System Restore/Post Maintenance Testing						-	-		-		-	
19 Close Out						-	-		-		-	
20 Demobilization						-	-		-		-	
<b>Shared Cost</b>												
21 Project Management Staff		-		-		-	-		-		-	
22 QA/QC Staff		-		-		-	-		-		-	
23 Job Expenses		-		-		-	-		-		-	
24 Project Specific Training		-		-		-	-		-		-	
25 Consumables / Tools		-		-		-	-		-		-	
26 Exceptions		-		-		-	-		-		-	
<b>Total</b>		-		-		-	-		-		-	
<b>Grand Total</b>												-

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## Appendix D (Continued) – Remarks for Estimate Summary Table Template

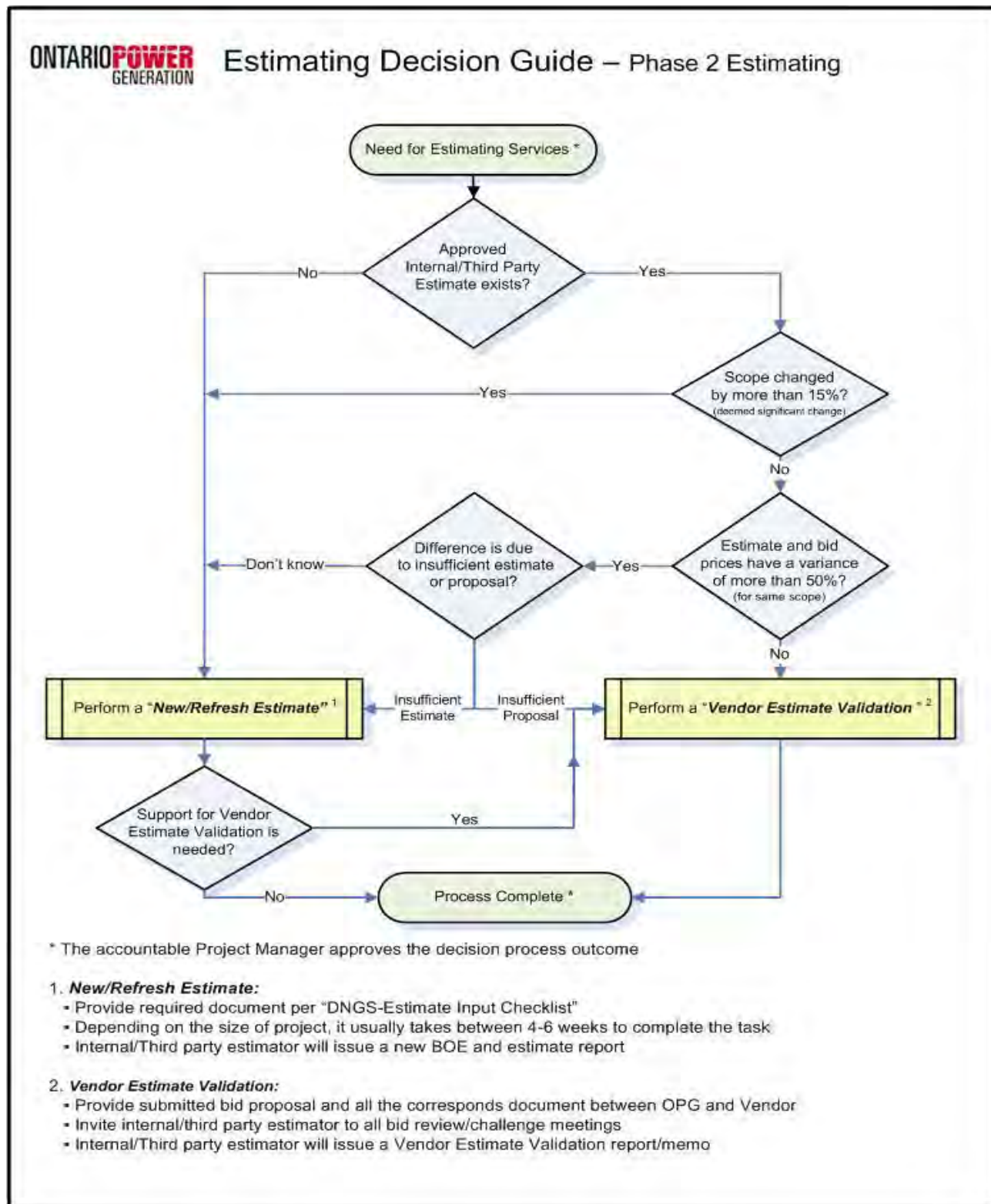
Estimate categories	Remarks
<b>Engineering/Installation cost (All DSR)</b>	
1 Preliminary Engineering (Mod Work Only) (Tier1)	Master EC, Design Plan, MDR, TS, HFE, OPEX Review, Walkdowns/Field Verification, Scoping/Prelim COMS, Software Categorization, Eng Specification for Long Lead Items, Disposition of Comments, etc
2 Preliminary Engineering (Mod Work Only) (Tier 2)	Master EC, Design Plan, MDR, TS, HFE, OPEX Review, Walkdowns/Field Verification, Scoping/Prelim COMS, Software Categorization, Eng Specification for Long Lead Items, Disposition of Comments, etc
3 Detailed Design - Tier 1 Subcon (Mod Work Only)	Tier 1 Engineering Staff Labour Costs for: Discipline EC's, Asset Suit Modifications, ADL, RDL, Change Papers, DBOM's, Design Manual Updates, Engineering Specifications, Tech Data Sheets, Engineering Calculations, Design Review Meetings/Reports, Regulator Support documentation, Engineering Reports (eg Seismic, etc), Create CatID's, TSSA Requirements, Detailed Design COMS, Pre-Start H&S Report, Review Specialist/Vendor Engineering, Disposition of Comments, Update budget for next phase.
4 Sub Contracted Engineering / PE - (Tier 2) (Mod Work Only)	Tier 2 Engineering Staff Labour Costs for all the tasks as mentioned in the above cell; this is Subcontracted Engineering for specialist services or supplemental resources for any of the deliverables in Detailed Design. <b><u>INCLUDES PROCUREMENT EFFORT LABOUR</u></b>
5 Work Planning & Assessing	Installation Work Plan, Commissioning Specifications, Commissioning Work Plan, Field Assessing / Walkdowns, CWP's, ITP's, Completion Forms
6 Equipment (Long Lead and Non Long Lead)	Purchased Cost of Major Equipment and/or Prefabricated assemblies from 3rd Party Vendors <b>EXCLUDES: Procurement Effort (labour), Bulk Materials, Small Tools &amp; Consumables</b>
7 Materials (Long Lead and Non Long Lead)	Purchased Cost of Bulk Materials (incl freight, env charges, etc) to be incorporated into the Work <b>EXCLUDES: Procurement Effort (labour), Equipment (see above), Small Tools &amp; Consumables</b>
8 Mobilization, Work Staging	Any cost related to mobilization.
9 Construction - Direct Performed	Construction Labour for Direct-hired Trades and First Line Supervision executing construction work inside the island (Factored for Work in Station). <b><u>INCLUDES PRE INSTALLATION WORKS.</u></b>
10 Construction Indirects	Indirect Construction Labour for Sr. Supv (GF, Supts), HOR's, MA's, Labourers & other Support Trades, Material Handling, Scaffold Safety Inspection Program, etc. This is based on an agreed factor or estimated separately when the proportion of indirect to direct is significantly higher or lower. <b><i>Note - this resource pool is managed at the Program Level</i></b>
11 Construction by Tier 1 Sub Con	Labour only for Tier 1 Construction Management Subcontractors. Job Expenses and materials should be included in the appropriate categories.
12 Construction by Tier 2 Sub Con	Many trades subcontractors include labour and material in their pricing. Also includes Vendor Specialists - we need to be intentional about having this required as a separate price in the quotation.
13 Eng Sup - Constr/Comm/AFS/Close (Tier 1)	Tier 1 Engineering Staff Labour for: Field Technical Support, Field Initiated Changes, Non-intent Revisions, Commissioning Tech Support, Review/Verify/Approve Commissioning Reports,
14 Eng Sup - Constr/Comm/AFS/Close (Tier 2)	Tier 2 Engineering Staff Labour for: Field Technical Support, Field Initiated Changes, Non-intent Revisions, Commissioning Tech Support, Review/Verify/Approve Commissioning Reports,
15 Commissioning/AFS Support	Construction Labour assigned to support commissioning activities directed by others - OPG or Vendor Reps.
16 Engineering Support - Comm/AFS (Tier 1)	Tier 1 Engineering Staff labour for AFS Walkdown & Reports, Update MEL, As-Built Change Papers, Incorporation of Change Papers into Station Drawings & Design Manuals, Update DBOMs.
17 Engineering Support - Comm/AFS (Tier 2)	Tier 2 Engineering Staff labour for AFS Walkdown & Reports, Update MEL, As-Built Change Papers, Incorporation of Change Papers into Station Drawings & Design Manuals, Update DBOMs.
18 System Restore/Post Maintenance Testing	Support for refilling and re-establishing the system alignment prior to system startup. Post Maintenance Testing for Mod and Non Mod work.
19 Close Out	Engineering Labour assigned to support closeout activities.
20 Demobilization	Any cost related to demobilization.
<b>Shared Cost</b>	
21 Project Management Staff	Project Manager, Project Engineer, Project Coordinators, Project Admin Staff, Scheduler, Project Controls, Cost Control, etc., Project HSE Manager performing Project Initiation, Planning, Risk Management, Monitoring & Control through Closeout. Includes Project Management for Tier 1 Subcontractors only.
22 QA/QC & Completion Staff	QC Supervisors, QA/QC Auditors, Source Surveillance, Completions Supervisor, Completions Walkdowns.
23 Job Expenses	Trailers/Project Offices, Travel, Project Specific Insurance, Temporary Services (e.g. wash trailers), Permits associated with the Work, Services or rentals associated with providing Project offices/trailers and/or other Job Expense items. Project-specific software licenses (e.g. completion systems).
24 Project Specific Training	Training associated with a project specific technology or process to be provided to either Project Trades, Staff and/or OPG Operations and Maintenance
25 Consumables / Tools	Single use consumables specific to the project scope of work (e.g. resin, glycol, pickling solutions, nitrogen, etc).
26 Exceptions	Any exceptional cost not listed above

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### Appendix E – Estimating Decision Guide







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**Revision Summary**

<b>Revision Number</b>	<b>Date</b>	<b>Comments</b>
R002	2015-03-30	Major Revision to the document to address the integration of the draft P&M Risk Guide RISK-G-01 and to incorporate direction of the new Risk Management and Oversight (RMO) tool. Integration of all NR manuals (RISK-04, RISK-05, RISK-06, RISK-07, RISK-08) regarding OPEX, lessons learned, assumptions and decisions management into a single document.
	2014-06-28	Updated the Risk Management Process to include Key Risk Areas and the related sponsors' responsibilities
	2014-03-24	Integrate N-MAN-00120-10001-Risk 05 (contingency development) to create a consolidated single document. Removed the cost control/change control/reporting sections for contingency. Non-intent updates to provide clarification or context as requested by manual users.
R001	2013-07-07	Minor updates
R000	2012-07-25	First Issue

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## NUCLEAR PROJECTS RISK MANAGEMENT

### 1.0 DIRECTION

Risk management is a systematic approach to identifying, analyzing, and responding to project risks. The goal of risk management is to proactively identify and manage risks in order to deliver projects safely, with quality, on time and on budget. This document provides direction to projects for both day-to-day risk management activity as well as the risk management preparations for authorization packages presented at funding gates/committees.

### 2.0 SCOPE

A graphic depicting the “inputs to” and “outputs of” risk management activity that fall under the scope of this document is outlined below. The sections of this manual are structured in alignment with this diagram.



Figure 1: The Risk Management Process

#### 2.1 Risk Management and Oversight Tool (RMO)

The Risk Management and Oversight (RMO) tool is an application project managers will use to perform risk management activity for projects. The Project Management Office (PMO) is the owner and administrator for this tool and provides training, support, and guidance to the organization. This manual does not include detailed direction for using the RMO tool. For details on how to use the RMO tool, refer to *N-GUID-09701-10123, Risk Management and Oversight Tool*.

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### 2.2 PMO Role

The PMO Risk Department will provide guidance to the project managers in the application and interpretation of the requirements outlined in this manual. The support provided exists both in the day-to-day application as well during preparation of funding approval packages (e.g. Gate Review Board). The PMO risk department will perform oversight of the RMO contents on behalf of the Nuclear Projects organization and will prepare reports, metrics, self-assessments, and other such analyses from time to time to monitor the effectiveness and use of the processes outlined in this manual. Annually a consolidated report will be prepared incorporating a strategic review and identification of any corrective actions.

Additional project controls support and deliverables, where applicable, are outlined in the appropriate section of this manual.

### 3.0 RISK MANAGEMENT INPUTS

Risks to project objectives can be identified from a number of sources. If these sources of risk are not considered both in the development of the initial risk profile as well as during ongoing risk management activity the ability for the project manager and senior leadership to make informed decisions about the project may be adversely impacted.

#### 3.1 Operating Experience (OPEX) and External Lessons Learned

OPEX is information ***gained through experience*** that should be retained for future use. Depending on the observation made, OPEX could be a valuable technique, a best practice or a successful outcome you wish to repeat or an undesirable result you wish to avoid. When applicable OPEX is recognized, the project manager is then equipped with the knowledge to incorporate it into their baseline cost and schedule or manage it as a risk.

The Nuclear Projects process complies with *OPG N-PROC-RA-0035, Operating Experience Process*. This base standard has an operational focus. For project risk management, the goal is to look beyond operational events and seek out events that have happened both in nuclear and non-nuclear projects that may present risks to the project that is being undertaken.

OPEX obtained through RA-0035 process is added to the RMO database by the PMO and dispositional by the designated department or project. Anyone with access to the RMO tool can add an OPEX event under the OPEX tab. The PMO can assist the project manager in searching for specific event types and populating the RMO OPEX library with new information that will be helpful to others.

Lessons Learned (LL) are similar to OPEX items, in that they have a foundation in past events. A lesson learned however ***goes beyond an individual event to provide key insights and clearly identify the causal factors that contributed to a positive or negative outcome.*** The RMO tool contains a searchable lessons learned library, with major lessons learned categorized as Programmatic Lesson Learned (PLL). Each PLL

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is assigned an owner within Nuclear Projects whose accountability is to ensure that proper actions are developed, assigned, and are monitored to completion.

### 3.1.1 Project Manager Direction

Project managers should be up to date on the content of the OPEX and LL libraries as they conduct their day-to-day risk management activities. Good practice would be to establish periodic reviews of OPEX and LL within their project teams during regular risk reviews.

Prior to any funding gate a detailed review of the RMO OPEX and LL library must be performed and any items that were considered in the preparation of the baseline cost and schedule or resulted in a project risks shall be identified. A summary of the review performed shall accompany the gate or funding approval package in the form of a narrative in *N-FORM-11652, Nuclear Projects Risk Management Input Assessment*.

#### PMO Role

The PMO Risk Department receives external OPEX from the central nuclear OPEX coordinator. The OPEX received has been pre-screened as per *N-GUID-04947.02-10000 External Events Screening Guide* and is determined to be relevant to Nuclear Projects. These items are populated in the RMO tool by the PMO risk department. The PMO risk department will also proactively seek out external and internal project related OPEX events through a variety of sources identified in Appendix A. The PMO risk department provides oversight support and disseminates significant information in real time through email communications. The PMO risk department creates programmatic lessons learned (PLL) based on significant OPEX and presents them to CARB.

### 3.2 Project Definition Rating Index (PDRI)

The Project Definition Rating Index (PDRI) is an industry best practice front end planning tool that helps assess the level of project scope definition and stakeholder alignment during the critical formative stages of the project. The objective of a PDRI is to identify gaps in scope definition early on, prior to committing significant funding to the project. The gaps in understanding or definition identified in the PDRI workshop shall be closed by the project manager prior to proceeding further (i.e. prior to submitting the funding package for approval). At minimum if the gaps cannot be resolved the project manager can use the insights gained in the PDRI session to inform the project risk register.

The requirement for a project to undertake a PDRI workshop is defined by the gating process. The PMO Risk Department can assist the project manager in executing a PDRI workshop by providing resources and facilitation.

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### 3.3 Assumptions and Project Bases

Assumptions are factors in the planning process that are considered to be true, real, or certain, without proof or demonstration. Assumptions are ***not completely defined in project documents*** but are required in order to develop the cost and schedule estimates for projects.

Project bases are ***documented descriptions of how an estimate, schedule, or other plan component was developed*** and defines the information used in support of development.

To the extent possible when preparing funding approval packages, the use of assumptions shall be minimized. It is important when preparing the cost and schedule estimates to disposition assumptions so that the project plan being presented has been validated and is supported by project bases. Any residual assumptions that cannot be dispositioned or built into the cost and schedule as a project basis shall be entered into the RMO assumption log and reviewed during preparation of the project risk register. Assumptions are to be populated in the RMO tool, and can be initiated by any Nuclear Projects personnel with access. Project bases that are not documented in other project documents (such as the basis of estimate) shall also be documented in the assumptions log in the RMO tool.

#### 3.3.1 Assumption Revision or Closure

Assumptions can be closed when they are no longer relevant or when they are known to be incorrect or invalid. New or modified assumptions that impact other projects directly, or those that are widely applicable (i.e. "program" level assumptions) shall be broadly communicated by the initiating project manager in order to bring awareness to those affected departments or projects. For example, an assumption pertaining to contracting or resourcing strategies may have a wide ranging impact on projects already in flight therefore strategic, effective communication is imperative.

#### 3.3.2 Project Manager Direction

Prior to submission of funding approval packages, the project managers shall populate the assumptions log in RMO. These assumptions shall be assessed to determine if they introduce risk to the project and require entry to the project's risk register. A summary of the assumptions made shall accompany the gate or funding approval package in the form of a narrative in *N-FORM-11652, Nuclear Projects Risk Management Input Assessment*.

The project managers shall keep up to date on the content of the assumptions log as they conduct their day-to-day risk management activities, and assess risks against assumptions made. Good practice would be to establish periodic reviews of the RMO assumptions log for any new programmatic assumptions made or any assumptions made for projects that may impact the subject project. The project manager shall re-validate their assumptions on a regular basis and at minimum at funding approval gates or when initiating the change control process.

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### 3.4 Decisions

***Documented decisions form a part of the project basis.*** Decision records are critical for maintaining an auditable trail for Nuclear Projects and assist in “telling the story” of the projects. In most cases, decisions exist in the form of approved documentation generated by following existing approved processes (the modifications and the engineering change control processes, Engineering or Operational Decision Making, for example). Decisions made under the execution of these processes do not need to be duplicated in the RMO tool.

Project decisions that should be entered into the RMO are those that are not covered by existing processes. These decisions tend to be strategic in nature and arise when there is not a clear path forward but rather a number of possible options to achieve the project’s objectives. Too often, these decisions are made informally without the appropriate authority and are not communicated effectively, resulting in adverse impacts on the projects. These decisions shall be documented in a DRAS (*Decision Record and Analysis Summary*) N-FORM-11390 and entered into the RMO tool once approved. A control document number shall be obtained for the DRAS and the DRAS shall be submitted to records in parallel with being added to the RMO decision log.

This decisions process and associated N-FORM is flexible and may be applied to provide structure to a number of different project departments for a number of different types of decisions. While all decisions documented in a DRAS shall be recorded in the RMO tool, this manual will not provide direction for all the various possible applications.

#### 3.4.1 Project Manager Direction

There is no strict prescription or threshold for entering decisions in the RMO tool. If there is confusion regarding the appropriateness of preparing a DRAS, contact the PMO risk department for support and guidance. As a general rule, the project manager should use judgment and input decisions in the RMO tool if:

- The decision forms a fundamental aspect of the project basis and is not documented elsewhere as part of approved project processes, and/or
- The decision would assist external and internal personnel in understanding the rationale and the considerations made in establishing the project plan, and are not documented elsewhere as part of approved project process.

In all cases, decisions must be validated with sufficient authority to ensure prudence and facilitate alignment among multiple organizations. Where a decision has a financial impact, the DRAS approver must have the authorization to approve the decision based on OPG-STD-0017, Organizational Authority Register. At minimum, for decisions that impact (or have the potential to impact) other OPG organizations, the Stratum IV manager of that department, or their delegate, shall review and comment. It is the project manager’s accountability to ensure this happens. Any DRAS that results in a change of scope to the project must be submitted to the appropriate project review board/committee for authorization prior to approval. Any employee can initiate a decision in the RMO tool provided it is supported by an approved DRAS.



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To the extent possible when preparing funding approval packages, the practice of documenting decisions is encouraged. The objective when preparing the cost and schedule estimates is to formally document decisions to support the project basis. A summary of the decisions made and recorded in RMO in the development of the project plan shall accompany the gate or funding approval package in the form of a narrative in *N-FORM-11652, Nuclear Projects Risk Management Input Assessment*. Good practice would be to establish periodic reviews of the RMO decisions log for any new decisions made that may impact the subject project and following up on any impacts if required.

Owners of the decisions recorded in the RMO tool shall review these decisions quarterly and update the project risk register as appropriate. Decisions that impact multiple organizations shall be broadly communicated by the decision owner in order to bring awareness to those affected departments or projects.

## 4.0 RISK MANAGEMENT

Project managers are accountable to apply the risk management (RM) practices identified in this section to their projects. The PMO Risk Department will provide tools, guidance, training, and support to the project managers.

The RM process includes the following fundamental steps:

- (a) **Planning** – defining how to conduct risk management activities for the project or program.
- (b) **Identification** – determining events that may affect the project objectives and documenting their characteristics.
- (c) **Assessment** – analyzing and prioritizing identified risks based on probability and impact (qualitative), and estimating the potential cost and schedule implications of the risks to the approved objectives if they were to occur (quantitative).
- (d) **Treatment** – determination of the most appropriate risk response to reduce threats to project objectives, or exploit opportunities to improve project performance.
- (e) **Monitoring and Control** – implementing risk response plans, monitoring identified risks, identifying new risks, and evaluating risk process effectiveness throughout the project life cycle.

### 4.1.1 Risk Management Planning

A Risk Management Plan (RMP) describes how risk management responsibilities structured and performed. Each project should prepare a standalone RMP or have a section dedicated to risk management within its Project Management Plan (PMP). Where the project is a subset of a larger program, referencing the program RMP or PMP and documenting any specific project deviations or details to the parent plan is acceptable.

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Included in RMPs are the following sections:

- **Risk Management Methodology** - defines the approach, tools, and data sources that may be used to perform risk management on the project.
- **Roles and Responsibilities** - defines the risk management leads, support personnel, and other team members including their responsibilities and accountabilities to ensure compliance with the risk management process.
- **Monitoring and Control** – definition of when and how often the risk management process will be performed, including the establishment of major risk management activities to be included in the project schedule. Monitoring and update frequencies will reflect the phase of the project life cycle (i.e. the execution phase will require a focused effort to stay on top of risks with more frequent updates).

### 4.1.2 Risk Identification

Risk identification is an iterative process because new risks may evolve or become known as the project progresses. The risk profile presented to support contingency development in a funding approval package is a “point-in-time” snapshot. Failure to perform ongoing risk management activity is negligent from a project management perspective and will result in adverse impacts to the individual project and the overall portfolio.

A number of techniques or forums may be used to identify risks. The project team and functional and external stakeholders should be involved in the process so they can develop and maintain a sense of ownership and responsibility for the risks and associated actions.

Tools and techniques to identify risks include, but are not limited to:

- (a) Facilitated workshops
- (b) Structured Interviews with experienced project team members, stakeholders and SMEs.
- (c) Project Definition Rating Index (PDRI) Workshops
- (d) OPEX and Lessons Learned Review
- (e) Basis of Estimate (BOE) Review; review of assumptions and constraints in the BOE can be used as a source for risk identification.
- (f) Project Schedule Review; review of near critical, critical path and schedule float in schedule assumptions can be used as a source for risk identification.
- (g) Review of a standard risk breakdown structure for potential risks (Refer to Appendix C)

#### 4.1.2.1 Common Pitfalls in Risk Identification

There are five common pitfalls in risk identification that leads to inefficiencies in managing risks:

- (a) Identifying Risk Without Clear Project Objectives

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Effective risk identification requires a high quality project plan with clearly defined cost, schedule, quality, and safety objectives. Without this, one cannot effectively identify risk to these objectives and items raised will be based in speculation and not facts. This can lead to initiating actions too early, team confusion, and create a perception that risk management is not an effective use of time or resources.

#### (b) The Presumption of Failure

Too often project and functional managers submit project plans (scope, cost, schedule, resources) for approval that they do not believe are reasonable and achievable. Further, a large risk register may be viewed as a means to indicate to the approval board that the project "is not easy" or has been unsuccessful in the past. This presumption of failure creates too many risks to effectively manage and a lack of clear prioritization for the team. A project risk register is not a repository to capture known shortcomings of an underdeveloped project plan.

#### (c) Identifying Issues as Risks

Issues are events that have 100% probability of occurring, or have occurred already and require resolution. As such, these are not preventable risk events but rather issues that should be addressed. Identifying issues as risks may distract the project managers and prevent them from focusing on the adverse impacts that are truly preventable.

#### (d) Business-as-Usual Risks

Events that will be addressed in the normal course of conducting work are termed Business-as-Usual items. These are items that have a process, plan or organization in place to address them, but the concern is that the execution may be "less than adequate". Examples of poor use of Business-as-Usual risks include:

- "Project Managers may not meet milestones".
- "Oversight plan may not provide complete details to provide guidance for oversight."

In general, in order to be a risk there has to be impact to the objectives of the project plan. Business as usual items may truly present a risk to the project but the cause and the impact must be clearly identified in the risk description in order to be effectively managed.

#### (e) Vague or Misleading Risk Titles and Risk Descriptions

Risk titles that are vague or misleading may result in response plans that do not address the real risk that the project is facing.

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#### 4.1.2.2 Risk Titles

Risk titles describe the event and the context of the event.

**“There is a risk of insufficient welders available <event> to support Execution <context>”**

#### 4.1.2.3 Risk Descriptions

Risk descriptions should be comprised of the risk **event**, the **cause** of the event, and the **impact** of the event on project objectives. The absence of any one of these critical items would preclude the item from being added to the risk register due to the inability to define a proper risk treatment.

**“There is a risk of insufficient welders available <event> to support Execution due to competition with other large industrial projects in the province <cause>, resulting in a delay that will impact the critical path by 30 days <impact>”.**

#### 4.1.2.4 Opportunities

An opportunity is an event that, if it is implemented or occurs, increases the likelihood of achieving project objectives. An opportunity must demonstrate a clear benefit to achieving a project objective *in sufficient magnitude to offset the risk presented by changing course*. Opportunities identified in the SharePoint log “Opportunities Inbox” will be reviewed periodically by the PMO risk department and reported in the Risk Oversight Committee meetings for further consideration. In all instances where opportunities are identified as valid, they are to be pursued with focus (i.e. exploited to the extent possible).

### 4.1.3 Risk Assessment

#### 4.1.3.1 Risk Register

A project risk register is a living repository of risks and is the project manager’s tool for identifying, assessing, monitoring, and updating project and program risks. The RMO tool contains the risk registers for all nuclear Projects – it is the working tool and also provides storage and backup of all risks and the associated logs. Risks included in the risk register should include **all project life cycle risks** that can be properly defined, without speculation, bias, or other such features identified in section 4.2.1.

#### 4.1.3.2 Qualitative Scoring of Risks

Qualitative risk scores assist those inside and outside project team in quickly determining the biggest risks to the project. A “heat map” scoring approach is taken based on the probability of occurrence, schedule impact and financial impact of a risk (refer to Figure 2). After the probability, financial impact and schedule impact scores are determined the risk score is calculated by multiplying the probability score with the financial or schedule score, whichever is highest. The heat map scoring is standard for probability and schedule impact, but scaled to four categories for cost assessment criteria based on magnitude of the project and financial impact of the risk. This scaled

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approach allows all project managers to qualitatively assess and prioritize risks to their project, with the understanding that a high risk to a \$500K project is not as impactful as high risk to a \$100M refurbishment project that has the same score.

Impact Score	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
RED = Major Risks YELLOW=Significant Risks GREEN = Minor Risks		1	2	3	4	5
		Probability Score				

**Figure 2: Generic Heat Map identifying the potential qualitative risk scores for Nuclear Projects**

Refer to Appendix D for the risk assessment criteria/scale and guidelines for how to use the heat map.

### 4.1.3.3 Urgency

Urgency is another qualitative risk measure that assists project managers in prioritization. In the RMO, an urgency score shall be applied for each risk. The measure of urgency for risks in Nuclear Projects is as defined below:

Urgency Score	Approximate Timeline for risk response	Urgency Assessment Criteria
1	> 1yr	Risk treatment activities complete or risk not required to be addressed for the foreseeable future
2	6 months – 1 yr	Risk can be addressed in the long term and risk treatment will still be effective
3	1-6 months	Risk should be addressed in the midterm for risk treatment to be effective
4	Within 1 month	Risk must be addressed immediately for the risk treatment to be effective

### 4.1.3.4 Quantitative Risk Analysis

Quantitative risk analysis is the process of assigning a dollar value to the effect of identified risks on overall project objectives. Quantitative risk analysis is performed on risks that have a significant qualitative residual risk score and require contingency funding. Not all risks qualitatively scored and managed per this process will require contingency (refer to Section 5.1 for guidelines). Wherever possible, the estimating

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group should be engaged in supporting the determination of the cost impact of a risk to the project plan. If the quantification of risk exceeds the cost benefit argument for the project, the viability of the project should be revalidated.

#### 4.1.4 Risk Treatment

Risk treatment requires effort to develop a plan to minimize the risk and implement response actions where appropriate. All risks in the risk register should have one of the following risk responses:

- **Avoid** – Obtain information to better define the risk source, eliminating the risk entirely. In this case the residual risk score should be reduced compared to the current risk score to reflect the level of confidence in the ability to avoid this risk.
- **Transfer** – Shifting some or all negative impacts of a threat to a third party (e.g. to a contractor via contract terms and conditions). If this response is chosen, the risk owner is still accountable to manage this risk on an ongoing basis. In this case the residual risk score should be less than the current risk score due to the consequence of the risk being transferred to a third party.
- **Mitigate** – Take actions to reduce the probability and/or impact of an adverse risk event to be within acceptable limits. In this case the residual risk score should be less than the current risk score due to mitigation actions being taken.
- **Accept** – Take no action and accept the possibility that the risk could occur. In this case the residual risk should reflect the current risk score, because nothing is being done to reduce the risk. Accepting risk may result in significant cost impacts, as such the risk owner is required to gain the endorsement of the responsible project director prior to selecting this response.
- **Monitor** – Periodically assess the risk through the normal course of project execution until, a) clear mitigating actions are identified, or b) a more appropriate risk response is identified. In this case the residual risk should reflect the current risk score, because nothing is actively being done to reduce the risk.

An informal cost-benefit analysis may be performed to evaluate the appropriateness of the risk response. For example, if the cost to mitigate the risk is greater than accepting the probability and the impact of the risk “as-is”, then the risk response should be “Accept” and not “Mitigate”.

##### 4.1.4.1 Evaluating the Effectiveness of Risk Responses

All risks in the risk register should have three risk scores:

- Pre-Response Risk Score** – the score assuming that the risk will be accepted. This is a one-time assessment at the “point of discovery” of the risk.
- Post-Response Risk Score** – the score of the residual risk assuming the risk response is completed successfully. This score is subjective and based on the confidence level of the risk owner in the effectiveness of their risk response. This post response score is a gauge of how manageable the risk owner believes the risk is.

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- (c) **Current Risk Score** – the score reflecting the current status of the risk. This is the primary measure of risk exposure for the purpose of planning and risk metrics/response analysis.

## 4.2 Risk Monitoring and Control

### 4.2.1 Risk Reviews

The risk owner identified in the RMO tool has complete accountability for the content of their risks in the tool and for the implementation regular reviews of these risks. This is true even if they have delegated their authority to update or manage the risk to others. Each risk owner shall perform, at minimum, monthly risk reviews to:

- Ensure risk responses are optimal based on the latest information;
- Ensure mitigation actions are on track and status the actions in the actions log in the RMO tool and initiate new actions were warranted;
- Determine if the assumptions related to the risks are still valid and update in the Assumptions log in the RMO tool, if applicable;
- Determine if the risk characteristics have changed;
- Determine if new risks should be identified;
- Determine if risk has been realized or has expired and can be closed in the RMO Tool (with justification).
- Assess, modify and validate the risk score and any other applicable fields (such as owner, comments, etc.) in the risk register as required.

### 4.2.2 Risk Reporting

Risk reporting is performed in line with monthly or quarterly reporting cycles. The content of risk reports can be taken directly from the RMO Tool using the Business Intelligence (BI) report engine. For senior management and external stakeholder reporting, the PMO risk department may make the the risk wording in the RMO tool more concise to align with the level of detail required in the specific reporting vehicle.

Examples of reporting vehicles for risk include:

- Risk Dashboard
- Key Risk Area Summary Report
- Program Reports
- Quad Charts
- NOC ( Nuclear Oversight Committee) Reports
- Quarterly ERM (Enterprise Risk Management) Reports
- User Reports (“boxed” reports) from BI

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### 4.2.3 Risk Metrics

In order to assess the effectiveness RM in Nuclear Projects, the PMO risk department will prepare metrics. The Risk Dashboard will contain the primary metrics that will identify trends and allow comparisons of risk across the projects, functions, and Nuclear Projects as a whole. As risk management is a qualitative measure, with no focus on achieving a quantitative “target”, metrics prepared shall be geared towards process compliance only. As the risk management practice in Nuclear Projects evolves and matures, additional metrics may be introduced.

### 4.2.4 Key Risk Areas

Key Risk Areas are used to group risks from different projects which may impact major, overarching Nuclear Projects objectives. Each Key Risk Area is assigned a senior management sponsor who is responsible for providing oversight of the Key Risk Area to ensure that it is effectively being managed as a whole. Key Risk Areas are intended to provide a cross-cutting look at high level risk areas which need increased visibility and attention within Nuclear Projects. It is important to note that not all risks in the RMO Tool need to be categorized under a Key Risk Area.

The Sponsor of a Key Risk Area is required to champion the risk management process to ensure that, as an aggregate, the Key Risk Area is being addressed **efficiently** and **effectively** in order to minimize impact on NR objectives. It is expected that the Key Risk Area Sponsor is:

- **Knowledgeable of** and **able to communicate** the general “health” and status of the Key Risk Area at the R-ROC and in other major communication vehicles, as required.
- **Proactive in initiating change in their Key Risk Area** to improve the efficiency and effectiveness of the NR response.
- **Available to provide the strategy/rationale** for the requested change to the individual risk owners, when required.
- **Rigorous in follow up** to ensure sponsor directives have been implemented.

## 5.0 RISK MANAGEMENT OUPUTS

Effectively managing the outcomes of realized risks is critical to recovering project objectives. Ineffectively managing realized risks can create a snowball effect where distractions result in loss of focus on the remaining risks leading to their eventual impact on the project.

### 5.1 Contingency

Contingency is a tool to manage uncertainty and risk throughout the life of a project. The contingency reserve should be proportional to the project size, duration, complexity, risk exposure and tolerance, prior experience with the work, and



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confidence levels set by management. ***Contingency is not a tool to compensate for an underdeveloped project plan.***

Contingency covers the *known unknowns* in a project. Specifically, these are the uncertainties associated with a schedule and cost estimate, as well as the discrete risk events that impact the objectives defined by these fundamental products. Any contingency development exercise requires a high quality, vetted estimate and schedule. Without a high quality project plan, one cannot effectively identify risks or the level of uncertainty. Without a high quality risk register and well understood uncertainty profile, one cannot effectively calculate an appropriate contingency estimate. It is the expectation that the project plan presented for contingency analysis is reasonable and achievable and endorsed by necessary stakeholders during its development.

The PMO risk department will work with the project managers to develop an appropriate project contingency estimate. Contingency should be calculated in advance of submitting the funding approval package to the approving board/committee but after the development of the cost and schedule estimate. Once approved, ongoing contingency adequacy reviews should be performed through the PMO risk department in line with Section 5.1.5.

Management Reserve (MR) is an amount of the project's calculated contingency withheld for management control purposes.

### 5.1.1 Discrete Risks

Risk events have cost, schedule, quality, or safety impacts, all of which can be characterized into potential financial consequences.

The cost score should indicate the direct cost impacts resulting from the realization of the risk exclusive of time dependent costs. Using three point estimates to establish ranges of possible outcomes for risks, the impact of the discrete risks can be modelled in a Monte Carlo simulation to estimate the amount of contingency required to address these specific events.

The schedule score identified on the risk register indicates the impact to a project's critical path, usually expressed in "days" and easily translated to dollars based on burn rates. This approach to schedule contingency (i.e. burn rate x days delay) is high level approach and is less precise than range analysis on a CPM schedule, which is the preferred method. This approach uses a Monte Carlo methodology and assigns three point estimates to critical path project activities considering the risks identified.

### 5.1.2 Cost Estimate Uncertainty

Cost estimate uncertainty is a function of estimate class and is an implicit risk to project objectives. For example, a point estimate built upon conceptual design information is only assumed accurate within a very broad range and may have many potential outcomes. Uncertainty in estimates is expected to decrease over time as the project definition improves and the project matures. Appendix E Table 1 identifies the ranges of uncertainty associated with estimate class definition as defined by AACE.

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The determination of the size of the contingency fund must take into the account the estimate accuracy and project phase.

Cost growth areas typically covered by estimating uncertainty contingency are more general than those covered by discrete risks, and include items such as:

- Minor errors in omissions in the estimating process (e.g. precise quantity is only known during execution)
- Variability of productivity (e.g. estimating based on execution in the summer, but actually executed in the winter)
- Variability in wages (e.g. labour agreements expiring during execution)
- Variability in prices (e.g. material prices assumed)

Effort must be made to ensure the factors covered by cost estimating uncertainty are not duplicated in the project risk register. Using three point estimates, the impact of the cost estimate uncertainty can be modelled in a Monte Carlo simulation to estimate the amount of contingency required to address these events.

Estimate uncertainty does not capture variability in scope.

#### 5.1.3 Risk Tolerance and Confidence Levels

Risk tolerance is the degree, amount, or volume of risk that an organization is willing to accept. Nuclear Projects risk tolerance is informed by a number of contributors including the experience and instinct of the project management team, past performance of similar projects, and stochastic methods.

In stochastic risk analysis, it is often expressed in a percentage value called a confidence level. For example, a P50 value on a Monte Carlo contingency estimate means that a project manager can be 50% confident that the contingency allocated is sufficient to address the risks and uncertainties defined for the project.

In managing a portfolio or program of projects, the concept of confidence levels can be useful in managing contingency funds. For example, for a given project's contingency analysis, the following structure could be employed to support the approval authority of contingency funding. This is for illustrative purposes and may be applied differently for different funding streams and risk tolerances within the Nuclear Projects organization.

Contingency \$ at Confidence Level	Up to P50 (Current Phase Risks and Uncertainties)	Up to P50 (Future Phase Risks and Uncertainties)	P50 → P70 (All Risks and Uncertainties)	P70 → P90 (All Risks and Uncertainties)
Treatment Upon Project Approval to Proceed	Released to Project	Allocated to Project but not Released	Allocated to Project but not Released to	Allocated to Management Reserves

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		to Project	Project	
<b>Authorization for Release to Project</b>	N/A	VP Nuclear Projects	VP Nuclear Projects	SVP Nuclear Projects

Table 1: Example of how contingency developed for a specific project feeds into portfolio or program management

### 5.1.4 Probabilistic Analysis of Uncertainties

Monte Carlo simulation is a form of probabilistic analysis. It is a method to predict the impact of defined risks and uncertainties using project simulations. Gathering the three point estimates required for the Monte Carlo method can be quick and simple or rigorous, and should be commensurate to the overall magnitude or cost of the project. For example, small projects can use the projects manager's judgment for inputs but large projects should be done with rigor and inputs from knowledgeable personnel. Poor quality inputs to the Monte Carlo (including choosing a misrepresentative probability distribution, or omissions of key risks) will produce misleading results – "garbage in, garbage out".

The PMO risk department will perform the Monte Carlo analysis for risk and uncertainty inputs defined by the project manager. All contingency requests in support of funding approval packages are required to have a supporting Monte Carlo analysis, unless an exception is approved by the Director of the executing Nuclear Projects organization.

The general steps to executing the Monte Carlo contingency analysis are as follows. The PMO risk department can help provide direction and guidance to project teams where required:

- Confirm the basis of analysis. The project scope, schedule, and estimate should be well defined/finalized with minimal anticipated changes.
- Conduct risk screening to determine which risks are warranted to have contingency allocated against them. Not all risks are suitable for contingency allocation. Appendix E Table 2 provides a guideline on how risk screening should be conducted.
- Gather inputs for probabilistic analysis. This involves obtaining three point estimates (Most Likely, Optimistic, and Pessimistic) for residual risk impacts, cost uncertainty, and the logic tied critical path schedule activities.
- Run Monte Carlo simulations using software and analyze the results. Results will be presented as S-Curves or in other tabular forms/reports generated from the Monte Carlo tool.
- Determine the size of contingency required for the determined level of confidence.
- Reassess the inputs if required based on the outcome of the analysis and iterate steps (a) through (e).

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### 5.1.5 Monte Carlo Analysis - Limitations

Monte Carlo project predicts the impact of the identified risks and uncertainties by running simulations to identify the possible outcomes of the project. This technique helps in forecasting the likely outcome of a project, thereby helping decision makers and project managers in make informed decisions.

***Monte Carlo contingency analysis is not intelligent. It will not compensate for omissions or errors in the risk registers or estimates that are submitted for analysis. The output of a Monte Carlo considers only those risks and uncertainties the project manager has identified as an input to the process.***

### 5.1.6 Contingency Adequacy Review

The owner of contingent funds should re-evaluate the amount of contingent funds required as the project progresses. Contingency funds defined in funding approval packages are “point-in-time” estimates that reflect the project risk profile in that instance. As the project progresses, risks will be retired and new risks will emerge. It is critical that the contingency estimate is updated to reflect this and maximize the organization’s flexibility in managing these funds.

Contingency reviews should be conducted at the following checkpoints:

- (a) Gate submission, including gate refreshes; BCS submission or superseding BCS submission
- (b) Upon initiation of the project change control process;
- (c) Release planning;
- (d) Risk realization, especially a risk with high demands for funds;
- (e) Unexpected event requiring high demands for funds;
- (f) Significant change in the risk register;
- (g) Significant deviation from the planned usage of contingency
- (h) Alongside regular cost forecasting as defined by the PMO cost control department.

Note that the contingency adequacy review (or contingency assessment during normal forecasting activity) may reveal that there is too much contingency or not enough contingency allocated to the project. The project manager should return contingent funds that are no longer required via change control. If additional funds beyond what has been approved at the gate or release are required, then the function manager or project manager should request additional funds via change control process.

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### 5.1.7 Refurbishment Contingency Development

All projects being executed within the Nuclear Projects organization, including refurbishment projects, are required to comply with this manual. However, for Nuclear Refurbishment, a white paper will prepared for each release period detailing how the contingency estimate is assembled. This white paper will be governed by this manual but will contain sufficient detail and additional considerations commensurate to the magnitude of the project.

### 5.2 Internal Lessons Learned

Internal lessons learned (ILL) are valuable because they ***provide real time, directly applicable experiences that other project managers can use when establishing their project plans***. ILL usually take the form of detailed reports prepared upon project completion as defined in the modifications process. While this is valuable the objective of the ILL process is to share lessons both large and small in an effective way with minimal administration. Management and documentation of ILL is conducted electronically in the RMO Lessons Learned library.

ILL entries can be generated by Nuclear Projects staff for the purposes of sharing non-confidential OPEX and Lessons Learned from their department, project, a specific task, pre-post job debriefings, oversight activity, benchmarking trips, meetings, human performance observations or any other source.

#### 5.2.1 Project Manager Direction

All project managers shall proactively document important lessons learned throughout the project life cycle to support improved project performance within the Nuclear Projects organization. Project managers will notify the PMO risk department to ensure lessons are documented and disseminated properly to increase awareness among the Nuclear Projects organization and improve management decision making.

#### PMO Role

The PMO Risk Department actively solicits real-time feedback on ILL throughout the organization, ensures accessibility to all members of the project and ensures standards, quality and completeness is accomplished. PMO Risk Department will provide simple templates for the project management team and prepare communication products (reports, emails, articles) for dissemination to the Nuclear Projects organization and its vendors.

### 5.3 Issues Resulting from Realized Risks

An issue is defined as ***a point or matter in question or in dispute***. For projects, issues that arise usually surface gaps that must be addressed in order to achieve project safety, quality cost, and schedule objectives. Project issues can occur when risks are realized, assumptions made during the development of the project plan are

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proven to be invalid, or as the result of project authorization to proceed at risk with an underdeveloped plan.

Issues ***are not the normal challenges encountered in the progression of project planning and execution.*** Similar to risks, issues generated from realized risks – as defined in this manual - must demonstrate the potential to impact approved project objectives.

### 5.3.1 Project Manager Direction

Management of issues resulting from realized risks have one of two outcomes:

- A recovery plan is prepared and implemented with the target of achieving the approved plan, or
- The issue cannot be recovered and impacts the ability to execute the approved plan, resulting in a need to modify the plan (i.e. move milestones, increase costs beyond contingency).

When an issue of this type arises a Station Condition Record (SCR) shall be raised to document the issue as an adverse condition. In most cases this SCR will be trended D4 and closed out to recovery actions input to the RMO action log or to the change control process, as appropriate, wherein the issue will be managed to closure. Any actions generated in the RMO action log associated with an issue of this type shall reference the SCR. As defined by the requirements of the SCR process, and depending on the severity of the issue, actions inside the SCR process may be required. In this scenario, the actions do not need to be duplicated in the RMO actions log.

The project manager, depending on the severity and possibility of repeat occurrence, shall work with the PMO risk department to generate an internal lesson learned for distribution by the PMO.

## 5.4 Actions

Project actions not included in an existing managed system (project schedule, business plan, action tracking, etc.) will be documented and managed in the RMO action log. This action log can take the place of Microsoft excel or word files that project managers may be using to track actions.

Nuclear Projects action sources should be diverse and comprehensive and may include, but are not limited to, meeting actions, audit response actions, actions to mitigate risks, actions to validate assumptions, actions arising from assumptions, decisions, issues, oversight, OPEX and lessons learned implementation actions. Actions that are part of the normal course of executing project work such as day to day individual accountabilities and “business as usual” actions should not be included in the log.

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### 5.4.1 Reporting

User reports can be generated by anyone at any point in time. These online business intelligence (BI) reports may be communicated from time to time in meetings or other forums. PMO risk department will administer these reports and facilitate project team access to them, in real time. Change to reports will occur from time to time as required.

## 6.0 ROLES AND ACCOUNTABILITIES

### 6.1.1 Senior Vice President and Vice Presidents in Nuclear Projects

Champion the risk management process in Nuclear Projects.

### 6.1.2 Project Managers and Directors

Apply this manual to all projects being executed by the Nuclear Projects organization.

### 6.1.3 Project Team

Support project managers and directors through application of this manual.

### 6.1.4 PMO Risk Department

Support project team members in the application of this manual and the RMO tool. Maintain this manual and provide guidance, training, and support to project teams. Support Nuclear Projects executives by providing oversight and reporting of the risk management program in Nuclear Projects.

## 7.0 ACRONYMS

<b>AACE</b>	Association for the Advancement of Cost Engineering
<b>BOE</b>	Basis of Estimate
<b>CARB</b>	Corrective Action Review Board
<b>CCF</b>	Change Control Form
<b>CII</b>	Construction Industry Institute
<b>COG</b>	CANDU Owners Groups
<b>DRAS</b>	Decision Record and Analysis Summary
<b>ERM</b>	Enterprise Risk Management Team
<b>LL</b>	Lessons Learned
<b>MR</b>	Management Reserve
<b>NOC</b>	Nuclear Oversight Committee
<b>NR</b>	Nuclear Refurbishment
<b>OAR</b>	Organizational Authority Register

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### NUCLEAR PROJECTS RISK MANAGEMENT

<b>OPEX</b>	Operating Experience
<b>OPGN</b>	Ontario Power Generation Nuclear
<b>PDRI</b>	Project Definition Rating Index
<b>PMO</b>	Project Management Office
<b>RBS</b>	Risk Breakdown Structure
<b>RM</b>	Risk Management
<b>RMO</b>	Risk Management and Oversight Tool
<b>RMP</b>	Risk Management Plan
<b>SCR</b>	Station Condition Record
<b>SME</b>	Subject Matter Expert
<b>SRB</b>	Scope Review Board
<b>WBS</b>	Work Breakdown Structure

## 8.0 RECORDS AND REFERENCES

### 8.1 Governing Documents

Any controlled documents which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0003, Controlled Document Management.

Any records which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0042, Quality Assurance Records.

The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (Asset Suite Type/ Sub-Type)
Risk Input Assessment Form	N-FORM-11652	N	Not required to file. Template for RMO Tool, submit with package to Risk Management group. Form to be destroyed after update or RMO database.
Decision Record and Analysis Summary Form	N-FORM-11390	N	File in Asset Suite, Records Management Module, completed form will be linked and confidential as auto generator number as NK38-LIST-09701-XXXXX RRC NO2-0049 Retention: 10 years after completion of the overall Refurbishment program.

A final report, detailing projects Nuclear Refurbishment Risks, Actions, Issues, Decisions, Assumptions, OPEX and Lessons Learned located today in the Risk Management and Oversight (RMO) tool will be sent to Records, retention as above, during project close phase.



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## 8.2 References

### 8.2.1 Performance References

N-GUID-09701-10123 Risk Management and Oversight Tool

N-FORM-11390 Decision Record and Analysis Summary Form

N-FORM-11652 Project Risk Input Assessment

### 8.2.2 Developmental References

- WANO-GL 2003-01, Guidelines for Operating Experience at Nuclear Power Plants
- NK38-REF-09701-0535862 Nuclear Refurbishment Opex\lesson Learned Program Strategic Plan
- N-STD-AS-0028, Project Management Standard
- N-PROC-RA-0035, Operating Experience Process
- N-PROC-RA-0022, the Station Condition Record (SCR)
- N-PROC-AS-0003, Controlled Document Management
- N-GUID-04947.02-10000, External Events Screening Guide
- OPG-STD-0017 , Organizational Authority Register
- OPG-PROC-0094 , Enterprise Risk Management Process
- Construction Industry Institute. Applying Probabilistic Risk Management in Design and Construction Projects. Implementation Resource 280-2. June 2012.
- Project Management Institute. Project Management Body of Knowledge (PMBOK Guide), Fourth Edition. 2008

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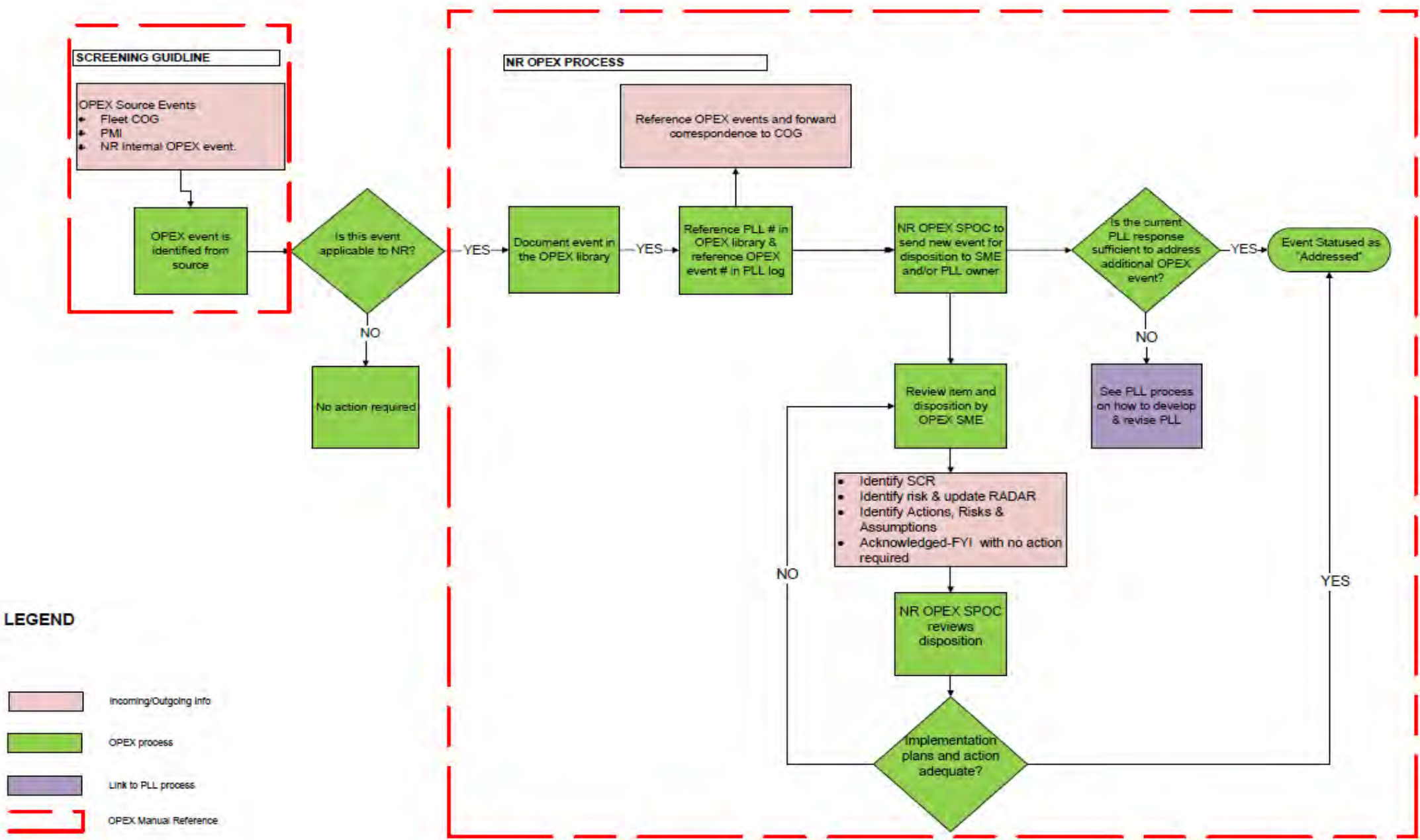
### Appendix A: OPEX and Lessons Learned Resources

The following are OPEX and Lessons Learned resources available for use by all NR employees. Please contact your SME or the NR OPEX SPOC for assistance to setup newsfeeds or alerts.

- **CANDU Owners Group Weekly Screening Meeting (COG WSM)**
  - COG OPEX Database, COG Newsgroups and COG Publications
  - Station Condition Records (SCRs) database
  - World Association of Nuclear Operators (WANO)
  - Institute of Nuclear Power Operators (INPO)
  - International Atomic Energy Agency (IAEA)
  - Electric Power Research Institute (EPRI)
  - Safety Flash Report
- **NR Internal OPEX events**
  - Risk Assessment Database and Register (RADAR)
  - OPG Self Assessment Database
- **Other Sources**
  - Project Management Institute (PMI)
  - INPO Project Management
  - Professional Journals / Newspapers
  - Lessons Learned Reports from other projects (Asset Suite)
  - Benchmarking visits to other stations and employees' experience with similar projects

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Appendix B: OPEX Flowchart



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Appendix C: Sample Risk Breakdown Structure

COMMERCIAL	BUSINESS PLAN	BUSINESS CASE
		FEASIBILITY
		ECONOMIC INCENTIVES / BARRIERS
		MARKET / PRODUCT
		STANDARDS / PRACTICES
		OPERATIONS
		COMPETITION
		INTEREST RATES
		TAXES / TARIFFS
CONTRACTUAL	FINANCING / FUNDING	SOURCES AND FORM OF FUNDING
		FOREIGN CURRENCY FLUCTUATIONS
CONTRACTUAL	COMMERCIAL	ESTIMATE UNCERTAINTY
		PAYMENT TERMS
		INSURANCES
		LIABILITIES
		INTELLECTUAL PROPERTY
		PERFORMANCE GUARANTEES
		FOREIGN CURRENCY FLUCTUATIONS
		CHANGE MANAGEMENT
		NOTICE REQUIREMENTS
CONTRACTUAL	PROJECT SCOPE	SCOPE DEFINITION
		TECHNOLOGY
		HAZARDOUS MATERIALS
		HEALTH & SAFETY
		UTILITIES / OFFSITES
		SITE SELECTION & CLEAR TITLE
		APPROVALS / PERMITTING
CLIENT	CLIENT	RELATIONSHIP
		CLIENT SPECIFIC REQUIREMENTS
		APPROVAL OR PRE-APPROVAL PROCESS
		PAST EXPERIENCE
		INTERFACE REQUIREMENTS INCL. PMC OR OWNERS ENGINEER
TECHNICAL	ENGINEERING & DESIGN & EXECUTION	ENGINEERING / DESIGN PROCESS
		ORGANIZATIONAL STRUCTURE
		PLANNING & PROCEDURES
		EXECUTION PLANNING
		TECHNOLOGY SELECTION
		PARTNERS
		HIGH VALUE ENGINEERING/DESIGN SERVICES (HVEC)
		HOME OFFICE SCHEDULE
		RESOURCES
		PROJECT MANAGEMENT
		CONSTRUCTABILITY

EXTERNAL	TAX / TARIFF	TARIFFS / DUTIES
		VALUE ADDED TAX
		LEGAL ENTITY ESTABLISHMENT
		APPLICATION OF TAX LAWS AND ENFORCEMENT OF CHANGES
		TECHNOLOGY TAX
		PERSONAL INCOME TAX
		CORPORATE INCOME TAX
		TAX EQUALIZATION
		CHANGE IN FISCAL / MONETARY POLICY
		MISCELLANEOUS TAX
EXTERNAL	GEOGRAPHICAL	COUNTRY / AREA
		NATURAL DISASTER
		FORCE MAJEURE
		WAR / INSURRECTION
		SOCIAL UNREST / VIOLENCE
		GOVERNMENT PARTICIPATION & CONTROL
		RELATIONSHIP WITH GOVERNMENT & OWNER
EXTERNAL	CULTURE	TRADITIONS & PRACTICES
		PUBLIC OPINION
		RELIGIOUS DIFFERENCES
EXTERNAL	LEGAL	LEGAL BASIS
		LEGAL STANDING
		GOVERNING LAW / FORMALITIES / LANGUAGE
		CONTRACT TYPE & PROCEDURES
		ENVIRONMENTAL PERMITTINGS
		CORRUPT BUSINESS PRACTICES
EXTERNAL	POLITICAL	NATIONALISM & EXPROPRIATION
		GOVERNMENT OR POLITICAL INSTABILITY
PROCUREMENT	SOURCING & SUPPLY	LOCATION / LOGISTICS / DELIVERY
		LONG LEAD EQUIPMENT (LLE) DELIVERY
		ENGINEERED EQUIPMENT PRICING
		PACKAGED EQUIPMENT SYSTEMS
		BULK MATERIALS / COMMODITY PRICING
		SUBCONTRACTORS
		IMPORTING & CUSTOMS

CONSTRUCTION	CONSTRUCTION	SAFETY DURING CONSTRUCTION
		CLIMATE
		WORKFORCE AVAILABILITY
		CONSTRUCTION PERMITTING
		CONSTRUCTION DELIVERY METHOD - SUB / DIRECT HIRE
		GENERAL CONTRACTOR AVAILABILITY
		CONTRACTOR PAYMENTS
		CONSTRUCTION SCHEDULE
		WORKFORCE LOGISTICS & SUPPORT
		COMMUNICATIONS / DATA TRANSFER
CONSTRUCTION	STARTUP	QUALITY
		TRAINED WORKFORCE
		FACILITY TURNOVER
		FEEDSTOCK & UTILITIES
PRODUCTION/ OPERATIONS	PEOPLE	OPERATIONAL SAFETY
		SECURITY
		LANGUAGE
		HIRING / RETAINAGE
PRODUCTION/ OPERATIONS	LEGAL	GOVERNING LAW / OPERATIONAL LIABILITY
		PERMITTING
		INSURANCE
		EXPORTS
		ENVIRONMENTAL COMPLIANCE
PRODUCTION/ OPERATIONS	TECHNICAL	LOGISTICS & WAREHOUSING
		SUPPLY CHAIN
		DATA SECURITY
		RELIABILITY
		FACILITY MANAGEMENT
PRODUCTION/ OPERATIONS	MAINTENANCE	INFRASTRUCTURE SUPPORT
		TECHNICAL SUPPORT
		QA/QC
		OPERATIONAL SHUTDOWNS

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**Appendix D: Program and Functional Risk Assessment Criteria/Scale**

Nuclear Projects Risk Assessments Scale							
Risk Attribute	Definition	1 (Minimal)	2 (Minor)	3 (Notable)	4 (Substantial)	5 (Major)	
Probability	The probability that a risk will occur	<20%	20%-40%	40%-60%	60%-80%	>80%	
Schedule Impact	The impact that a risk would have on the project critical path	No Delay	< 1 Week	1-2 Weeks	2-6 Weeks	>6 weeks	
Financial Impact							
Refurbishment	Program (Functions)	Financial consequences of a risk should it occur	<\$50M	\$50M-\$100M	\$100M-\$200M	\$200M-\$400M	>\$400M
	Projects (Bundles)		<\$1M	\$1M-\$10M	\$10M-\$50M	\$50M-\$200M	>\$200M
AISC Projects	<\$1M	Financial consequences of a risk should it occur	<\$50K	\$50K-\$100K	\$100K-\$300K	\$300K-\$500K	>\$500K
	\$1M - \$5M		<\$200K	\$200K-\$500K	\$500K-\$1M	\$1M-\$2M	>\$2M
	\$5M - \$10M		<\$400K	\$400K-\$1M	\$1M-\$2M	\$2M-\$4M	>\$4M
	\$10M - \$20M		<\$700K	\$700K-\$2M	\$2M-\$4M	\$4M-\$8M	>\$8M
	>\$20M		<\$2M	\$2M-\$5M	\$5M-\$10M	\$10M-\$20M	>\$20M

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**Appendix E: AACE Estimate Class and Expected Accuracy Ranges**

Table 1 - AACE Estimate Class and Expected Accuracy Ranges

ESTIMATE CLASS	Primary Characteristic	Secondary Characteristic		
	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges <sup>[a]</sup>
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Notes: [a] The state of process technology, availability of applicable reference cost data, and many other risks affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

Figure E-1: AACE Estimate Class and Expected Accuracy Ranges

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**Table E-2 - Optimal Response based on Risk Probability and Impact**

Quadrant	Description	Optimal Response	Contingent Funds Assignment?
Low Impact, Low Probability	<ul style="list-style-type: none"> <li>Essentially negligible</li> <li>In the unlikely condition that it does arise it should be possible to deal with it simply and with minimal impact</li> </ul>	<ul style="list-style-type: none"> <li>Monitored to determine that the impact or likelihood does not increase</li> </ul>	No
High Impact, High Probability	<ul style="list-style-type: none"> <li>Management should determine if project should proceed or if the benefits of taking the risks is justified</li> </ul>	<ul style="list-style-type: none"> <li>Budget for mitigating actions in the project scope to lower the probability and impact of the risk</li> </ul>	Yes – for the residual risk post-mitigation
Low Impact, High Probability	<ul style="list-style-type: none"> <li>Uncertainties from common sources in a project (e.g. cost of labour, materials, actual duration of activities, productivity, etc.)</li> <li>Each of these uncertainties alone would have little impact, but the cumulative effects may have impact</li> </ul>	<ul style="list-style-type: none"> <li>Reduce uncertainties in estimates by obtaining additional information or improving work processes</li> <li>Budget for mitigating actions in the project scope to lower the probability and impact of the risk, if reasonable to do so</li> </ul>	Yes – for the residual risk post-mitigation
High Impact, Low Probability	<ul style="list-style-type: none"> <li>Rare occurrences</li> <li>Difficult to assign probabilities based on past events</li> <li>Cannot be effectively funded by contingency, especially if maximum impact is realized</li> </ul>	<ul style="list-style-type: none"> <li>Budget for mitigating actions in the project scope to lower the probability and impact of the risk, if reasonable to do so</li> </ul>	Case-by-case basis. If yes, should be covered by Management Reserve



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## NUCLEAR PROJECTS RISK MANAGEMENT

### Appendix F: Outputs of the Monte Carlo Method

Several standard outputs are available to provide project managers with insights to cost, and even schedule predictability in their projects. These graphical representations of results allows for robust means of communicating risk, and provides additional data to support decision making and identify the possible outcome of decisions.

Figures F-1 and F-2 are graphs depicting the results of a Monte Carlo simulation defining the probability distribution of cost and schedule outcomes based on input assumptions. This type of information is useful for understanding the expected cost/duration and the range/dispersion of the projected cost and durations.

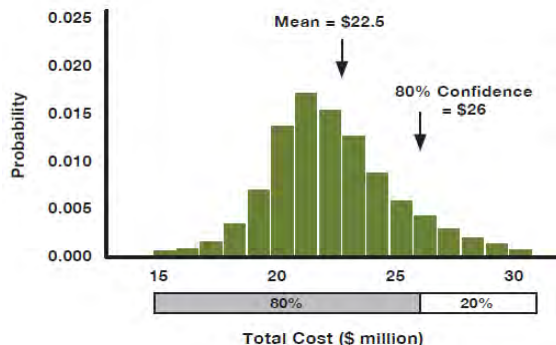


Figure F-1: Sample Probability Mass Function on Project Costs

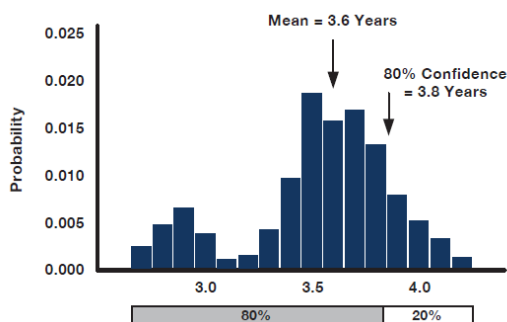


Figure F-2: Sample Probability Mass Function on Schedule Duration

### Confidence in Cost or Schedule

The cumulative probability functions shown in Figure F-3 provide the same information shown in Figure F-1, but in a cumulative manner. The cumulative functions provide a quick reference for the mean (P50) and a confidence level in the estimate or schedule.



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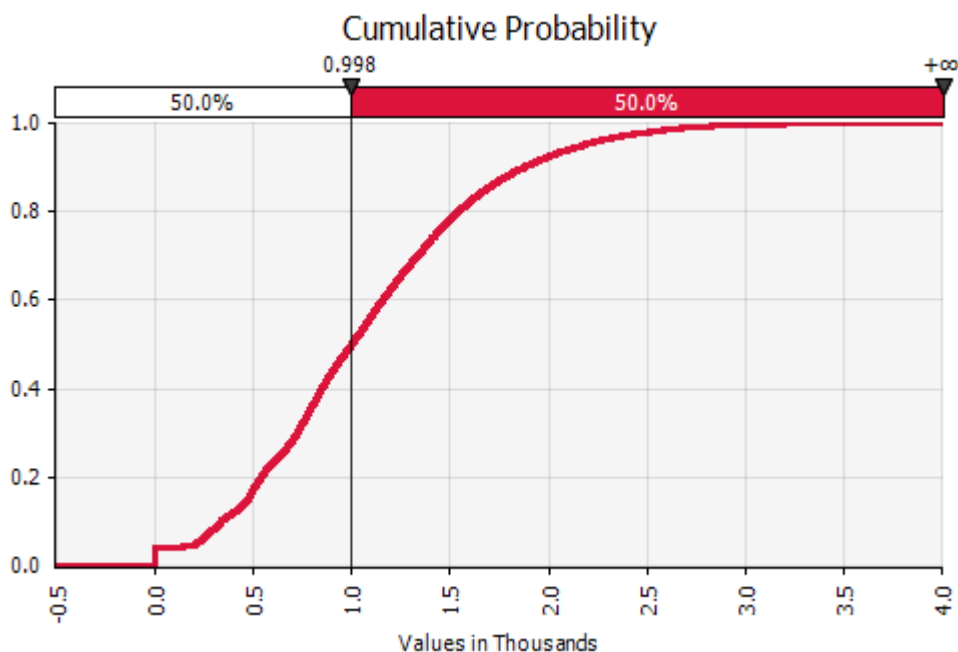


Figure F-3: Sample Cumulative Probability Function on Project Costs

### Identification of Risks with the Greatest Impact

Sensitivity analysis is a primary modelling output that can be used in the valuation of the impacts of individual risks. Figure F-4 Sample Sensitivity Analysis on Project Risks provides a sensitivity analysis in the form of a “tornado diagram”. Tornado diagrams depict the influence of individual risks and highlight the greater contributors to the overall risk. Using this information, project managers or function managers can spend more effort on mitigating the risks that has the higher impact on the success of the project/function.

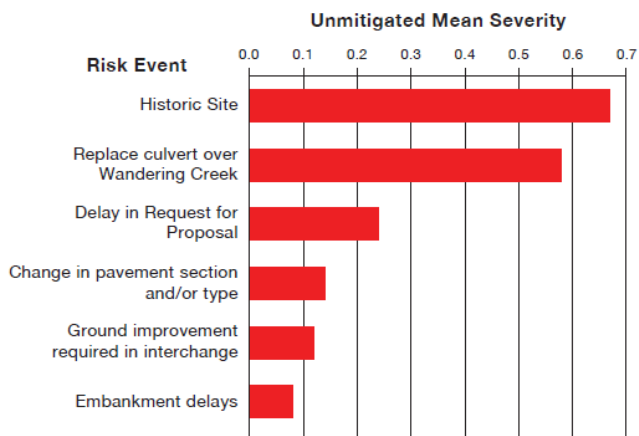


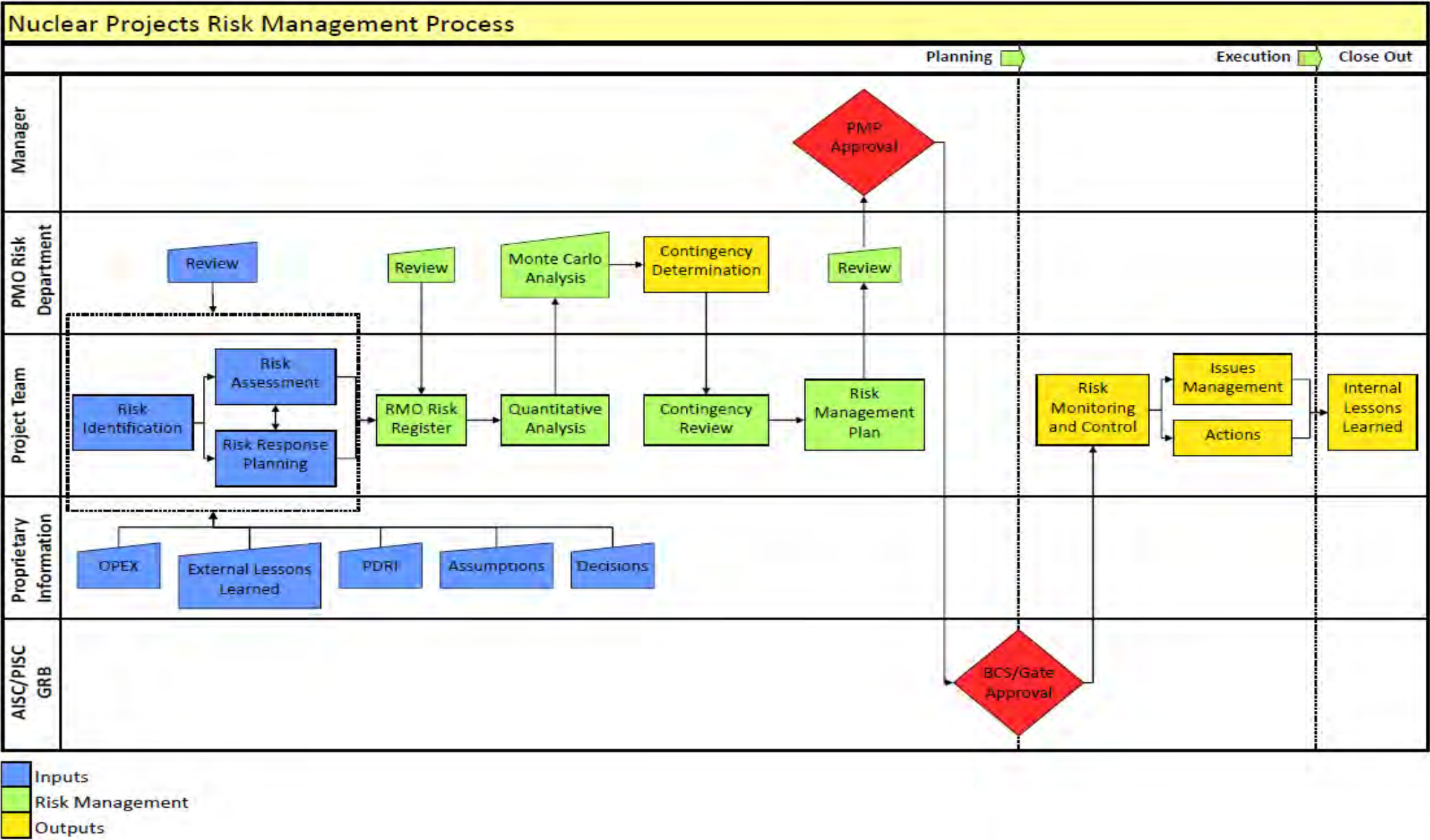
Figure F-4: Sample Sensitivity Analysis on Project Risks

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Appendix G: Risk Management Process



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### NUCLEAR PROJECTS SCHEDULE MANAGEMENT

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## Nuclear Projects Schedule Management

**N-MAN-00120-10001-SCH-R001**  
2013-05-14

Order Number: N/A  
Other Reference Number:

### Internal Use Only

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**Revision Summary**

Revision Number	Date	Comments
R001	2013-05-14	Revised to apply to all Nuclear Projects.

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### 1.0 DIRECTION

Establishing an accurate and realistic schedule is a critical planning tool for a project. The schedule is the main planning tool used to understand and communicate the status, interrelationships and dependencies among project activities and deliverables. The schedule is critical to properly strategize, plan and prepare for upcoming project work, resource requirements and corrective actions as required.

This manual outlines scheduling management principles and requirements for Nuclear Projects and is in compliance with N-STD-AS-0028, Project Management Standard. It is applicable to project teams and contractors managing OPG-N project work.

Schedules are to be developed with inputs from all stakeholders and it is an ongoing planning and monitoring process throughout the project lifecycle.

Schedule detail must be developed at an appropriate level to allow the project team to communicate the plan, monitor project progress and cost performance, and use the data to make accurate forecasts, strategize and plan upcoming work.

### 1.1 Overview

Scheduling includes:

- (a) Establishment of schedule Work Breakdown Structure (WBS) and hierarchy level requirements.
- (b) Identification of key activities including their start and finish date, duration and resources.
- (c) Activities that are deliverable based.
- (d) The sequence and logical interrelationship of activities and milestones.
- (e) Identification and optimization of the critical path.
- (f) Regular monitoring and updating to track performance, forecasting, and initiate corrective action for schedule threats.
- (g) Look ahead at planning and strategizing to identify and manage priorities, opportunities, and threats.

### 2.0 THE OVERALL PLANNING AND SCHEDULING PROCESS

The overall planning and scheduling process can be represented in two major stages:

- (a) Project Planning and Schedule Development, resulting in the formation of a Baseline Schedule

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- (b) Schedule Management, Monitoring, Analysis, Reporting, and Mitigation, resulting in regular periodic schedule updates and schedule change control management

The planning process uses a top-down approach for schedule development and a bottom-up approach for schedule management.

## **2.1 Multi level scheduling system**

The concept of multi level scheduling comes from the need to have schedules with different levels of detail to suit a specific audience and purpose. Project schedules may be prepared at up to three levels of detail; level 0 contains the lowest level of detail whereas level 3 contains much more detail.

For example, projects where most of the work will be performed by EPC contractors will utilize, at a minimum, detailed level 3 schedules. OPG acting as the owner performs project management and control utilizing level 0 to 2 schedules.

The required level of detail is also directly aligned to the phase of the project. Immediate and current phases should have schedules with greater detail (Level 3 minimum) while the schedule for the future phases will have less detail. As the project moves into subsequent phases and the scope is more defined, the required schedule detail is increased to reflect the improved scope definition. For example, a project entering the Definition phase requires a minimum level 3 for the included engineering work, but the construction and close-out work (future Execution/Close-out phases) might only be detailed at level 1 or 2. This is called Rolling Wave Planning.

## **2.2 Multi Level Scheduling for Nuclear Program**

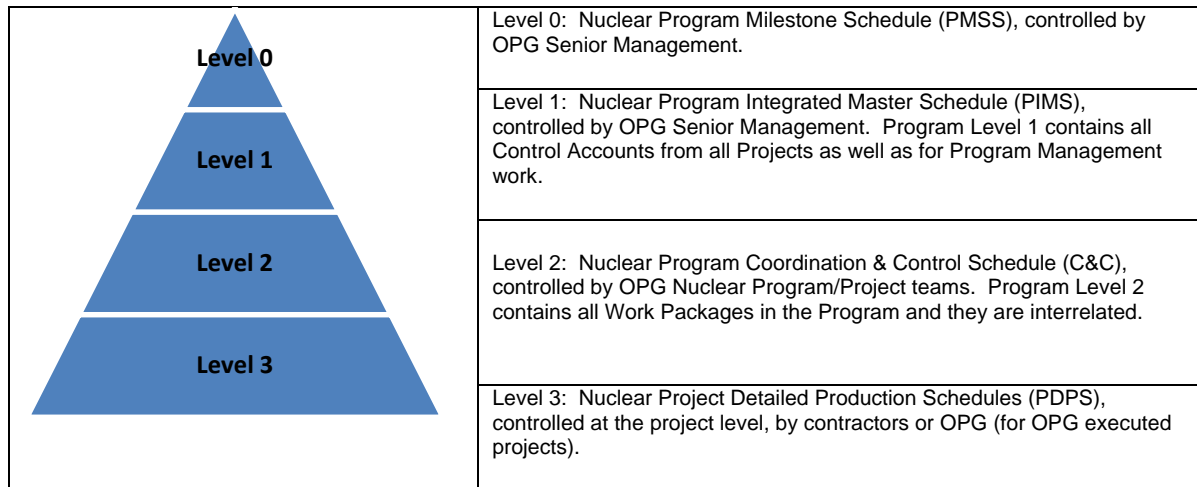
A nuclear program will generally contain multiple interrelated projects and therefore significant coordination and control is needed crossing different project teams. This integration and control is exercised through the Program Integrated Master Schedule, NK38-PLAN-00300-10000, (Program Level 1) and Program Coordination & Control Schedule (Program Level 2), whilst details are addressed by Project Level 3 Schedules that are precisely aligned with Program Level 1 and Program Level 2. Refer to Figure 1.



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**Figure 1 – Nuclear Program Multi Level Scheduling Frame**



### 2.2.1 Level 0 Schedule

Level 0 consists of the **Program/Project Milestones and Key Dates**, e.g., online outage and project contract dates and other major interface dates.

Audiences for this schedule Level include, but are not limited to client, senior executives and general managers. If included with a bid and/or the Contract, demonstrates conformance to contractual and other milestones.

### 2.2.2 Level 1 Schedule

Level 1 schedule is the **Nuclear Program/Project Integrated Master Schedules (PIMS)** that contains all Control Accounts (Level 1 Activities) in the program or project.

Control Account is not a financial term but rather a certain level of WBS element that has a particular work scope, a time window, and a responsible organization.

In nuclear programs and projects, Work Breakdown Structure, Control Accounts and Work Packages are important terms for multi level scheduling and Earned Value Management.

A standard naming nomenclature is applied to all Level 1 activities (Control Accounts).

The level 1 schedule provides a high-level management summary of the project. It will represent all Units, Phases, and Bundles.

The level 1 schedule is a summarization of the C&C (Co-ordination and Control Schedule) at the Control Account level.

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The schedule is prepared by OPG as part of the initial planning phase of the project and updated to reflect the progression of planning, i.e. as projects are better defined, the Level 2 Control and Co-ordination Schedule is updated.

Audiences for this type of schedule include, but are not limited to general managers, sponsors, and program or project managers.

### 2.2.3 Coordination and Control Schedule (C&C)

Level 2 Schedules are the ***Nuclear Program/Project Coordination & Control Schedules (C&C)***, controlled by OPG.

The C&C schedules are the major planning and scheduling documents for owner's program/project coordination and control is applied at this level.

At the C&C schedule, each Control Account is broken down to several Work Packages, such as Engineering Packages, Procurement Packages, and Construction Packages.

For a certain Nuclear Program, all C&C schedules are interrelated, and also all C&C activities have logic ties with relevant program Milestones.

The C&C schedule covers the scope of work by Phase, Unit SCI, and Type of work and contains full Critical Path Method (CPM) logic. This is the schedule which will be used, at the Phase and Unit level, to track the overall schedule status of the Program. It will be updated and controlled by OPG and based on the Contractors detailed Level 3 Schedules. The following are some key features of the C&C schedule:

- Contains an adequate number of activities with realistic activity durations to clearly show the sequence and logic in performing all projects, within the Program, at the Phase and Unit level, in a systematic manner. It will include all interfaces between OPG and contractor, and or between contractors.
- Defines the Program critical path and activity total floats
- Schedule variances shall be prepared

Audiences for this type of schedule include, but are not limited to program or project managers.

### 2.2.4 Level 3 Schedule

Level 3 schedules are ***Project Detailed Production Schedules (PDPS)*** in which Work Packages are broken down to detailed activities, mainly prepared by EPC contractors performing the work.

Level 3 schedules shall be precisely aligned with higher level schedules maintained by OPG, the owner. A Level 3 schedule uses the same WBS as that in the owner's Level

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1 and 2 schedules, it also contains WBS Summary Activities for every Work Package that follow the same naming nomenclature as that in the owner's WBS.

The Level 3 schedule is also coded to allow summaries of all the C&C Schedules controlled by OPG, the owner.

The level 3 detailed schedules will be prepared by the group executing the work, mainly suppliers and contractors, however, in some case by OPG where OPG is self performing work. The schedule must be prepared in accordance with the Program's Work Breakdown Structure ("WBS") and coding guideline. This schedule contains the lowest level of detail required to manage and execute the work. It is structured in a way to allow summarizing of the activities in order to update the Level 2 C&C Schedule.

- The Level 3 shall include the full scope of each suppliers / contractor showing all interfaces with other contractors / OPG.
- The schedule shall be resource loaded to the lowest level of the defined Resource Breakdown Structure as agreed by OPG.
- The schedule shall define all long lead procurements.
- After being captured as a baseline, the schedule will be regularly updated, providing the basis for status reporting, progress physical percent complete at the activity / Work Package Level, forecasting, and change management.
- All supplier / contractor baseline schedules needs to be approved by OPG to ensure program milestones, WBS and scheduling guidelines and coding are followed.
- Schedule variances and mitigation plans will be analyzed from the Level 3 schedule.
- Daily, Weekly and Monthly look-ahead reports will be generated from Level 3 schedule.
- This method will also be utilized where OPG is self performing the work

Audiences for this type of schedule include, but are not limited to, project managers, superintendents, and general foremen.

### 2.3 Schedule Integration

All Contractors' Level 3 Schedules or OPG Functional detailed schedule are fully aligned, utilizing a common Work Breakdown Structure and coding guideline, and integrated in the overall C& C Schedule.

The C&C Schedule will be the program's basis for measuring schedule progress. Refer to **Appendix A**.

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## NUCLEAR PROJECTS SCHEDULE MANAGEMENT

### 3.0 SCHEDULE MANAGEMENT

#### 3.1 Schedule Requirements

Project teams, including contractors, shall follow the relevant OPG Nuclear procedures, manuals, guidelines and plans to develop, update and monitor project schedules as follows:

##### 3.1.1 Scope and WBS

OPG project teams should follow N-MAN-00120-10001-SCH-05, Nuclear Program/Project WBS Manual, to establish a quality WBS that addresses 100% of project work, down to Work Package level.

Particularly, the WBS should be deliverable oriented and based on project SOW documents. The WBS shall reflect contract strategies so that work scope, budgets and responsibilities can be clearly allocated.

Contractors should use the WBS developed by OPG project teams to develop lower level WBS, mainly Work Packages. The lower level, more detailed WBS developed by the contractors shall be concurred by OPG.

##### 3.1.2 Milestones

The definition of **milestones** is different from **deliverables**. Deliverables are expressed by means of WBS components/activities at certain levels, while milestones refer to those most significant events or targets that mark achievement or progress of the program or project.

For example all supplier contract dates and major interfaces shall be defined as milestones in the schedule.

See N-MAN-00120-10001-SCH-06, Nuclear Refurbishment – Program Milestone Definition Framework, for more information.

##### 3.1.3 Activity Planning

Activity planning is a team effort involving all key members of the project team and stakeholders in order to help identify all project deliverables. The project deliverables for the requested release should be developed to schedule level 3 and to level 1 or 2 for any future releases as there is typically less information available regarding the future releases. Project teams must create a schedule sufficiently detailed to allow them to plan, monitor and control their projects effectively.

Activity planning should be completed with input from scoping and estimating processes. It is critical that the activities be deliverable based and not resource based. The activity needs to describe what specific deliverable needs to be accomplished. For example an activity such as “Create design specification” is a deliverable based

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specific activity where as “Design support” is a generic resource based activity that provides little useful information on what needs to be done and when.

### 3.1.4 Resource-Loading

Resource availability and task execution duration estimates must be provided from detailed estimates or by those who will be responsible for carrying out the related tasks and activities.

In the contractors’ Detailed Production Schedules (PDPS, Level 3 Schedules), all Work Package Summary Activities are required to be loaded with the following resources.

- **Value Unit for Labour (VUL):** refers to the total Labour Hours. An average hourly rate can be applied to the VUL to obtain the budget.
- **Major Work Quantities**, e.g. number of pressure tubes to be removed or electric boards to be inspected, number of pumps to be installed, cubic meters of concrete to be poured.

For additional detail refer to N-MAN-00120-10001-SCH-07, Nuclear Refurbishment Earned Value Management.

Additionally, OPG resource requirements are to be loaded in OPG Level 3 schedule activities. The C&C schedule is not resource loaded.

### 3.1.5 Activity Sequencing

Connecting the activities and milestones together with ‘sensible’ logic is the foundation of the project schedule. Every activity, except the first and last, should be connected to at least one predecessor (preceding task) and one successor (succeeding task). Ensuring compliance will prevent the schedule from containing open-ended activities and allow proper analysis of the critical path.

Team meetings or workshops involving key team members is an excellent means to develop schedule logic and will ensure better planning results.

Logic planning, or activity sequencing, is an iterative planning process and is further refined during schedule development to optimize project timelines and resources.

When developing schedule logic, interfaces with other processes such as N-PROC-MA-0013, Planned Outage Management, and N-PROC-MA-0022, Integrated On-Line Work Schedule, should be taken into account.

### 3.1.6 Activity Durations

Determining activity durations involves estimating how long it will take to complete the defined work activities. Much of this information may come from estimates, contractor estimates and supporting organizations however, resource availability across the

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Nuclear Program/Portfolio must be taken into consideration. Estimating activity durations is generally completed once all activities have been defined and logically tied. This allows the project team to consider all other activities in the schedule and project constraints while determining durations.

### 3.1.7 Schedule Quality

The project schedule should be reviewed for overall quality to ensure it meets process requirements. This includes an adequate level of detail, minimal use of constraints and level of effort activities, use of lags (positive and negative), open-ended activities and identification of the critical path. This should be performed on a regular basis in both the developmental stage and normal updating of the schedule.

Project teams should follow the Schedule Assessment Checklist (see Appendix C) to perform schedule analysis in order to make sure that the schedule is of good quality. Also refer to DR Program P6 Scheduler's User Guide, N-MAN-00120-10001-SCH-08, for additional details.

### 3.1.8 Basis of Scheduling

Contractors should issue a basis of schedule document with the submission of the baseline schedule. The document shall include the following, only if not captured in any other document:

- Summary description of the scope and main deliverables
- List of all Project/Payment milestones and key dates
- WBS / Primavera files structures and integration
- Coding structures for generating the various Schedules layouts
- Calendars used with the various activities
- Productivity rates / Assumptions
- Benchmarking to similar projects for duration assumption
- Progress measurement process for all work packages
- Regular scheduling reports

## 3.2 Schedule Review and Approval

The schedule must be reviewed and approved by the project team members and key stakeholders. The review must consider project and program constraints, milestones, resource requirements, and critical path to determine the acceptability of the schedule. If alterations are required, changes are made to the schedule logic, resource allocations, and/or activity durations and then the schedule is re-calculated. Schedule

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reviews must also assess the possibility of conflicts with other projects and operational demands. These iterations continue until an acceptable schedule is developed.

### 3.3 Schedule Baseline

- (a) Once approved, schedules shall be baselined by the project owners as a benchmark for measuring implementation performance.
  - Baselined schedules are archives and shall not be modified. Changes to the baseline occur via a re-baselining process based on cost & schedule analysis and only through authorized change control.
- (b) For Level 3 schedules, schedule variances to baseline shall be explained and justified; corrective action(s) shall be required for any forecasted delay to any defined milestone; mitigation plan shall be prepared by the Contractor and approved by the OPG project manager.
- (c) Once a change application for a Level 3 contractor schedule is received, the OPG project team shall calculate the changes in the Level 2 schedule in order to check potential impacts to milestones and to other projects.

If there are no impacts or the impacts are acceptable, OPG may approve the proposed changes. The Level 2 and Level 1 schedules will all be revised to reflect the change.

### 3.4 Schedule Software

Primavera P6 has been selected as the major scheduling software for Nuclear Projects.

## 4.0 SCHEDULE MONITORING AND UPDATES

Monitoring and updating a project schedule involves revising the project activity status and actual progress (e.g. started, completed, % complete), and forecasting future performance and completion data. The forecasting of completion dates and remaining costs ensures that accurate projections are reported for project metrics and the ongoing management of schedule risks. The project schedule shall be updated and communicated on a regular basis.

Progress is monitored and controlled against the project baseline to illustrate any variance. This allows the project team to visualize what areas of the project require greater priority, potentially leading to changes in strategy or the creation of recovery plans in order to maintain plan commitments or at least minimize impacts.

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## **4.1 Schedule Update and Analysis**

### **4.1.1 Level 0, Level 1 and Level 2 Schedules**

OPG Project Teams shall perform the following:

- Closely track the progress status, perform trend analysis and timely updates to the Program/Project Level 0, 1, and 2 schedules, based on updated status information from the Level 3 Schedule.
- Monitor the status of all Program/Project Milestones, Level 1 Activities (Control Accounts) and Level 2 Activities (Work Packages)
- Analyze and communicate scheduling issues.
- Develop recovery plans for Milestones and Work Packages at risk.

### **4.1.2 Project Detailed Production Schedules (Level 3 Schedules)**

- 1) All nuclear project teams should perform the following on Level 3 Schedules:
  - Closely track the implementation progress status, perform trend analysis and timely updates to the project schedules.
  - During updates, monitor project milestones and activities that may impact upper level schedules.
  - For any significant changes that might impact project milestones and/or upper level schedules, carefully analyze, communicate, and take effective actions to mitigate the impacts. Follow the change control process and forms in accordance with N-MAN-00120-10001-PC, Project Controls.
- 2) Contractors shall provide timely updates and submit the revised project schedules per the project requirements.

Projects should maintain records that explain changes in activity durations or logic as they are being made in the project schedule. Activity log notes can be used for this purpose. Apply change management notes or codes to activities that have had baseline changes. Such records and coding can be used to reconstruct changes to project schedules and store the reasons for the alterations.

## **4.2 Schedule Reporting**

- (a) OPG project control and project teams shall review the progress status in all aspects as per Level 0, 1 and 2 schedules, and submit periodic progress reports and specific reports to OPG Senior Management, regarding the nuclear program or project.



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- (b) All OPG project teams shall review the progress status in all aspects as per Level 2 and contractors' Level 3 schedules, and submit periodic progress reports and specific reports to OPG project control.
- (c) All contractors shall submit periodic progress reports along with project schedules updated and further detailed for certain look ahead periods, to OPG project control and project teams.
- (d) Standard reports shall be issued by all Contractors as per OPG requirements.

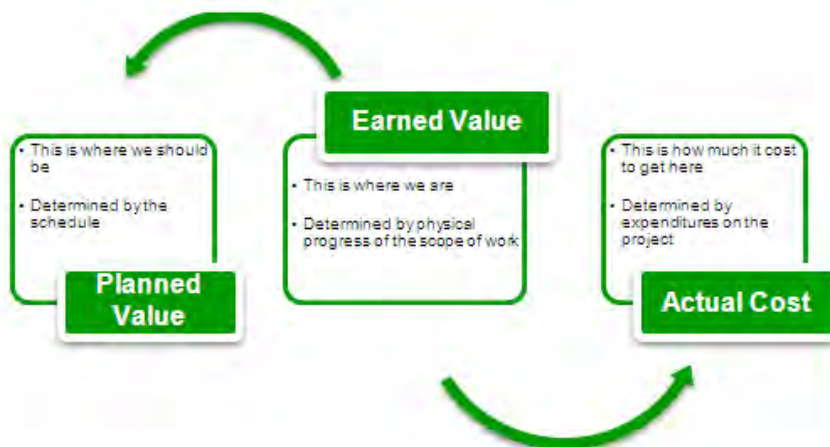
## 5.0 OVERVIEW OF EARNED VALUE PROCESS

Earned Value Analysis (or Earned Value Management) is a commonly used project management technique for gauging the progress and performance of a project. Compared to the conventional analysis of budgeted costs versus actual costs, Earned Value Analysis also considers the amount of progress made as compared to what was planned. As the name implies, value is earned as activities are completed.

EVM involves the assignment of time-based budgeted value to all program/project work; once the work is finished, the relevant value is earned, and this Earned Value is the basis for performance monitoring.

EVM provides necessary incentive mechanisms to project teams and contractors; it also provides effective approaches to assess program/project progress and cost status, and is the basis for a more precise forecast for time and cost control during schedule implementation.

In order to conduct Earned Value Analysis, three components are needed; Planned Value to be earned, Earned Value (physical progress) and Actual Costs. See figure below – Earned Value Process.



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## NUCLEAR PROJECTS SCHEDULE MANAGEMENT

### 5.1 Purpose

The benefits of Earned Value Management are set out in the following industry recognized publications:

*ANSI/EIA-748-B-2007 Earned Value Management Systems*

EVMS provides a sound basis for problem identification, corrective actions and management re-planning as may be required. It provides for early identification of performance trends and variances from the management plan and allows management decision making while there is adequate time to implement effective corrective actions.

*PMI – A Guide to the Project Management Body of Knowledge*

Earned Value is a commonly used method of performance measurement. It integrates project scope, cost and schedule measures to help the project management team assess and measure project performance and progress

### 5.2 Process

This Earned Value Management process is based on the following principles set out in ANSI/EIA-748B Standard for Earned Value Management Systems.

- Plan all work scope for the program from inception to completion
- Break down the program work scope into finite pieces that can be assigned to a responsible person or organization for control of technical, schedule, and cost objectives
- Integrate program work scope, schedule and cost objectives into a performance measurement baseline plan against which accomplishments may be measured
- Control changes to the baseline
- Use actual costs incurred and recorded in accomplishing the work performed
- Objectively assess accomplishments at the work performance level
- Analyze significant variances from the plan, forecast impacts, and prepare an estimate at completion based on performance to date and work to be performed

Use EVMS in the organization's management processes

### 5.3 Schedule and Cost Integration for EV Calculation

Proliance is the software for Earned Value calculation and analysis for every work package and control account.

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SPI/CPI shall be calculated at the Work Package level where Actual Cost is collected. Cost reports and earned value can be rolled to various levels according to the WBS/CBS and generated by bundle/unit.

% complete shall be calculated for every work package using L3 schedule and earning rules.

Refer to **Appendix B**.

## 6.0 CHANGE MANAGEMENT

The Contract shall submit with every schedule update a log, which shall contain records of any changes made to the schedule from previous submission:

- Records for all added/deleted activities
- Records for change in activity description/scope/duration
- Records for all changes to logical sequences and relationship between activities
- Any changes to WBS, added/deleted/split scope/work packages need to be formally communicated and approved by OPG before implementation.

## 7.0 DEFINITIONS AND ACRONYMS

### 7.1 Definitions

**Control Account (CA)** – The purposes of the Control Account are:

- Break the program or project down into manageable sub-divisions
- Enable reporting of cost and performance at a level suitable for providing high level indicators to Project and Program management
- Control Accounts shall reflect a consistent breakdown across Bundles and Units / Projects to allow analysis of performance and costs across projects or units for similar work elements
- Control Accounts should also represent the work assigned to one responsible organizational element on one program WBS element.
- A Control Account Manager or Team Leader will be responsible for management of each Control Account.
- A Control Account is a roll-up summary of associated Work Packages

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### NUCLEAR PROJECTS SCHEDULE MANAGEMENT

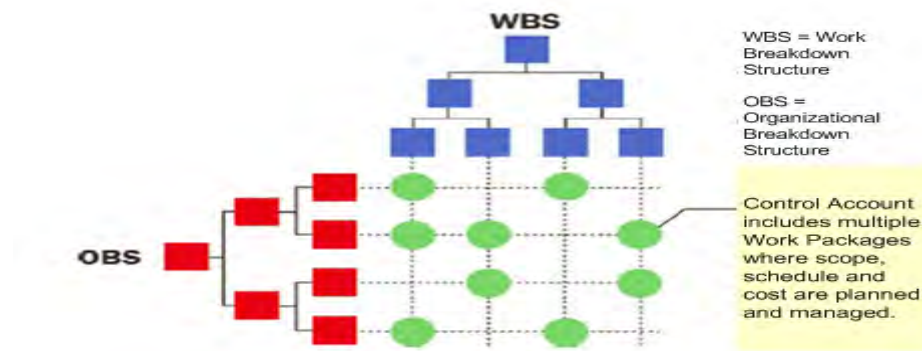
- The Scope, Resources, Cost and Schedule of the Control Account and the associated Work Packages will be defined in a Task Scoping Sheet (TSS) prepared by the Control Account Manager.
- The Resources, Cost and Schedule for each Control Account and Work Package will be derived from the relevant Project Gate or Function Release

**Earned Value** – The value of completed work expressed in terms of the approved budget assigned to that work for a schedule activity or WBS component. Also it is referred to as the Budgeted Cost of Work Performed (BCWP). Here value or cost can be expressed by dollars or labour hours.

**Work Package (WP)** – A Work Package is the WBS element at the lowest level of the WBS and is the level at which the comparison of actual costs to planned budgets and earned value are required. It is also the cost collection point that identifies the cost elements and factors contributing to cost and/or schedule variances.

At this level of the WBS an individual manager is assigned and is responsible for measuring progress, controlling variances, and preparing reports.

Work Packages are single tasks assigned to a performing organization for completion, and should be natural subdivisions of control account effort resulting in a definable end product or event. Each Work Package however, can be made up of a number of activities



Each Work Package will have the following characteristics:

- It represents units of work at the level where work is performed.
- It is clearly distinguishable from all other work packages.
- It is assigned to a single organizational element, or in an integrated product team environment,
- It has scheduled start and completion dates and, as applicable, interim milestones, all of which are representative of physical accomplishment

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- It has a budget or assigned value expressed in terms of Dollars (not in schedule), and Labour Hours, or Measurable Units in the Schedule
- Its duration is limited to a relatively short span of time. Longer tasks need objective interim measures to enable accurate performance assessments, or it is level of effort (LOE).

## 7.2 Abbreviations and Acronyms

<b>C&amp;C</b>	Program/Project Coordination & Control Schedule
<b>EPC</b>	Engineering, Procurement and Construction
<b>EVM</b>	Earned Value Management
<b>O&amp;M</b>	Operations and Maintenance
<b>OBS</b>	Organization Breakdown Structure
<b>PEPC</b>	Project Management, Engineering, Procurement and Construction
<b>PMSS</b>	Program/Project Milestone Schedule
<b>PIMS</b>	Program/Project Integrated Master Schedule
<b>PDPS</b>	Project Detailed Production Schedule
<b>P&amp;M</b>	Planning and Modifications
<b>P&amp;PC</b>	Planning and Project Controls
<b>WBS</b>	Work Breakdown Structure

## 8.0 RECORDS AND REFERENCES

Baseline Schedules, Monthly Schedules, and Earned Value Reports reside as data within Primavera 6 software application.

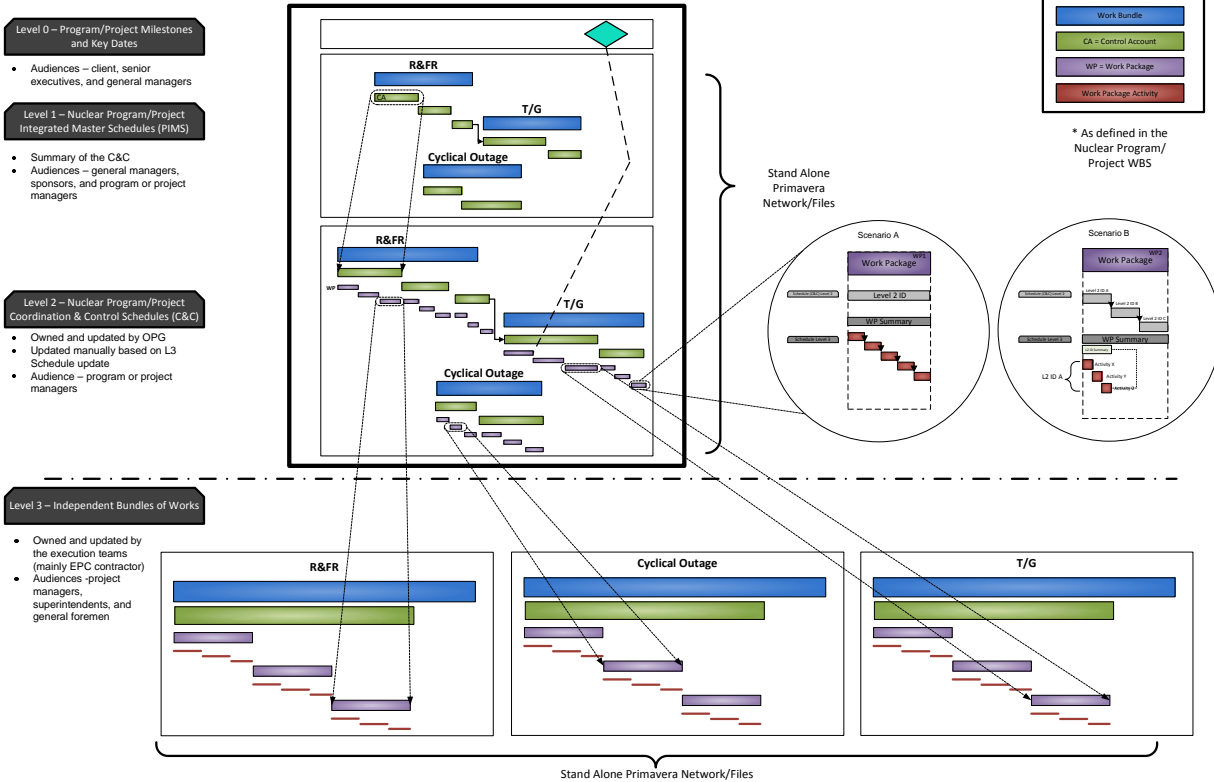
- [R-1] N-STD-AS-0028, Project Management Standard
- [R-2] NK38-PLAN-00300-10000, Darlington Refurbishment Program Integrated Master Schedule
- [R-3] N-MAN-00120-10001-SCH-05, Nuclear Program / Project WBS Manual
- [R-4] N-MAN-00120-10001-SCH-06, Nuclear Refurbishment – Program Milestone Definition Framework
- [R-5] N-MAN-00120-10001-SCH-07, Nuclear Refurbishment Earned Value Management
- [R-6] N-MAN-00120-10001-SCH-08, DR Program P6 Scheduler's User Guide
- [R-7] N-MAN-00120-10001-PC, Project Controls
- [R-8] N-PROC-MA-0013, Planned Outage Management
- [R-9] N-PROC-MA-0022, Integrated On-Line Work Schedule

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### Appendix A: Multi Level Scheduling System

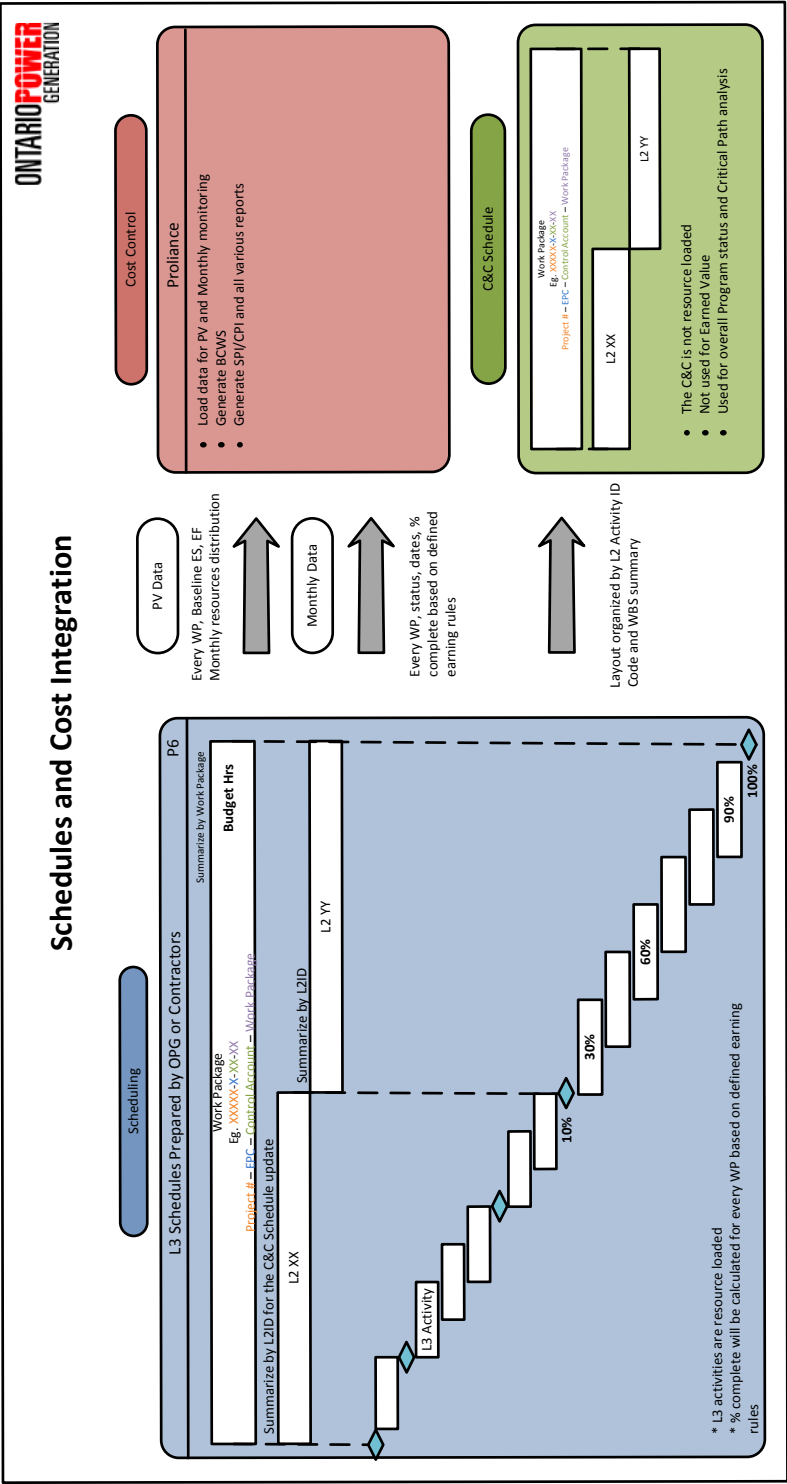


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NUCLEAR PROJECTS SCHEDULE MANAGEMENT

Appendix B: Schedules and Cost Integration



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**Appendix C: Schedule Health Assessment Checklist**

- Does the schedule reflect the total scope of work?
- Is the correct WBS element identified for each task, deliverables and milestones in the schedule?
- Is the schedule used by all levels of management for project implementation and control?
- Do all tasks/milestones have interdependencies identified to reflect a credible logical sequence?
- All task durations reasonable, measurable, and at appropriated level of detail for effective management?
- Does the schedule include all contracted and/or designated management control milestones?
- Does the schedule include all long lead procurement items?
- Does the schedule reflect accurate current status & credible start finish forecasts for all to-go tasks and milestones?
- Has the schedule been resources loaded and are the assigned resources reasonable and available?
- Is the critical path identifiable and determined by the calculated logic network?
- Is the critical path credible?
- Has adequate schedule margin been included and clearly defined within the schedule?
- Is there an excessive and invalid use of task constraints and relationship leads/lags?
- Are the correct task & resource calendars used in the schedule?





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Title:

**NUCLEAR REFURBISHMENT - COST MANAGEMENT AND REPORTING**

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**Nuclear Refurbishment -  
Cost Management and Reporting**

**N-MAN-00120-10001-PC-13 R000**  
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**Revision Summary**

Revision Number	Date	Comments
R000		Initial issue.

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### 1.0 PURPOSE

This guide defines the processes, including the interface to approved tools and source systems, used to execute Cost Management within the Nuclear Refurbishment Program. This manual takes authority from N-MAN-00120-10001-PC, Project Controls.

Cost Management includes the processes required to enable projects to be completed within approved budgets. The purpose of this manual is to establish the requirements in undertaking those activities.

Cost management is comprised of the following processes:

- (a) Cost Management Planning – The process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.
- (b) Cost Estimating – The process of developing an approximation of the monetary resources needed to complete project activities.
- (c) Cost Budgeting – The process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.
- (d) Funding – The process of providing the financial resources to meet the time-phased cash needs of the project. Funding is an importance part of the cost budgeting process.
- (e) Cost Monitoring and Control – The process of monitoring the status of the project to update the project costs and manage changes to the cost baseline.
- (f) Forecasting – The process of estimating or predicting the project's future based on knowledge and information available at the time of the forecast. Forecasting is an important element of cost monitoring and control.
- (g) Cost Performance Reporting – The physical or electronic representation of cost performance information compiled in project/program documents, intended to generate decisions, actions, and awareness. This information is generated during the cost monitoring and control process.

### 2.0 COST MANAGEMENT PLANNING

Cost Management planning is the process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.

Detailed Cost Management planning shall be performed as part of the overall Project Management (PM) planning process.

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The Cost Management Plan will define how the team will estimate the project cost, prepare and present a project budget, control project costs, as well as document the review and approval requirements for the cost management processes.

Definitions of the terms used in cost management are contained in Section 6.1 of this document.

### 2.1 Organization, Roles and Responsibilities

The organization responsible for cost management activities as well as individual roles and responsibilities are contained in Appendix A.

### 2.2 Cost Management Planning Parameters

Cost Management planning shall establish and document the following as a minimum:

- (a) Control Thresholds – Variances between actual and/or forecast performance and the baseline plan in excess of 5% should be investigated to determine the cause and develop a corrective action plan.
- (b) Control Accounts – Control accounts shall be established for Work Breakdown Structure (WBS) elements at a level consistent with maintaining effective control of the project scope-budget-cost-schedule using Earned Value Management (EVM) techniques. in accordance with N-MAN-00120-10001-PC-09, Earned Value Management.
- (c) Work/Planning Packages and Activities - Each control account shall contain one or more work packages (WP). Each work package may contain a number of activities. Except for functional areas and Cost Only WP, no more than 15% of the total project value shall normally be comprised of Level of Effort (LOE) work packages.
- (d) Reporting Period – Reporting periods shall be monthly and shall be based on the OPG fiscal calendar. During high periods of activity such as during execution, more frequent reporting may be required.
- (e) Earned Value Management (EVM) – As a minimum, EVM shall be performed at the work package level. The EVM measurement techniques to be used for each work package shall be documented and in accordance with N-MAN-00120-10001-PC-09, Earned Value Management.
- (f) Escalation – Adjustments for escalation due to inflation shall be established in consultation with Finance. They shall be tracked and reported in separate Cost Only WPs. Cost Only WPs are not included in EVM.

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- (g) Interest – Adjustments for interest costs shall be established in consultation with Finance. They shall be tracked and reported in separate Cost Only WPs. Cost Only WPs are not included in EVM.

## 2.3 Cost Management Tools

Proliance is the project Cost Management System tool. Proliance is a web-based application, accessible in the office or on site and enabling real-time communication. Using Microsoft's .NET application framework, it integrates with other systems, including NFRA.

The relationship between Proliance and other OPG business systems is shown in Figure 1. The source systems for cost management data are shown in Table 1.

**Table 1. Source Systems for Cost Management Data**

<b>Tools</b>	<b>Data</b>
Proliance	Cost-Only Work Packages, Planned Value, Earned Value, and Forecast
Primavera 6	Work Packages, Schedules, Physical Percent Complete, WBS
NFRA	Actual Costs

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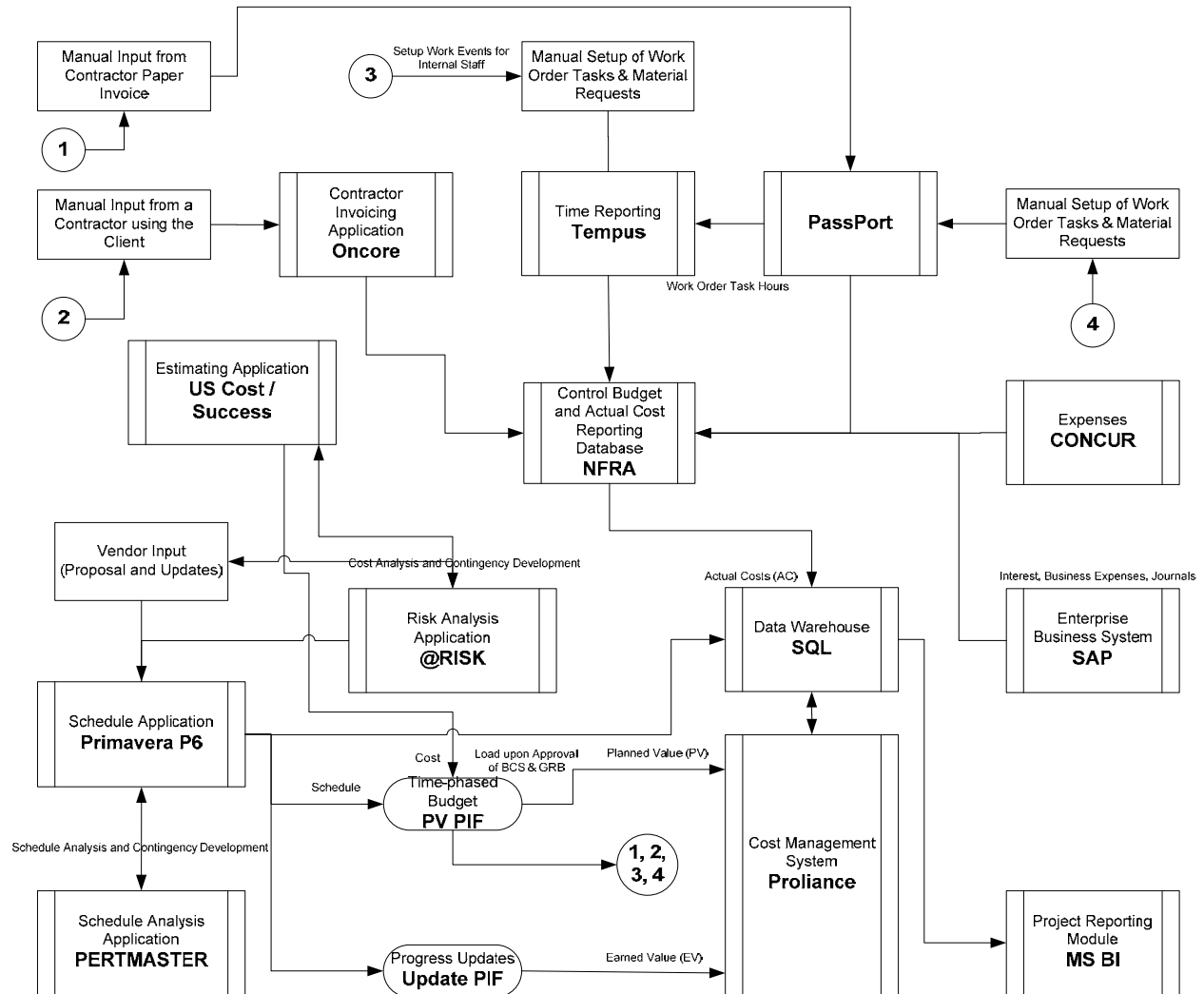
Primavera P6 is the source of all scheduling data. NFRA is the source of all actual costs (including data from Oncore, Tempus, and PassPort). Proliance Import Files (PIF) are custom formatted Excel spreadsheets that are used to import data into Proliance. Scheduling data is exported from Primavera P6 into the PIF.

Microsoft BI has been selected as the Project/Program Reporting tool. It pulls data from Proliance via the data warehouse to generate the Project/Program cost reports.

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**Figure 1. OPG Business Systems Context**





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### 2.4 Cost Management Outputs

Information obtained through Cost Management shall be used for the following purposes:

- (a) Contingency management, in accordance with N-MAN-00120-10001-RISK-05, Risk Management.
- (b) Cost performance reporting, in accordance with Section 5.5, Cost Performance Reporting.
- (c) Schedule performance monitoring in accordance with N-MAN-00120-10001-SCH, Schedule Management.
- (d) Financial reporting, in accordance with FIN-PROC-PA-013.
- (e) Development of cost data for future use in estimating and business planning etc.

### 3.0 COST ESTIMATING

Cost estimating is the process used to determine the total cost of labour, materials, equipment, fees, and other resources, required for the execution of a project or part of a project. Estimates are also used to evaluate changes, alternatives, and what-if scenarios to assist in decision making. An accurate cost estimate leads to a more precise project schedule and budget which forms the basis for project planning decisions, value and performance monitoring and control.

The Basis of Estimate (BOE) documents the parameters and scope used in support of developing the estimate and also includes the complete estimate details and breakdown. The BOE breakdown shall follow the approved WBS to support the funding and budgeting processes.

All estimates shall be performed in accordance with N-MAN-00120-10001-EST, Cost Estimating.

### 4.0 COST BUDGETING

Cost Budgeting is the process of developing time-phased costs of individual activities or work packages to establish an authorized cost baseline.

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### 4.1 Funding

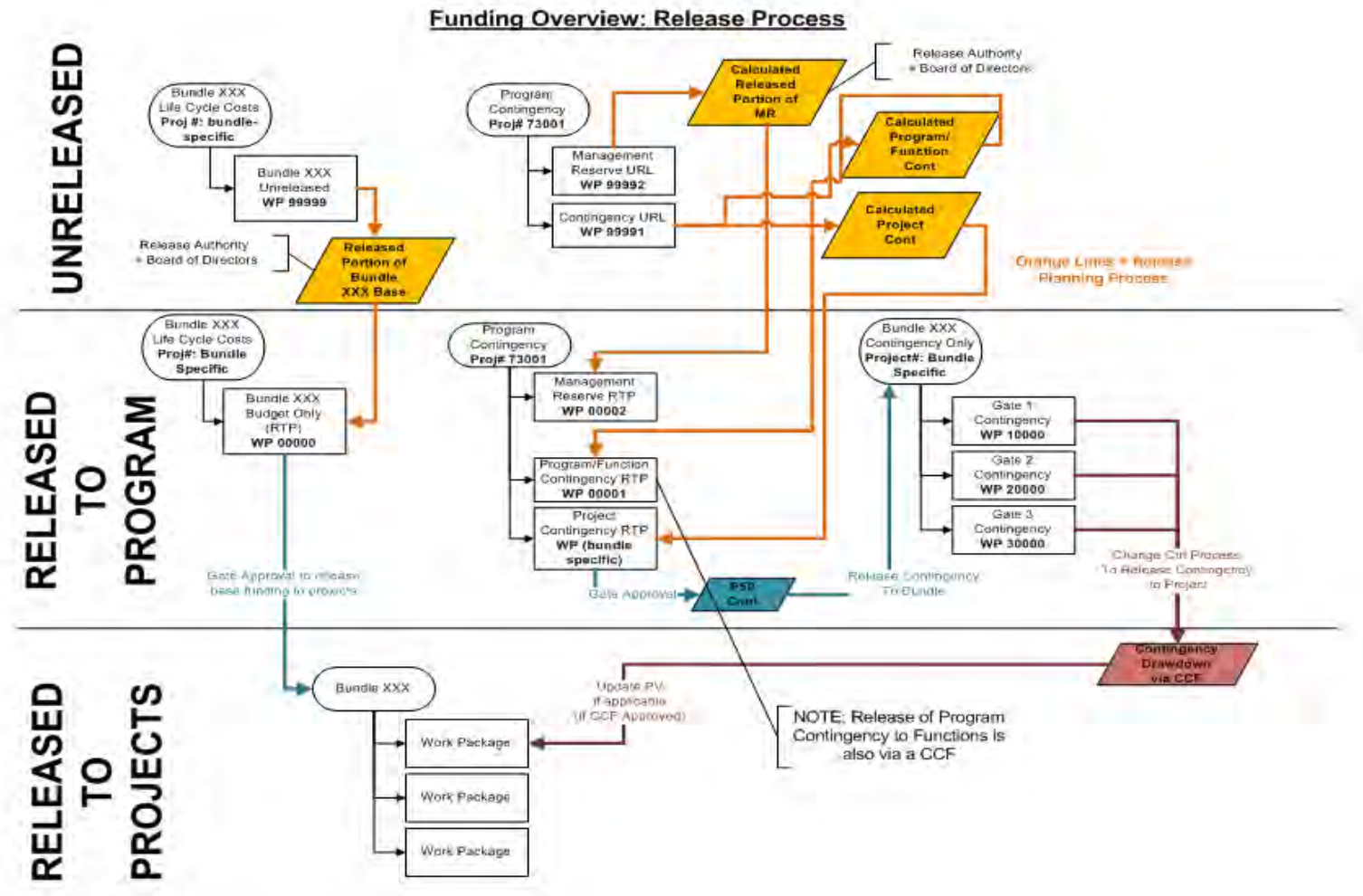
Funding provides the financial resources to finance a need, program, or project. Funding is approved by the OPG Board of Directors (BOD) in the form of Program Funding Releases.

An overview of the Funding Release Process is shown in Figure 2.

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Figure 2. Funding Release Process Overview



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The aggregated cost estimates form the basis of the Program Funding Release submission to the BOD and once approved become the Original Budget (OB). Original Budget funding for the release period will be allocated directly to functional groups upon release approval. Project funding will be allocated from the program via the Gated Process and the Gate Review Board in accordance with N-MAN-00120-10001-GRB. Estimated funding requirements for the program life cycle beyond the current release will be documented as unreleased funds at the Bundle and/or project and functional levels.

Program releases will also establish program level Contingency and Management Reserve funding. Project level Contingency funding may be allocated within the Definition and Execution phases via the Gated Process. Contingency funding at all levels is based on known risks. Management Reserve funding is set based on “unknown-unknowns” that could impact the viability of the program. NR guidance and strategies for managing Contingency and Management Reserve are defined in N-MAN-00120-10001-RISK-05, Nuclear Refurbishment – Contingency Development and Management. Release of Contingency and Management Reserve funding will be controlled via the change control process as described in N-MAN-00120-10001-PC-12.

### 4.2 Control Budget

Once funding is approved at the project and/or functional levels, budget information is loaded into the Proliance cost tool. Budget information is loaded at the Work Package level such that initially:

$$OB = CB = AF = FC$$

Where each of the above is a summary column in Proliance representing:  
OB = Original Budget, which serves as the original baseline and remains unchanged for the life of the project.

CB = Control Budget, representing the current baseline and Planned Value (PV) for the Work Package.

AF = Approved Funding, representing the current approved cost envelope for the Work Package.

FC = Forecast, representing the projected cost of the Work Package, including any pending changes yet to be approved.

## 5.0 COST MONITORING AND CONTROL

Cost Monitoring and Control is the process of gathering, accumulating, analysing, forecasting, reporting and managing the costs on an ongoing basis. Nuclear Refurbishment will utilize Proliance for the effective cost management of all programs and projects.

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### 5.1 Cost Control

Cost Control is the process of measuring progress and monitoring performance against plans; measuring variances from authorized budgets, and allows effective action to be taken to optimize costs.

Nuclear Refurbishment utilizes Earned Value Management (EVM) as the fundamental process for evaluating the overall health of schedule and cost. As such, Proliance, and the associated reports generated from the cost tool, are configured to provide all elements of an Earned Value Management System. These include:

- Planned Value (PV) is (in cost terms) the current Control Budget assigned to the work.
- Earned Value (EV) is the dollar value of work performed in terms of the approved budget assigned to the work.
- Actual Cost (AC) is the dollar amount actual cost incurred as recorded in the OPG financial source system (NFRA).
- Schedule Performance Index (SPI) is the ratio of EV to PV.
- Cost Performance Index (CPI) is the ratio of EV to AC.
- Cost Variance (CV) is the difference between EV and AC.
- Budget Variance (BV) is the difference between PV and AC.
- Schedule Variance (SV) is the difference between EV and PV.

It is incumbent upon the entire team to fully and diligently participate in cost control activities. These activities will be accomplished through the use of formal cost monitoring and reporting procedures. Cost Control is a line-owned function facilitated through the Planning and Controls team. The Cost Control functions described above shall be executed via the following activities:

(a) Measuring progress:

- (1) Measuring physical progress for earned value assessment.
- (2) Updating progress (i.e. percent complete) in the P6 schedules.
- (3) Updating progress in Proliance.
- (4) Ensuring actual costs are collected in the appropriate cost or control accounts.
- (5) Ensuring accruals are captured in the actual costs.

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- (6) Identifying incorrect, inappropriate, or unauthorized charges and implementing corrective actions to rectify.
- (b) Reviewing progress;
  - (1) Gathering all commitments and payments.
  - (2) Monitoring commitments against budgets.
  - (3) Identifying and analyzing variances.
  - (4) Identifying and analyzing trends.
  - (5) Identifying items requiring corrective action (i.e. unfavourable variances and trends).
- (c) Reporting progress: Prepare and distribute status data (e.g. PV, EV, AC, variances, forecasts, and trends) and corrective action plan status as detailed in Section 5.5 of this document.
- (d) Taking corrective action: Initiate any corrective action and recovery plans required to mitigate and resolve identified issues. If warranted, change requests shall be initiated as detailed in Section 5.4 of this document.

## 5.2 Forecasting

Forecasting is the process of estimating or predicting the project's future based on knowledge and information available at the time of the forecast.

Forecasting is performed by analyzing the work performed against the work planned, identifying trends, analysing remaining the work, and determining the impact of performance on the estimated cost and schedule going forward.

Forecasting cost shall take into consideration the committed costs, the actual execution efficiency of the work performed, and the planned efficiency for the remaining work.

The Project Manager is accountable for having the forecast updated as necessary to reflect the latest status and expected performance of the project. Effective forecasting can be achieved when experience and objective judgement are applied together with consideration of risks and the usage of quantitative forecasting techniques, such as Earned Value technique.

All forecasts shall be performed in accordance with N-MAN-00120-10001-PC-14, Nuclear Refurbishment - Forecasting.

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### 5.3 Change Control

Changes to functional and project Performance Measurement Baselines (PMB) will be managed via a formal control process as described in N-MAN-00120-10001-PC-12, Change Management.

### 5.4 Invoice Management

OPG-PROC-0051 specifies and documents the processes, principles and responsibilities for payment of vendor invoices.

FIN-PROC-AP-011 outlines the line responsibilities for invoice approval, defines accountabilities of Account Payment and Supply Chain in support of the line's accountabilities in this process.

FIN-PROC-AP-006 defines the processes, principles, responsibilities, and documents to be utilized in determining approvals required and supporting documents for progress payments. The Procedure establishes the general requirements including governing rules, supporting documentation, and condition to reject or revise a Progress Payment.

FIN-PROC-AP-010 defines the processes, principles, responsibilities, and documents to be utilized in determining approvals required and supporting documents for holdback payments.

### 5.5 Cost Performance Reporting

Cost Performance Reporting is the process of reporting the costs on an ongoing basis. OPG Nuclear Projects will utilize Microsoft Business Intelligence (BI) as the report generation tool for all programs and projects.

This section details the requirements for cost performance reporting. Overall reporting requirements are contained in N-MAN-00120-PC, Project Controls.

#### 5.5.1 Report Planning

The Director, Planning and Control, NR shall establish the cost reporting requirements structured according to WBS.

Cost reporting shall:

- (a) Encompass the entire program and project scope, including activities that are the responsibility of contracting companies.
- (b) Enable the following:

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- (1) Definition of the process for formally identifying the basis for cost, schedule, and performance reporting.
- (2) Specification of the expectations for documents required to establish cost and progress reporting.
- (3) Documentation of the need for a standard set of reports.

The cognizant PM shall provide the information necessary to establish status of the work (including the WBS), provide explanations of the causes of variance from the baseline plan, and propose changes to address the variance (typically for those > 5%).

### 5.5.2 Report Development

Following approval, Cost Management shall perform the following:

- (a) Establish a cost progress review and reporting process to provide a set of reports with the information necessary for the Project Managers, Project Management Office and contracting companies to understand the status of the work.
- (b) Update reporting of cost to show actual progress and performance achieved against the baseline, inclusive of approved or pending changes.

Definitions of the terms used in this section are contained in Section 6.1 of this document.

As a minimum, the following data shall be summarized and reported at the project and functional area level;

- Project/Functional Area WBS Code And Description
- For the Current Period (CP)
  - PV, EV, AC, CPI, SPI
  - Cost Variance (CV)
  - Budget Variance (BV)
- For Life to Date (LTD)
  - PV, EV, AC, CPI, SPI
  - CV, BV
- At Completion (Gate) and At Completion (Phase)



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- BAC, EAC, VAC

As a minimum, the following WP data shall be summarized at the project or function level and reported;

- LTD
  - PV, EV, AC, CPI, SPI
  - CV
- At Completion (Gate)
  - Original Budget (OB)
  - Directed Changes (DC)
  - Scope Transfers (ST)
  - Control Budget (CB) which is the BAC
  - Funding Variance (FV)
  - Approved Funding (AF)
  - Estimate At Completion (EAC)

Depending on the audience, the above information may be viewed for the Current Period, At Completion (Gate), At Completion (Release), At Completion (Life Cycle), or Life To Date.

### 5.5.3 Performance Reporting Process

The project team shall seek input from scope budget holders, Finance Department, Supply Chain, and contracting companies, to update the cost report based on observed progress, change approvals, and commitments. This information shall be received in a form that facilitates data entry into the cost management systems.

The project team shall use the information received to update the cost management systems and perform the following:

- (a) Assess the earned value of completed work.
- (b) Validate the actual costs of delivered work and services that have been imported into Proliance from NFRA.
- (c) Update the value of contractor invoices approved for payment, and calculate accrual balance.

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- (d) Identify the value of change orders not yet approved, and any future commitments that are forecast to be required.
- (e) Maintain the current budget through budget transfers and contingency drawdown.
- (f) Identify the variances between current budgets and forecasts.
- (g) Update the risk management system (including contingency drawdown) based on actual activity.
- (h) Update the cash-flow forecast to reflect actual spending to date.
- (i) Track the amount of committed cost, scope, and responsibilities.

### 5.5.4 Outputs from Cost Performance Reporting

Project Reporting shall issue reports monthly and provide NR Project Teams and Project Stakeholders with summarized and detailed information such that project performance and status may be determined and corrective action taken.

During the Project Execution phase, Project Reporting shall issue additional project reports weekly.

Reports shall enable an understanding of (at a minimum) the following:

- (a) Cost and schedule performance against the baseline plan.
- (b) Forecast performance, including EAC.
- (c) Cost and schedule variance explanations (typically for those > 5%).
- (d) Required actions from identified corrective action plans and mitigation strategies.

## 6.0 DEFINITIONS AND ACRONYMS

### 6.1 Definitions

**Accrual** is the value of work completed and eligible for payment but not yet included on an invoice.

**Actual Costs (AC)** is the realized costs incurred for the work performed during a specified time period.

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**Approved Funding (AF)** consists of the Control Budget (CB) plus all approved Funding Variances (FV).

**Budget at Completion (BAC)** is the sum of all budgets established for the work to be performed.

**Budget Variance (BV)** is the difference at a given point in time between the Actual Costs (AC) and Planned Value (PV) (i.e.  $BV = AC - PV$ ).

**Change** is a modification from the approved Performance Measurement Baseline (PMB).

**Committed Costs** is value of work purchased, but not yet paid for.

**Contingency** is an amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs. Some of the items, conditions, or events for which the state, occurrence, and/or effect is uncertain include, but are not limited to, planning and estimating errors and omissions, minor price fluctuations (other than general escalation), design developments, and changes within the scope, risk response, and variations in market and environmental conditions. It is typically estimated using statistical analysis or judgment based on past asset or project experience. Contingency **excludes**:

- (a) Major scope *changes* such as *changes* in end product specification, capacities, building sizes, and location of the asset or project.
- (b) Extraordinary events such as major strikes and natural disasters.
- (c) **Management Reserves.**
- (d) Escalation and currency effects.
- (e) Changes in scope or major social or natural events such as war, strikes, floods or earthquakes.

Contingency is generally included in most estimates, and is expected to be expended, see *Management Reserve*.

**Contingency Drawdown** is the method by which the contingency fund is used.

**Contracting Companies** are organizations external to Nuclear Refurbishment working on a Nuclear Refurbishment project under a contractual arrangement (includes Engineer-Procure-Construct Contracts at an agreed-to level of detail).

**Control Budget (CB)** consists of the OB plus the sum of all approved Directed Changes (DC) and Scope Transfers (ST) (i.e. PMB changes). It is also known as the Budget at Completion (BAC).

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**Cost Performance Index (CPI)** is a measure of the cost efficiency of budgeted resources expressed as the ratio of Earned Value (EV) to Actual Cost (AC).

**Cost Variance (CV)** is the difference at a given point in time between the Actual Costs (AC) and Earned Value (EV) (i.e.  $CV = AC - EV$ ). It should be noted that PMI defines this term as  $CV = EV - AC$  and hence the sign would be different.

**Deliverable** is any unique product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project.

**Directed Changes (DC)** constitutes re-baselining, and is generally caused by situations beyond the control of the budget/work program owner that renders the existing baseline obsolete. An approved DC will result in changes to the Control Budget (CB) of the appropriate function or project as well as equal and opposite changes to the appropriate contingency account CB.

**Earned Value (EV)** is the measure of work performed expressed in terms of the budget authorized for that work.

**Estimate at Completion (EAC)** is the expected total cost of completing all work expressed as the sum of the actual costs to date and the estimate to complete. It represents the responsible Project Manager's estimate of the cost at completion of the current release, gate, and the entire Project Lifecycle including all pending (i.e. unapproved) funding change requests plus the impact of undocumented funding impacts based on managerial judgment.

**Estimate to Complete (ETC)** is the expected cost to finish all remaining work.

**Forecast** is the project team's estimate of the most likely outcome for a given element of the project (e.g. cost forecast, schedule forecast etc.).

**Forecast Trends (FT)** are Budget Owner forecast estimates of future **anticipated** changes to Approved Funding levels. Such changes are documented for management forecasting and do not impact budgets. They are reflected in the Estimate at Completion (EAC) column of the cost management system.

**Funding Variance (FV)** is an approved change that does not meet the DC criteria but requires a change in funding requirements. A FV will result in changes to the Approved Funding (AF) of the appropriate function or project as well as equal and opposite changes to the appropriate contingency account AF.

**Management Reserve** is an amount added to an estimate to allow for discretionary management purposes outside the defined scope of the project, as otherwise estimated. Use of management reserve requires a change to the project scope and cost baseline. (Contrast with contingency funds that are used for items within the project's approved scope.)

**Original Budget (OB)** is the approved funding established by the release or Gated Process. Original Budgets cannot be altered for the period in which they apply.

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**Pending Changes (PC)** consists of all changes proposed changes but not yet approved.

**Performance** is the comparative ratio between the planned rate of progress and the actual rate of progress.

**Performance Measurement Baseline (PMB)** is the approved, integrated scope-schedule-cost plan for the work against which project execution is compared to measure and manage performance. The PMB includes contingency, but excludes management reserve.

**Planned Value (PV)** is the authorized budget assigned to scheduled work.

**Scope Transfer (ST)** is the reallocation of scope, and its associated budget, from one work package to another. The net variance is always zero.

**Schedule Performance Index (SPI)** is a measure of schedule efficiency expressed as the ratio of Earned Value (EV) to Planned Value (PV).

**Trend** is a non-random variance of actual performance from that which was planned. Analysis of performance measurements is required to determine if an observed performance variance is a trend (i.e. predictable), or a random outcome (i.e. unpredictable), and that determination will influence subsequent control actions and forecasts.

**Variance** is the nominal differential between earned, planned, actual, and forecast performance.

**Variance at Completion (VAC)** is the difference between the BAC and EAC.

**Work Breakdown Structure (WBS)** is the hierarchical decomposition of the work to be carried out to accomplish the objectives and create the required deliverables. It is a tool used to define and group a project's discrete work elements (or tasks) in a way that helps organize and define the total work scope of the project.

**Work Package (WP)** is the work defined at the lowest level of the Work Breakdown Structure (WBS) for which cost and duration can be estimated and managed.

## 6.2 Abbreviations and Acronyms

<b>BI</b>	Business Intelligence
<b>BOD</b>	Board of Directors
<b>BOE</b>	Basis of Estimate
<b>CAD</b>	Canadian Dollars

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<b>CP</b>	Current Period
<b>CSA</b>	Cost/Schedule Analyst
<b>DSR</b>	Darlington Scope Request
<b>EPC</b>	Engineer-Procure-Construct
<b>EPSCA</b>	Electrical Power System Construction Association
<b>EVM</b>	Earned Value Management
<b>FTE</b>	Full-Time Equivalent
<b>GRB</b>	Gate Review Board
<b>LTD</b>	Life to Date
<b>LOE</b>	Level of Effort
<b>NR</b>	Nuclear Refurbishment
<b>OPG</b>	Ontario Power Generation
<b>PC</b>	Pending Changes
<b>PIF</b>	Proliance Import File
<b>PM</b>	Project Management
<b>RAPID</b>	Recommend, Agree, Perform, Input, and Decide
<b>RFS</b>	Ready for Service
<b>SVP</b>	Senior Vice President
<b>UOM</b>	Unit of Measure
<b>WSIB</b>	Workplace Safety Insurance Board

## **7.0 RECORDS AND REFERENCES**

### **7.1 Records**

Any records which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0042, Quality Assurance Records.

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Deliverables Completion Declaration	D-FORM-10790	N	File locally by department

## 7.2 Governing Document

Nuclear Refurbishment's (NR's) approach to cost management is defined in N-STD-AS-0028, *Project Management Standard*. Cost management and control practices are further detailed in N-MAN-00120-10001-PC, *Project Controls*.

## 7.3 References

### 7.3.1 Performance References

- FIN-PROC-AP-006, Progress Payments Procedures
- FIN-PROC-AP-010, Holdback Payments Procedure
- FIN-PROC-AP-011, Payment Approval Process for Services Provided
- FIN-PROC-PA-013, Project Accounting and Reporting Procedure
- N-PROC-AS-0003, Controlled Document Management

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- N-PROC-AS-0042, Quality Assurance Records
- N-MAN-00120-10001-EST, Cost Estimating
- N-MAN-00120-1001-GRB, Gated Process
- N-MAN-00120-10001-PC, Project Controls.
- N-MAN-00120-10001-PC-09, Earned Value Management
- N-MAN-00120-10001-PC-12, Change Management
- N-MAN-00120-10001-PC-14, Forecasting
- N-MAN-00120-10001-SCH, Schedule Management
- N-MAN-00120-10001-RISK-05, Risk Management
- N-STD-AS-0028, Project Management Standard
- OPG-STD-0017, Organizational Authority Register
- OPG-PROC-0051, Payment

### 7.3.2 Developmental References

- HYDRO and EP documents for definitions
- NK054-PROC-0016, DNNP Project Controls
- A Guide to the Project Management Body of Knowledge, 5<sup>th</sup> Edition (PMBOK Guide)
- Total Cost Management Framework: An Integrated Approach to Portfolio, Program, and Project Management, 1<sup>st</sup> Edition, Revised (TCM)



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## Appendix A: Cost Management Roles and Responsibilities

The following accountability model has been selected and is in use on the Darlington Nuclear Refurbishment project. It details the responsibilities and accountabilities throughout the life cycle of a scope of work, from the Darlington Scope Request (DSR) to the declaration of Ready for Service (RFS).

- (a) The guiding philosophy behind the project revolves around the Project Manager having the ultimate accountability for delivering a successful project. That said, an accountability model showing the Project Manager accountable for each and every element of the project would do little to communicate the width and breadth of effort required to perform the complete scope of work.

The **RAPID** model (as shown in Figure A.1) is used to describe who in the organization has the primary role in making **Recommendations**, establishing **Agreement**, **Performing** the work once decided, providing **Input** to the decision, and being accountable to make that **Decision**.

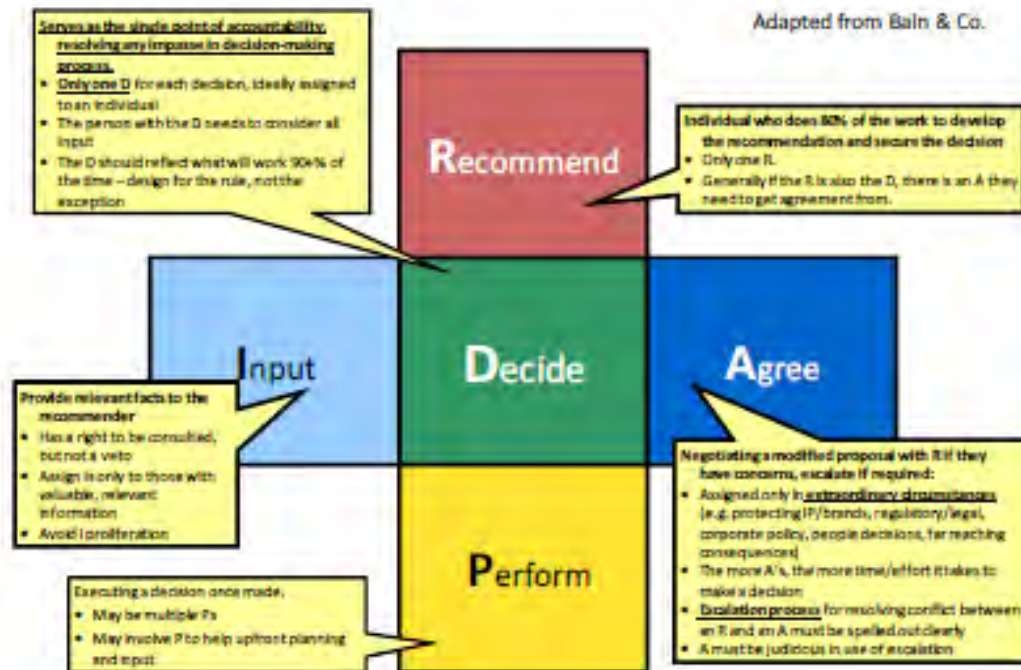
It is important to understand that with this model the Recommender is the role that is primarily responsible for the element of scope and that the primary accountability resides with the role of the Decider.

It is also important to note that this model is centred on each of the elements and their associated responsibilities and accountabilities. The model does not abdicate fundamental accountabilities as defined by the Internal Responsibility System, Chain of Command, Governance, and Delegated Authorities.

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Figure A.1. RAPID Accountability Model



- Input (I):** Provide relevant facts to the Recommender.
- Recommend (R):** Provide data and analysis based on research and stakeholder management.
- Agree (A):** Negotiate modified proposal with Recommender with ability to veto and escalate.
- Decide (D):** Single point of accountability; bringing decision to closure; implementing decision.
- Perform (P):** Executing the decision promptly and effectively.

## A.1.0 PRIMARY ROLES

### A.1.1 Director, Planning and Controls, NR

Establishes and sets direction for cost management and project reporting activities for NR and support organizations to ensure activities, deliverables, and costs are controlled and appropriate information is reported.

### A.1.2 Manager, Project Control and Reporting, NR

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Manage the operation of the cost management and project reporting systems to provide appropriate outputs.

Establish the processes, guides, and tools necessary to facilitate the successful implementation of the direction herein.

### A.1.3 NR Directors and Managers

Manage approved budgets for projects and functions and ensure costs are appropriately charged to the right budget item.

Provides updates to the cost management and reporting processes as required to meet project reporting cycles.

Review cost reports and take corrective action in accordance with established thresholds.

### A.2.0 COST MANAGEMENT RESPONSIBILITIES

Specific responsibilities for the cost management processes detailed in this document are contained in Table A.1.

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**Table A.1. Cost Management Responsibilities**

Activity	Responsibility												
	BOD	GRB	SVP, NR	Director, Planning & Controls, NR	Manager, Project Reporting	Estimating	Cost Management	Reporting	Project Scheduling	Planning & Controls Leads	Project Infrastructure	NR, Directors & Managers	Finance
Cost Management Planning				D	A	I	R	I	I	I	I	I, P	I
Cost Management Tools				D	A		I				R, P	I	
Cost Estimates				D	A	R, P						A, I	
Funding Requests - Program	D		R, P	A	I					I		I, P	A
Funding Requests - Projects		D	A	A	A	I	I		I	R		A, P	
Cost Budgeting - Program				D	R		P					I	A
Cost Budgeting - Projects					A	I	I		I	R		D	
Cost Monitoring and Control				D	A		R, P		I	R		I	I
Forecasting				A	A	I	I			R		D, P	

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Activity	Responsibility												
	BOD	GRB	SVP, NR	Director, Planning & Controls, NR Manager, Project Reporting	Estimating	Cost Management	Reporting	Project Scheduling	Planning & Controls Leads	Project Infrastructure	NR, Directors & Managers	Finance	
Cost Performance Reports - Program				D	A		I	R, P	I	I			I
Cost Performance Reports - Projects				A	A		I	P	I	R		D	I

- Input (I):** Provides relevant facts to the Recommender.
- Recommend (R):** Provides data and analysis based on research and stakeholder management.
- Agree (A):** Negotiates modified proposal with Recommender with ability to veto and escalate.
- Decide (D):** Single point of accountability; brings decision to closure; implements decision.
- Perform (P):** Executes the decision promptly and effectively.



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## Nuclear Refurbishment - Program Change Management

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R1	2016-04-22	Revision to section 6.4 contingency; add fast track process; update with new cost system terminology.

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# NUCLEAR REFURBISHMENT - PROGRAM CHANGE MANAGEMENT

## 1.0 BACKGROUND

*Change* is inevitable in a project. Well managed and controlled projects must manage change. A robust change management process provides guidance on how changes are assessed, implemented and reported on a project. This change manual will be reviewed and updated periodically to reflect the changing environment with respect to project controls tools.

## 2.0 PURPOSE

The primary purpose of Program Change Management is to control cost, schedule and scope changes against approved *baselines*, to manage the proper allocation of contingency funds, to document the nature and cause of changes and to analyse and minimize the impact to cost and schedule.

## 3.0 DIRECTION

### 3.1 Principles

- The *executing organization* will first attempt to mitigate the impacts of change by evaluating alternatives, such as reassigning resources to other available work, to mitigate the impact of change.
- Change is managed at the lowest level of the organization that has the authority to do so.
- Change that has a significant potential impact on project or program scope, cost and schedule is reviewed in detail and the recommended direction is approved at the appropriate level.
- The process balances flexibility and control.
- All changes are documented, tracked and included in relevant reports.
- Detailed evaluation of the impacts of the change takes place when necessary.
- Trends of changes are identified and followed up; the Station Condition Record (SCR) system is utilized when applicable.
- Only after the change is approved by the appropriate authority level, is the work assigned for action by the executing organization.
- Changes are not made solely for the purposes of correcting performance issues that are within the control of the work program owner.

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- Projects are re-baselined only when the cumulative effect of multiple Changes or a significant execution strategy Change renders the existing baseline no longer meaningful.

### 3.2 Definition of Change and Change Management

For the purposes of this procedure, a *change* is any deviation from an approved plan or procedure that results in a real or potential impact on program or project cost, schedule or scope.

*Change Management* is the Project Management process (including the supporting tool) that provides a framework to identify and record changes in cost, schedule and or scope against the approved baselines.

See Section 11.0 for a complete list of definitions for this procedure.

### 3.3 Program Baseline and Performance Measurement Baselines

The Change Control Process as defined in this document is performed from project inception through completion. The constraints of cost, schedule and scope must be continuously and rigorously managed either by rejecting or approving changes and subsequently incorporating approved changes into the revised *Program* and *Performance Measurement Baseline*, where applicable.

#### Program Baseline

The aggregate planning efforts during Definition Phase will converge to an overall Program Plan at Release 5, or Release Quality Estimate (RQE). This is the point when the majority of projects have sufficiently defined their execution strategies, cost, schedule and scope that will allow an overall Program Baseline to be set. The Program Baseline will be maintained as a high confidence estimate for all four units and project level changes assessed.

#### Performance Measurement Baseline

The Performance Measurement Baseline for Project and Functions is the cost, schedule and scope approved during the Release Quality Estimate (RQE) and Changes subsequently approved via this Change Management process. The Project Performance Measurement Baseline will be maintained and cost and schedule performance against the baseline monitored.

The use of Baseline in this document refers to the Performance Measurement Baseline.

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### NUCLEAR REFURBISHMENT - PROGRAM CHANGE MANAGEMENT

## 4.0 SCOPE

This document takes authority from N-STD-AS-0028 Project Management Standard and guidance from N-MAN-00120-10001-PC, Project Controls.

This Change Management process, illustrated in Appendix A, Change Process Flow, is for NR Funded and Darlington Outage Cyclical Maintenance work, including transfers in and out of the Program, is applicable to the following:

- Changes that occur between Gates to Projects already approved by the gating process and approved by the Gate Review Board (GRB), including scope transfers between Projects, Bundles or sub-Bundles;
- Changes to OPG functional work programs approved by the Functional Business Planning Release;
- Changes to contractual agreements between OPG and external contractors, suppliers or vendors when the change impacts project scope, cost or schedule;
- Changes in contracting or execution strategy;
- Engineering change control process outputs that impact project scope, cost or schedule;
- New/Changed Project Numbers;
- New/Changed Work Packages;
- Changes to *Work Breakdown Structure (WBS)*;
- Changes to project attributes, example Bundle or Sub-Bundle
- Changes to cost, schedule or scope that are approved by other governing documents or bodies, including the Project Decision Meetings, Options Review Boards, Regulatory Affairs or alternative localized decision making committees.
- Changes to scope and scope transfers agreed by both receiving PM and transferring PM.
- New scope, including scope funded by other methods (example AISC) if the work is being executed during the NR Execution Outage.
- Advancing or transferring funds that have not been released by the GRB in circumstances where the work must be performed prior to the next Gate and funding is required to proceed in order to control risk.
- Project and program contingency changes irrespective of value, either drawn or returned back to contingency.

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- Administrative updates to the Program Baselines as approved by senior management.

This Change Control process is **not** applicable to:

- Projects that have not yet been presented and approved by the Gate Review Board (GRB), i.e., projects for which there is no approved baseline.
- Changes to correct performance issues that are within the control of the work program owner, unless the change renders the existing baseline no longer meaningful
- Changes to budget amounts in closed accounting periods (changing historic data).

## 5.0 ORGANIZATION, ROLES AND RESPONSIBILITIES

All project team members are empowered and encouraged to identify and initiate the Change Control Process.

The OPG behaviours of “Say it, Do it, Simplify it, Think Top and Bottom Line, Integrate and Collaborate and Tell it as it is” apply to the change management process. Early identification of changes and their impacts and trends allow NR Management to focus attention on performance improvements, and drive the core behaviours.

### 5.1 Change Initiator

The Change Initiator, in conjunction with their manager, is responsible for reporting a change to cost, schedule or scope of their work. Anyone can be a change initiator. The Change Initiator contacts the P&C Lead for the executing organization for assistance with completion of the *Change Control Form* (CCF) N-FORM-11252.

### 5.2 Project Manager

The Project Manager (PM) is responsible for:

- Executing the full scope of project within constraints of working safely, meeting quality requirements, and performing within the approved schedule and budget.
- Reacting to change trends, taking corrective action and identifying and mitigating project risks.
- Limiting, controlling and recommending use or return of contingency.
- Managing contractors to control and mitigate increases to cost and delay to schedule.

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- Ensuring no commitment (including Project Change Directives (PCD), Project Change Authorizations (PCA), Consent to Proceed (CTP), or any other commercial commitment) is entered into with vendors or contractors, or into the approved baseline, prior to having sufficient budget and/or approval when necessary via a CCF.
- Assessing the impacts of changes to cost, schedule and risk as well as to commercial, union jurisdiction, safety and environment, work and radiation permits, decontamination, material handling and storage, change in resource, quality, other impacts if applicable and impacts to other projects.
- Providing all required data and supporting document for the CCF.
- Attend the Change Control Board to discuss and respond to questions for CCFs pending approval.
- Updating the Project Management Plan as a result of a change if required.

Within the context of the change management process, the PM has the ultimate accountability to ensure changes are fully documented via a CCF and approved by the appropriate authority level as outlined in Section 0 and that the processes documented within this procedure are adhered to.

### 5.3 Project Director

The Project Director is responsible for:

- Reviewing and challenging changes proposed by the PM that are within PM's approval authority.
- Challenging the Project Manager to find offsetting reductions to minimize cost increases.
- Recommending contingency changes to the appropriate contingency owners.

### 5.4 Unit Outage Manager

The Unit Outage Manager is responsible for:

- Ensuring new work orders are reviewed and urgent actions taken to protect the critical path schedule, while ensuring follow up with Project Managers to ensure baselines are maintained.
- Ensuring new work orders are assigned to Project Managers for acceptance of scope.
- Screening new scope through the Daily Work Screening process.

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- Referring new scope that is not accepted by the Project Manager during the Screening process to the CCB.
- Concurring that a CCFs requires use of the Fast Track process described in Section 7.4.3

### 5.5 Planning & Controls (P&C)

#### 5.5.1 Director, Planning and Controls, NR

The Director, Planning and Controls is responsible for:

- Establishing and setting the direction for Program Change Management activities for NR.

#### 5.5.2 Manager Project Controls, Cost & Change Management, NR

The Manager Project Controls, Cost & Change Management is responsible for:

- Establishing and managing the processes, guides, and tools necessary to facilitate successful implementation of Program Change Management process.
- Administration of the Program Change Control Board (PCCB) process.
- Reviewing CCF's for compliance with the principles and governance of this manual and providing feedback and coaching on requirements.
- Tracking and following up on requests made or actions assigned by the PCCB.

#### 5.5.3 P&C Leads

The P&C Leads are responsible for:

- Coordinating evaluation and disposition/approval of the change including routing the CCF to the appropriate functional department or subject matter expert to perform an independent evaluation of the impacts of the change.
- Assisting the PM with preparation of change documentation.
- Confirming impacted systems or tools are updated such as P6, the Master Project List (MPL), etc.
- Creating a SCR for adverse trends identified from change pattern analysis if applicable as defined in Section 6.



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### 5.5.4 P&C Cost/Schedule Analyst (CSA)

The P&C CSAs are responsible for:

- Supporting the P&C Leads in coordinating evaluation and disposition/approval of changes.
- Reviewing the CCF and supporting documentation to ensure compliance with the criteria set out in this procedure.
- Communicating disposition of the CCF to the stakeholders.
- Updating the cost management system.
- Maintaining the change register.

### 5.5.5 P&C Reporting Department

The P&C Reporting Department is responsible for:

- Providing monthly metrics including trend reports and reporting out of the Change Management process as required.

### 5.5.6 P&C Change Administrator

The Change Administrator is responsible for:

- Administration of the CCB process.
- Reviewing CCF's for compliance with the principles and governance of this manual and providing feedback and coaching on requirements.
- Analyzing CCF trends and presenting analyses to the CCB as required.
- Tracking and following up on requests made or actions assigned by the CCB.
- Following up on SCR actions related to this procedure and/or CCF trends.
- Providing an interface between the committees and boards in this Change Management process.

### 5.5.7 P&C NR Estimating

The P&C NR Estimating department are responsible for:

- Reviewing and/or validate estimating basis of submitted changes including the estimate class and accuracy and completing CCF input in Section 2.

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### 5.6 NR Controllership

NR Controllership is responsible for:

- Deciding the correct accounting determinations and project funding sources.
- Reviewing the change register including selected review of individual CCFs (Finance Assurance).

### 5.7 Functional Departments

Functional Department processes are governed by their functional procedures; however when changes in functional work impacts NR project cost, schedule or scope baselines the Change Management process applies. Example:

- To draw contingency when a contract change (an amendment, PCD, PCA or CTP) is required for additional scope, a CCF must be raised and approved prior to updating the vendor contract and commencing work.

Functional Department Managers' budgets released through the business planning release process are governed by this Change Management process if the change meets the criteria detailed under section 6.0. For the purposes of this procedure, Functional Managers hold the same accountabilities as a Project Manager.

### 5.8 Subject Matter Experts

Depending on the nature of a change, a Subject Matter Experts (SME) may be requested to provide written feedback and recommendations on a proposed change. SME's can be anyone with the specialized knowledge or experience to provide additional analysis and recommendations.

SME's provide an independent assessment of the impacts of change for consideration by the approving authority.

### 5.9 New Work Screening Committee

The Director Unit Outage is responsible for the New Work Screening process. Chaired by the Project Control Centre (PCC) Manager, the New Work Screening Committee is comprised of:

#### Required Attendees:

Operations  
Work Management  
Planning & Controls  
Maintenance  
Engineering  
Finance  
CPAAC Member

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Optional Attendees:  
Representative from Regulatory Affairs

All proposed scope additions, deletions or changes will be screened by the New Work Screening Committee prior to being released to the Project Manager to execute with the following being considered:

- Confirm if the work order requires an outage to execute, if no outage is required the work will be rejected.
- Determine if the new work is considered to be operations or maintenance work and if Operations or Maintenance agrees to accept the work, the work order can be approved into scope and a CCF will be submitted if required.
- Determine if the work is to be executed by a Project, and if the project owner accepts the work, the work order can be approved into scope and the Project submit a CCF if required.
- Determine if an Action Request from Regulatory Affairs and ensure the screening process is followed with Operations or Maintenance or a Project accepting the work.
- Work Orders removed from scope with greater than 1,000 hours will be reviewed to determine if an action needs to be assigned by the Screening Committee for the Project to initiate a CCF to reduce budget.

If the Screening Committee can't come to an agreement on an owner for the work then the person / group sponsoring the work (typically the SCF initiator) will prepare a CCF and the CCB will assign the work to Project. Once the Project is assigned, the project will finalize the CCF and obtain appropriate approval.

Action items arising from the Screening Committee will be recorded in the Risk Management and Oversight Tool (RMO) using Meeting Source "New Work Screening Committee".

### 5.10 Change Control Board

Chaired by the Vice President, Refurbishment Execution, the Change Control Board (CCB) is a diverse group of individuals who are responsible for making the ultimate decision regarding project changes. The CCB considers the implications of changes that exceed a Project Managers authority, approves Tier 3 Milestone changes and refers significant new or changed scope to the Project Decision Meeting or if deemed necessary obtain concurrence of the Program Scope Review Board (PSRB) or Program Change Control Board (PCCB). See NK38-CORR-09071-0591482 for the Terms of Reference for the CCB.

Note that staffing and resource changes are not within the authority of the CCB. The CCB needs to assess these requests and either reject the change or recommend the change for approval to the PCCB.

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Action items arising from the CCB will be recorded in the RMO Tool using Meeting Source "Change Control Board".

When the need arises for urgent approval of a CCF, a fast track process to allow CCB members to vote via email has been developed, see Section 7.4 Decision.

## 5.11 Project Decision Meeting (PDM)

When significant new or changed scope requires a decision as to whether or not it should be included in the NR Program or be moved to Darlington Station for processing through their change management process, a Project Decision Meeting (PDM) will be held.

The chair of the PDM is the Vice President, Refurbishment Execution (or delegate) along with senior representatives from Refurbishment Operations & Maintenance and Station Engineering.

Meeting participants will consider the appropriateness and implications of adding new scope. The following considerations should be made when evaluating the proposed scope:

- The scope requires the reactor to be de-fueled/de-watered.
- The scope could significantly exceed normal outage durations.
- The scope could significantly extend normal outage durations.
- The scope has other overriding long term operational impacts to the Station.

If the PDM decides that the proposed change warrants further work by the NR Program, a sponsor will be designated to create a DRAS as appropriate.

## 5.12 Options Review Board (ORB)

In cases where there are multiple potential options to address new scope, and the option set does not provide a clear preferred option, an Options Review Board (ORB) will review each option and decide which will be pursued. The ORB is responsible for making an informed and business-conscious decision. The ORB is administered by NR Execution.

The ORB is chaired by the Vice President, Refurbishment Execution along with senior representatives from Operations and Maintenance, Engineering, Planning and Controls, Execution, Supply Chain, Finance and External Oversight.

The ORB is empowered to make decisions to progress work toward full definition. Cost implications require a CCF and approval via this Change Management Process.

## 5.13 Program Change Control Board

The PCCB, Chaired by the Vice President Planning and Controls is convened to approve significant Program level cost and schedule changes. The PCCB also approves all Program Contingency draws or returns and impacts to Tier 1 and 2

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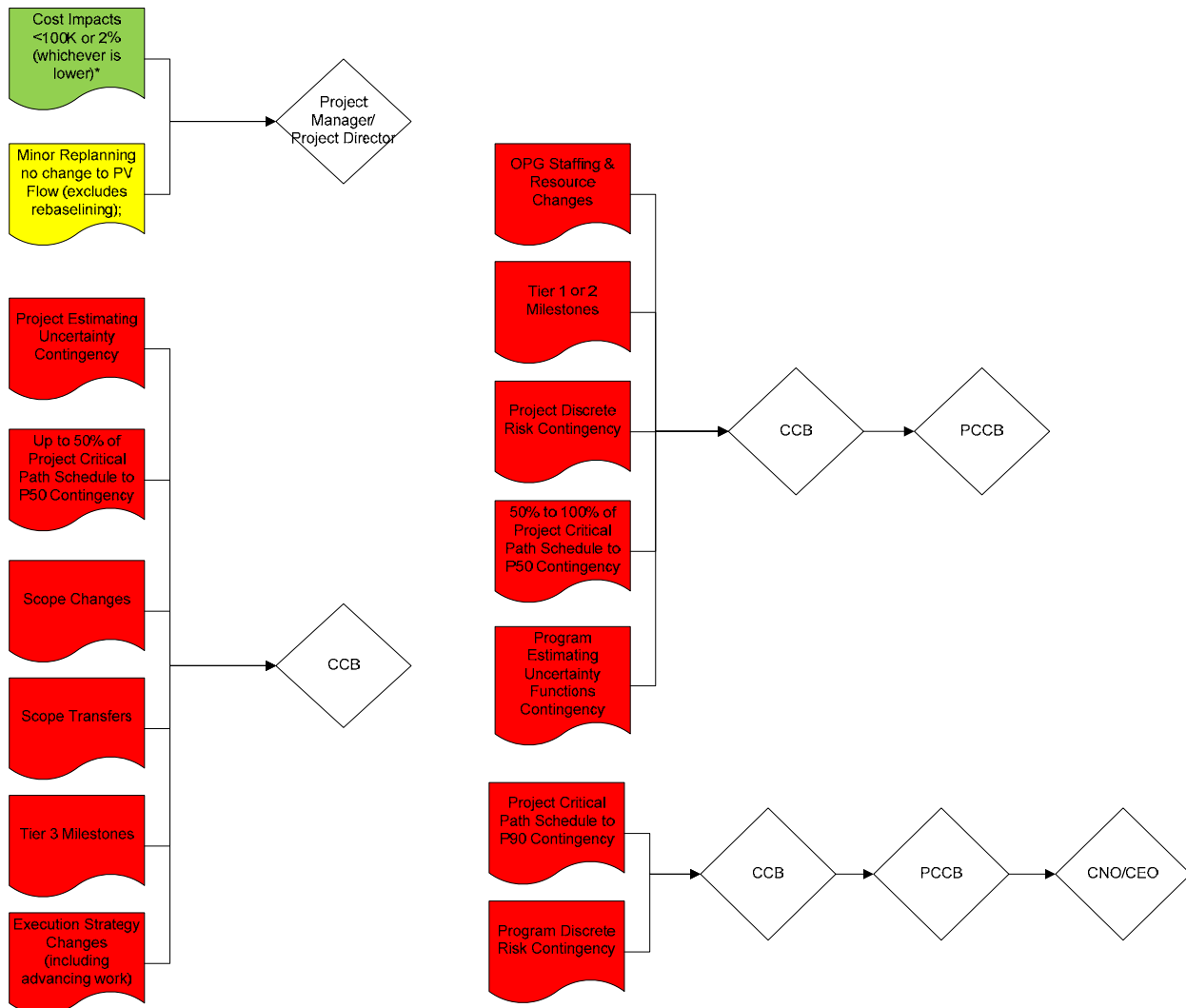
Milestones. See NK38-CORR-09071-0591416 for the Terms of Reference for the PCCB. The PCCB approves OPG staffing and resource changes.

Action items arising from the PCCB will be recorded in the RMO Tool using Meeting Source "Program Change Control Board".

## 6.0 CHANGE MANAGEMENT PROCESS

### 6.1 Change Decision Criteria

The Change *decision criteria* utilize GREEN, YELLOW, RED labels to identify the level of impact the change has on the project baseline, and consequently the level of approval required. The criteria are noted in the diagram below:



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Separate schedule criteria based on durations are not laid out as it is assumed that all schedule changes/delays will be translated to cost based on the *project burn rate* and the cost criteria applied.

### 6.1.1 Green Changes

GREEN changes are addressed within the level of authority of the project/function, an example is a change to contractor field execution work where an agreed alternate arrangement has been developed by the executing organization; a CCF will be entered for a GREEN change and will be tracked for trends. Green changes update the project forecast, but not the baseline. Green changes will be reviewed to ensure that they are accurately labelled as Green. For RFP approvals, Finance will accept an approved GREEN CCF as authorization for PO increases.

Adverse trends will be monitored by the Project Managers to ensure action is taken to correct, and submitted a RED CCF when required.

For small projects where the two percent threshold is not material, the Senior Vice President Execution has the authority to override the percentage and approve the change up to \$100K. Section 1 of the CCF completed with the amount initialled by the Senior Vice President Execution.

### 6.1.2 Yellow Changes

YELLOW changes are addressed within the level of authority of the Project Manager and Director within the envelope of the latest approved project's baseline. YELLOW changes will go through rigorous review and evaluation. YELLOW changes do not change the overall control budget. YELLOW changes can facilitate re-planning of future work within the same project budget (example cash flows). If there is an impact to field work, a scope change or a change in contracting, procurement or executing strategy the CCF is considered RED and must be approved by the CCB. The principles of not changing past and not changing solely for the purposes of correcting performance issues within the control of the project will be strictly enforced.

### 6.1.3 Red Changes

RED changes have a material impact on the Gate approved cost, schedule or scope. These include fundamental changes to Contracting Strategy, Procurement Strategy, Execution Strategy or Design Requirements and require a contingency draw or return. RED changes will go through rigorous review and evaluation. All scope changes, additions or transfer requests are considered to be RED changes that require significant review for impacts. All contingency draws are considered RED changes. The material cost impact threshold is considered:

<b>Projects &amp; Functions, the lower of</b>	\$5M	10%	of the current approved baseline budget
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The material schedule threshold is considered a revision to any of the Tier 1, 2 or 3 milestones as listed below (refer to N-MAN-00120-10001-SHT-06: Nuclear Refurbishment- Milestone Definition Framework):

Milestone	Description	Example
Program Tier 1	Milestones that are commitments to the Board or decisions at Board Level	Release Quality Estimate, and Unit Start/Finish Dates
Program Tier 2	Critical Impact Milestones normally documented in Phased based Program Business Case Summaries per Release Strategy	CNSC Approval of ISR
Program Tier 3	Program Controls, including the NR AIP Milestones and NR AIP Scorecard, Milestones that manage the health of the Program and keep it on track	All Projects Scope Freeze/Detailed Engineering Finished

Program Tier 1 and 2 Milestone schedule delays require approval by the PCCB.  
Program Tier 3 Milestone schedule delays require approval of the CCB.

Schedule impacts that do not impact on Tier 1, 2, or 3 milestones may also be considered to be a Red change if the cost impact of a delay reaches one of the cost thresholds listed above when taking the project burn rate into account.

The Schedule Change Control process is governed by N-MAN-00120-10001: SCH-11, DR Schedule Management Plan for Integrated Level 3 Execution.

Decision Type	Contingency				
	Impacts Forecast	Impacts Baseline or Cash Flow	Program	Project	Management Reserve
<b>GREEN</b>	Y	N	N	N	N
<b>YELLOW</b>	Y	MAYBE	N	N	N
<b>RED</b>	Y	MAYBE	Y	Y	Y

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### 6.2 Change Classification

The Initiator will choose a *Change Classification* from a drop down list. The following is a list of change classifications:

Classification			
1	Scope - OPG	9	Quality & Conformance - OPG
2	Scope - Vendor	10	Quality & Conformance - Vendor
3	Resources/Materials - OPG	11	Safety - OPG
4	Resources/Materials - Vendor	12	Safety - Vendor
5	Process & Communication - OPG	13	External Influence Nuclear Refurbishment
6	Process & Communication - Vendor	14	Refurb Program Strategy & Integration
7	Contract Management - OPG	15	Estimate Change - OPG
8	Contract Management - Vendor	16	Estimate Change - Vendor

Individual changes may not have an immediate significant impact on cost, schedule, or scope but they may be symptomatic of a larger problem that may cause more significant impacts in the future or may affect other projects. For example delay in or unavailability of a field service such as radiation protection, scaffolding or permitry may not cause a significant impact for one particular case if alternate work arrangement is possible; however future similar service issues could have much larger impacts if this trend continues and the systematic issues go unresolved.

Change classifications are assigned to all levels of changes to facilitate reporting on trends. Change classifications also have potential commercial implications related to contractor changes or claims.

### 6.3 Change Type

There are three (3) basic *Change Types*: *Forecast Change*, *Budget Change* and *Schedule Change*. The table below contains details of which categories are updated depending on the type of change:

Change Type				Contingency		
	Impacts Forecast	Impacts Schedule	Impacts Scope	Program	Project	Mgmt. Reserve
Forecast Change	Y	MAYBE	N	N	N	N
Budget Change	MAYBE	MAYBE	MAYBE	MAYBE	MAYBE	MAYBE
Schedule Only Change	N	Y	N	N	N	N



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### 6.4 Contingency Changes

The development of contingency amounts and time-phased planning and monitoring of contingency forecasts are governed by the Risk Management and Cost Management Sections respectively using N-MAN-00120-10001: RISK, Nuclear Projects Risk Management.

The Program Change Management process provides the structured framework and the mechanism to document, review and approve “draw” or “return” of contingency funds.

To facilitate tracking contingency usage, unused contingency must be returned to program contingency account using a CCF; it cannot be transferred between projects or bundles. The process of returning contingency does not apply to an underrun or savings realized on completed work.

Note that schedule contingency/float shall be reviewed for the impact on critical path, reference procedure N-MAN-00120-10001: SCH, Nuclear Projects Schedule Management.

The contingency management process for the DRP is incorporated in the project controls framework and focuses on early identification of risks and trends, active mitigation, forecasting, and contingency adequacy reviews in order to proactively manage the project estimate at completion.

Whenever possible, drawdown of contingency will be avoided by effectively managing and mitigating risks and trends including the use of favourable variances identified through project cost forecasting. When a risk or trend cannot be fully mitigated a drawdown of contingency will occur.

The following controls will be incorporated into the process for managing the drawdown of contingency:

All project changes, including scope, cost, and schedule, will be documented, reflected in the risk register and reviewed and dispositioned by the CCB.

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**6.4.1 Project Contingency**

Source	Approver	Approval Threshold
Estimating Uncertainty – Projects	SVP Refurbishment Execution	100%
Critical Path Schedule to Medium Confidence	SVP Refurbishment Execution	To 50% Consumption
	SVP Nuclear Projects	50% to 100% Consumption
Critical Path Schedule to High Confidence Duration	CNO and CEO	100%
Discrete Project Risks	SVP Nuclear Projects	100%

(1) Includes \$42 Million for Facility and SIO Projects

**6.4.2 Program Contingency**

Source	Approver	Approval Threshold
Estimating Uncertainty – Functions	SVP Nuclear Projects	100%
Discrete Program Risks	CNO and CEO	100%

All program contingency changes, including scope, cost, and schedule, will be documented, reflected in the risk register and reviewed and dispositioned by the CCB and PCCB.

In addition to the above approvals, the following controls will be implemented:

Any discrete risk resulting in an allocation of contingency greater than \$40 Million will require CNO and CEO approval. This aligns with the Organizational Authority Register (OAR) requirement for in-budget project investments.

Notification will be provided to the CNO and CEO on contingency draw downs that impact multiple units.

Any contingency allocation requiring CNO and CEO approval also requires CFO approval.

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Any low probability high consequence event that is outside the contingency determined for the project (e.g. Force Majeure, significant labour disruption, an international Fukushima Type Event) will be escalated to the DRC for approval. This may result in a revision to the DRP Business Case.

### 6.4.3 Management Reserve

Management Reserve funding approval, if it becomes necessary, will require resubmission of the NR business case to the Board of Directors prior to approval in a CCF.

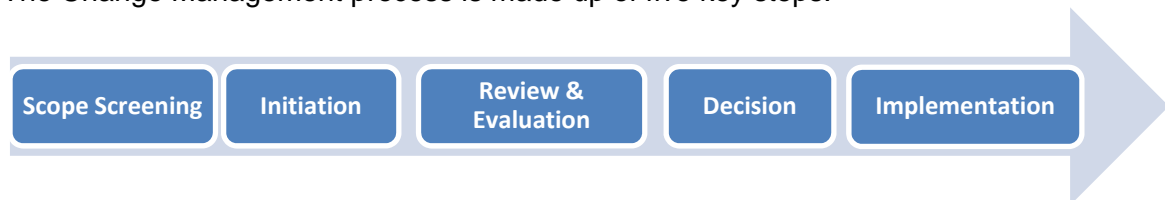
### 6.5 CCF Approval Authority Level

The CCF approval authority level is based on the cumulative change impact of all GREEN, YELLOW AND RED CCFs, not incremental change. When a project is re-baselined, the cumulative approvals of remaining contingency apply to the re-baselined value and not to the original project baseline value. Example:

	Incremental Change	Cumulative Change	Total	Growth	Authority Level
Project Baseline			\$6,000,000		
CCF #1	\$550,000	\$550,000	\$6,550,000	9%	within PM Authority, <10% or \$5M of Project or Functional Baseline
CCF #2	\$400,000	\$950,000	\$7,500,000	15%	not within PM Authority, >10% or \$5M of Project or Functional Baseline

## 7.0 CHANGE MANAGEMENT STEPS:

The Change Management process is made up of five key steps:



See Appendix D, Process Overview.

### 7.1 Screening, Scope Changes/Additions

All proposed scope changes and additions initiated by creation of a new Work Order or work request will be screened daily by the New Work Screening Committee. The process of screening scope is further defined in Appendix B. The Project Manager accepts the scope change and initiates a CCF if required based on the criteria of this procedure for approval at the CCB. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

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Significant new or changed scope will be referred by the CCB to the PDM and if approved, a scope sponsor prepares a DRAS for budget approval by the PSRB. In cases where there are multiple potential options to address new scope, the ORB will review the options and decide which will be pursued.

## 7.2 Initiation

The initiator starts the process with a CCF. Refer to Appendix E for an example of a CCF with instructions for completing the form.

For GREEN changes, the initiator completes Section 1 of the CCF. Section 1 provides the minimum information required to register a change for trending. GREEN changes are reviewed and if agreed to be GREEN go directly to Implementation. The output of Implementation for a GREEN change is trending metrics.

For RED or YELLOW changes, the initiator completes **all** Sections of the CCF, **no blank fields will be accepted**.

All required data on the CCF must be completed and the following supporting documents are required as applicable:

- Business rationale or justification for the requested change.
- Technical supporting documents if applicable.
- Cost Estimates prepared by OPG and/or Contractors in sufficient detail to allow review, including hours, rates, quantities and assumptions. Contractor estimates are reviewed and validated by P&C Estimating Department.
- Identify the change impact on project interest and include in the cost estimate.
- A resource loaded schedule with affected activities and Critical Path impacts listed if applicable.
- Identify impacts to the Work Breakdown Structure (WBS) including to the overall Program WBS if applicable.
- Identify impacts to the Risk Register, including listing any additional risks, closed risks, changes in impacts on probability, schedule and cost and mitigating actions required.
- A listing of the Work Packages affected by the proposed Change in the required in the following format:

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Work Package ID	Work Package Title	Original Budget	Approved Changes	Control Budget	Pending Changes	Control Budget + Pending Changes

- Identify impacts to Contingency.
- Identify the impact to the Project Life Cycle Estimate at Completion (EAC), provide a definitive EAC and compare to the Control Budget.
- Any other relevant supporting documents that facilitate review and evaluation of the change.

The CCF is a stand-alone document subject to audit and significant scrutiny, all documentation must be attached.

### 7.3 Review and Evaluation

The CCF is reviewed to ensure that an adequate amount of information and backup to fully support the proposed change is included as listed in Section 7.2 and that all required fields of the CCF are completed and correct. The evaluation of the impacts of change is integral to the success of a Project.

If required, the CCF is routed to the appropriate functional department or subject matter experts to perform an independent evaluation of the impacts of the change. Impacts that must be evaluated are:

- Cost
- Schedule
- Scope
- Basis of Estimate
- Estimate at Completion
- Risk

Project or vendor basis of estimates must be evaluated by the P&C Estimating Department. For estimates less than \$500K, allow two working days for review. For estimates greater than \$500K or of a complex nature, allow five working days. NR Estimating complete the "Estimate Review" section of the CCF.

Other Impacts to consider, but not limited to, are:

- Nuclear Safety
- Conventional Safety
- Environmental
- Union Jurisdiction
- Commercial
- Design

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- Work and Radiation Permits
- Decontamination
- Material Handling and Storage
- Work support activities

The key outputs of the Review and Evaluation of a CCF are:

- Independent written feedback regarding the identified impacts.
- Recommend action to the approving authority.

Outputs of evaluation are attached to the CCF as backup documentation.

### 7.4 Decision

The core expectation of this procedure is that change is managed at the lowest level of the organization that has the authority to do so and that change that has a significant potential impact on project or program scope, cost and schedule is reviewed in detail and the recommended direction is approved at the required level. Approval is based on the decision criteria applied in section 6.1.

#### 7.4.1. Change Control Board

The CCB is Chaired by the Senior Vice President, Nuclear Refurbishment (or delegate) and scheduled as/when required. The CCB may also refer a change for additional approval as required. The CCB approved change within their authority. The CCB recommend to the PCCB OPG staffing and resource changes.

#### 7.4.2. Program Change Control Board

The Program Change Control Board (PCCB) Chaired by the Vice President, Planning and Controls is scheduled as/when required. The PCCB convenes to approve significant Program level cost and schedule changes that require additional approval. The PCCB approve OPG staffing and resource changes.

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#### 7.4.3 CCF Fast Track Process

Due to the nature of construction projects and the need to process urgent changes that impact field work, a Fast Track process exists for urgent CCF's:

Step	Description	Responsible	Notes
1	Prepare CCF and Supporting Documentation	Project Manager	The Fast Track CCB processes will require quality CCF form, with supporting documents.
2	Assess if fast track process is required	Planning & Control Lead	Criteria for Fast Track: - Immediate impact to field work - Is not caused by poor planning
3	Concur that the fast track process is applicable.	Unit Director (Work Control)	Email: Project, Unit Director, Copy Change Administrator
4	If #3 = NO, CCF will be submitted via the regular CCB process and schedule	Planning & Control Lead	Register for next CCB
	If #3 = YES, Review CCF for quality, then prepare for a email-based voting process.	Change Administrator	Voting email to CCB members, copy Project Manager to respond to questions.
5	CCB Vote	Change Control Board	Upon approval, the results will be communicated and the change recorded in cost management system.

It should be noted that the Project Control Centre (PCC) has the authority to approve changes in the field in emergency situations and the change paperwork will be submitted after the fact.

Expectation is that turn-around time for fast track is to be less than 5 business days.

#### 7.5 Implementation

The final decision and disposition of a CCF will be communicated to all stakeholders listed on the CCF. The status of a CCF will be changed to "approved" once all actions are completed.

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The following systems and tools shall be updated, as applicable and verified updated by the P&C Lead:

ACTION	RESPONSIBLE
Budget cost and cash flow ("PV") baseline Proliance	NR Cost Management Section
Schedule baseline plan in Primavera P6	NR Schedule Management Section
Risk Management and Oversight (RMO) database	NR Risk Management Section
Project Management Plans	Project Managers, or designate
Contracts/Purchase Orders with Suppliers	Supply Chain
Update Change Register	NR Cost Management Section
Update IDB Data Sets	Data Stewards

## 8.0 CHANGE REGISTER

A Change Register will be maintained in the Cost Management system by the P&C Cost Management Section to record the sources of change, track and monitor status and provide inputs for key change related metrics.

The following are maintained in the Change Register:

- (a) Change Identification
- (b) Date Initiated
- (c) Change Type
- (d) Resultant Change Status
- (e) Action By (Submitter, Approver, Rejecter)
- (f) Approve/Reject Comments
- (g) Disposition Date (date approved or rejected)
- (h) Cost
- (i) Total Milestone Variance Days



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### 9.0 METRICS AND REPORTING

The data compiled in the Change Register will be used to generate Program and Project metrics. Metrics will be generated on a monthly basis and include statistics such as:

- (1) Number initiated
- (2) Number Approved
- (3) Number Rejected
- (4) Change Classification Trends
- (5) Contingency Drawn Percentage
- (6) Remaining Contingency value
- (7) CCF Cycle Time

A Station Condition Report (SCR) shall be created for adverse trends identified from GREEN change pattern analysis if applicable. The intent of the SCR is to put in place corrective actions that are consistent with the consequences involved.

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### 10.0 DEFINITIONS

A comprehensive listing of P&C Terms, Acronyms and Definitions are provided in N-MAN-00120-10001 PC-16. Acronyms and definitions used in this document are summarized below.

Term/ Acronym	Definition
Baseline	See Performance Measurement Baseline
Change	For the purposes of this procedure, a change is any deviation from an approved plan or procedure that results in a real or potential impact on project or program cost or schedule.
Change Classification	Used to differentiate the reasons for a change to facilitate trending analysis.
Change Control Form (CCF)	Change Control Form N-FORM-11252; used to document changes for trending and approval purposes.
Change Management Process	Change Management is the Project Management process (including the supporting tool) that provides a framework to identify and record changes in cost, schedule and or scope against the approved baselines.
Comprehensive Work Package (CWP)	A CWP is a collection of all necessary information required to complete the field implementation of construction work. It provides a systematic approach to completing the installation while taking into account nuclear, conventional, radiological and environmental safety.
Decision Criteria	RED, YELLOW or GREEN labels applied to differentiate the severity of a change so that the right risk-based change management controls are applied.
Executing Organization	The Project Team, OPG Function or Contractor's organization executing the scope of work.
Forecast	Forecast represents the projected cost of the Work Package, including any pending changes yet to be approved.
Integrated Data Base (IDB)	IDB is Nuclear Refurbishment's data repository where integration and mapping occur. Information is pulled into IDB for the purpose of integration, mapping, data quality analysis, data integrity, and reporting.
Performance Measurement Baseline (PMB)	<p>The Performance Measurement Baseline is the Project scope, cost and schedule approved during the Gated process for Project and Bundle Releases</p> <p>The approved budget and schedule allocated to Work Packages indicate cost and schedule performance which will be measured against Current Budget in the Cost Management System and the Project Baseline Schedule.</p> <p>The Performance Baseline will be established for both Cost and Schedule:</p> <ul style="list-style-type: none"> <li>Project Performance Baseline – Will be established at each Gate.</li> <li>Functional Performance Baseline – Will be established at each Release</li> </ul> <p>The Performance Measurement Baseline will not include:</p> <ul style="list-style-type: none"> <li>Contingency</li> <li>Management Reserve</li> </ul>

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Term/ Acronym	Definition
Program Baseline	The aggregate planning efforts during Definition Phase will converge to an overall Program Plan at Release 5, or Release Quality Estimate (RQE). This is the point when the majority of projects have sufficiently defined their execution strategies, cost, schedule and scope that will allow an overall Program Baseline to be set. The Program Baseline will be maintained and actual cost versus budget monitored.
Program Integrated Master Schedule (PIMS)	The Program Integrated Master Schedule is the Level 1 schedule controlled by OPG senior management and contains all control accounts from all projects, OPG functional as well as for program management work.
Program Milestone Schedule (PMSS)	The Program Milestone Schedule is the Level 0 schedule controlled by OPG senior management.
Program Tier 1 Milestone	Program tier 1 milestones are milestones that are commitments to the Board or decisions at Board Level.
Program Tier 2 Milestones	Program tier 2 milestones are milestones that are critical to the Program, normally documented in Phased based Program BCS's per Release Strategy.
Program Tier 3 Milestones	Program tier 3 milestones are milestones that manage the health of the Program and keep it on track
Project burn rate	The cost a project incurs on a daily or weekly basis as a result of overheads, direct expenses (e.g. equipment rental) and labour.
Program Work Breakdown Structure (PWBS)	The Program Work Breakdown Structure is a hierarchical decomposition of the entire scope of work to be executed by the program team to accomplish the program deliverables.
Scope	Within the context of this document scope refers to the data sets that are used to manage projects and the Darlington Refurbishment Program. These include for example, Darlington Scope Requests, Engineering Changes, Work Orders, <i>Comprehensive Work Packages</i> , Construction Completion Declarations (CCDs).
Work Breakdown Structure (WBS)	A hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables. The main purpose is to breakdown the scope of work into more controllable components and to identify responsible organizations for the completion of all components.

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**11.0 REFERENCES**

**11.1 Performance References**

- [R-1] N-MAN-00120-10001-PC: Project Controls
- [R-2] N-MAN-00120-10001-GRB: Nuclear Projects Gated Process
- [R-3] N-FORM-11252: Change Control Form
- [R-4] NK38-PLAN-09701-10003: Darlington Refurbishment Program – Program Scope Review Board – Terms of Reference
- [R-5] N-MAN-00120-10001: RISK, Nuclear Projects Risk Management
- [R-6] N-MAN-00120-10001:SCH-06, NR Milestone Definition Framework
- [R-7] N-MAN-00120-10001: SCH, Nuclear Projects Schedule Management
- [R-8] N-PROC-AS-0042: Quality Assurance Records
- [R-9] N-PROC-AS-0003: Controlled Document Management
- [R-10] OPG-STD-0017: Organizational Authority Register
- [R-11] N-PROC-RA-0022: Processing Station Condition Records
- [R-12] N-MAN-00120-10001: SCH-11, DR, Schedule Management Plan for Integrated Level 3 Execution.

**11.2 Developmental References**

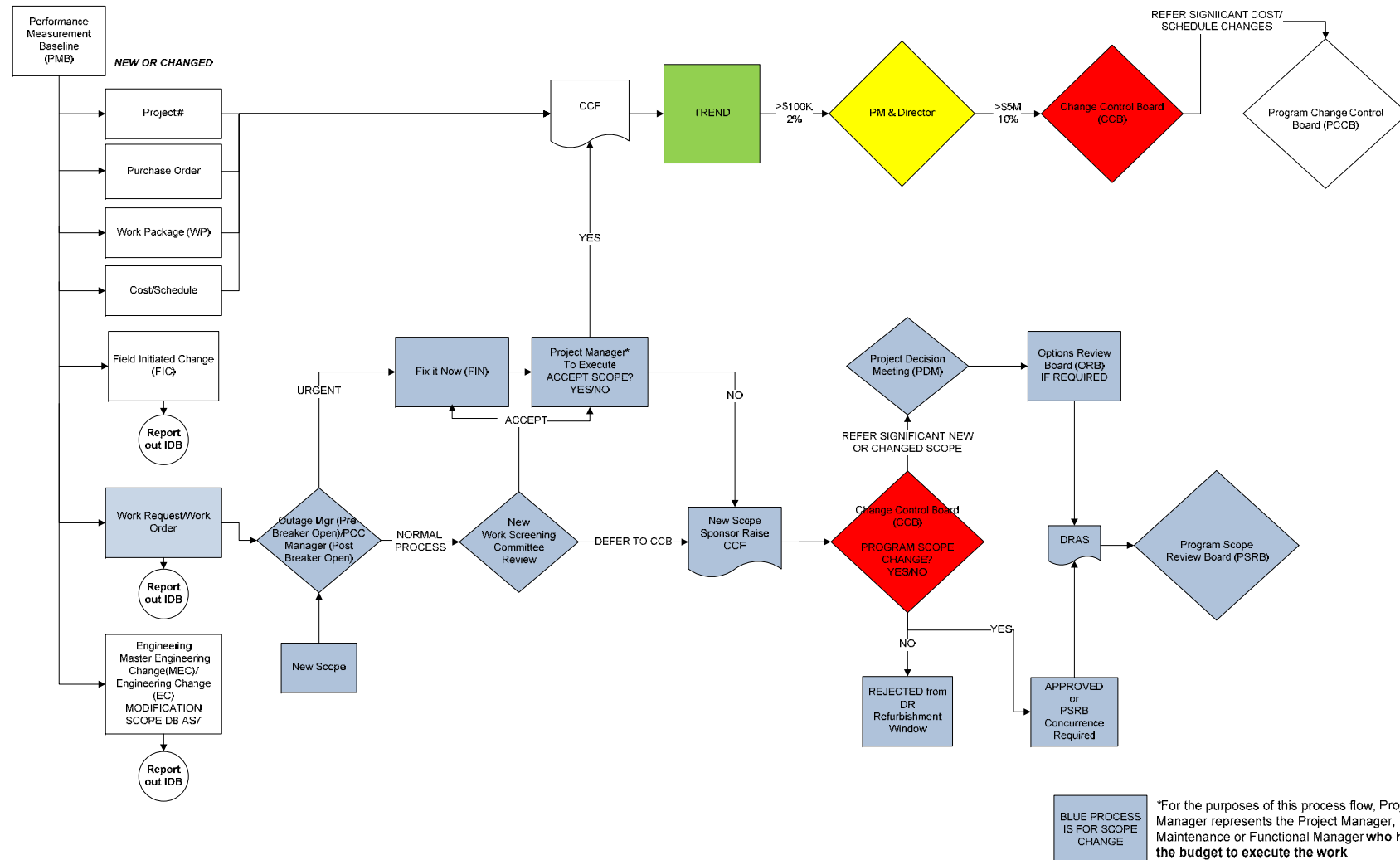
- [R-13] A Guide to the Project Management Body of Knowledge, 5<sup>th</sup> Edition (PMBOK Guide)
- [R-14] Managing Change in Organizations, PMI Practice Guide
- [R-15] Total Cost Management Framework: An Integrated Approach to Portfolio, Program, and Project Management, 1<sup>st</sup> Edition, Revised (TCM)
- [R-16] Project Control Handbook, September 2004 U.S. Department of Energy

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### Appendix A: Change Process Flow



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## **Appendix B: Scope Change/Addition Screening Process**

For the purposes of this document, "Project Manager" represents the Project Manager, Maintenance or Functional Manager who holds the budget to execute the work.

During Refurbishment execution, all requests for new scope will be handled through Asset Suite through the OMS Work Order Approval Process. A New Work Screening Committee (Screening Committee) will review work requests on a frequency depending on the volume received and categorize the work as to either execute during the Refurbishment outage or deferred as post-breaker close work.

For all types of new work orders not linked to current projects, consideration of the impacts of union jurisdictional issues and the Chestnut Park Accord Addendum (CPAA) work assignments should be made, reference file NK38-CORR-09701-0408278-T10. The CPAA Committee is available to assist with this impact assessment (contact Dan Smith dan.smith@OPG.com).

### **1.1 Emergent Work**

#### Non-Project Emergent Work

Emergent work categorized as Refurbishment by the Screening Committee and accepted by the Project Manager will be added to OMS and dispositioned by the Outage Manager as being an Available for Service requirement. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

Significant new or changed scope will be referred by the CCB to the PDM and if approved, a scope sponsor prepares a DRAS for budget approval by the PSRB.

#### New Work Team - Fix It Now (FIN)

If the emergent work requires immediate action due to station conditions, the Outage Manager (pre-breaker open) or the PCC (post-breaker open) will assign the work to the FIN Team.

The FIN team is a multi discipline team that reports to Director of NR Operations & Maintenance, which will support the Unit Director. The team will act as "first responders" for emergent work on the unit where repairs are required on Operating Systems not in the control of an EPC vendor.

Work Orders for urgent work generated from the FIN process must be accepted by the Project Manager the next business day. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

Work Orders that cannot be completed by FIN process will be prioritized, planned and integrated with appropriate windows in the outage schedule with the acceptance of the Project Manager.

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#### Project Emergent Work

Individual projects will manage their own project schedule and plan in P6, but these plans will interface with the Outage execution integrated schedule.

Additional work may be added to scope though the Screening Committee, CCB or PDM. The work must be characterized (mandatory or nice-to-have) based on work in progress, schedule and cost. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance.

#### **1.2 Cyclical Outage**

The Cyclical portion of the Refurbishment will be executed by the Refurbishment organization using Asset Suite and will follow the Refurbishment Planned Outage Management milestones and planning process.

#### Cyclical Scoping

Cyclical scoping will require a collaborative effort of Station & NR Engineering, Operations, Maintenance and Work Control. Accountability is maintained by Unit Director (NR Work Control). The Cyclical Scope selection will include the following:

##### Must Do:

- Station License or Regulatory Requirements.
- Testing/inspections required for normal shutdown and start-up of the Unit.
- Mandatory Inspections due during the Outage Period.

##### Need or Want To Do:

- Life Cycle Management inspections or Maintenance as required to facilitate RTS (Return to Service) expectations.
- Preventative Maintenance, Deficient Maintenance (DM) and Corrective Maintenance (CM) Work Orders as requested to achieve RTS expectations. These will be a subset of: PRL (Plant Reliability List) Work to Improve Unit Reliability, Reduce Forced Loss Rate, Station Cycle Plan Support and Operating Backlog Targets Support.
- Cyclical outage scoping strategy will consider scope that can be proven to add value to the station operations in future by improving maintenance method saving costs on outages, optimizing resources or improving operations. Replacement of components which due to scale of work makes economic sense.
- Operator Burden and Operator Work-Around elimination.

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This work is assigned to the Project Manager by the Screening Committee. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

**Note:** The cyclical scoping process cannot be used to circumvent the CCF or DSR/DRAS process.

#### Cyclical Schedule

The Unit Director is accountable for the preparation of cyclical schedules that will include all cyclical outage approved scope (Operations & Maintenance work orders, from breaker open to closed, required to allow operation until the next planned outage, D2221).

The cyclical outage schedule will include Operations I RTS detailed shutdown and return to service activities. Additionally, this schedule shall be reviewed for horizontal and vertical integration with the IL3 (Integrated Level 3) and CCL2 (Coordination and control level 2) schedule. Refer to N-MAN-00120-10001-SCH-11 (Darlington: Schedule Management Plan for Integrated Level 3 Execution) for more details on IL3.

The cyclical outage scoping process is initiated following the last planned outage prior to the start of the unit as per the Work Management Ownership Transfer Plan (NK38-PLAN-09701-10113-WM-01).

### 1.3 Major Scope

Significant new or changed scope will be referred by the CCB to the PDM and if approved, a scope sponsor prepares a DRAS for budget approval by the PSRB. In cases where there are multiple potential options to address new scope, the ORB will review the options and decide which will be pursued.

Major program scope changes referred to the PSRB by the CCB or PDM follow the Darlington Nuclear Program Scope Control, NK38- INS-09701-10001.

### 1.4 New Projects and Station Sponsored Work

During the time period when NR is the scheduling authority, the Station may desire to have work (new scope) performed on the unit. Since there is only one schedule to perform work in the Refurbishment unit, all Station or Projects & Modifications work groups must ensure their tasks are approved and shown on the Refurbishment schedule once approved.

New scope identified at the Screening Committee requires a scope sponsor who prepares a CCF for approval at the CCB. Significant new or changed scope will be referred by the CCB to the PDM and if approved a DRAS for budget approval by the PSRB is required. In cases where there are multiple potential options to address new scope, and that option set does not provide a clear



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preferred option, an Options Review Board (ORB) will review each option and decide upon which of the options will be pursued.

#### **1.5 Decision Escalation (Appeal) Process**

In the situation where a scope addition or change has been rejected by the Project Manager, a request can be made to escalate the decision to the CCB and PDM.

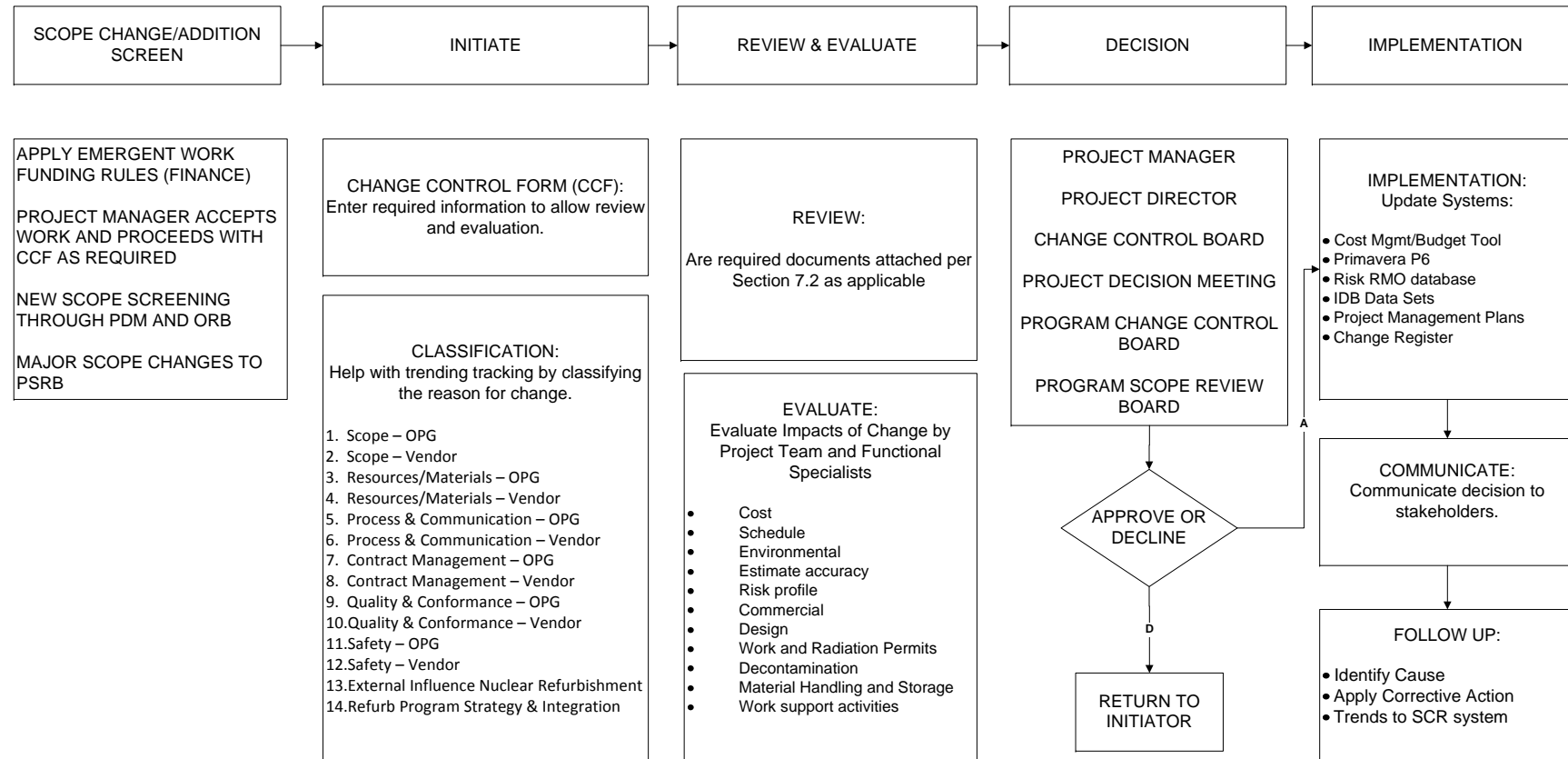
In the situation where a scope addition or change has been rejected by the CCB, a request can be made to escalate the decision to the PSRB. In such cases, a written request by the Sponsor must be made to the Chair of the PSRB with rationale. The PSRB chair will arrange an ad hoc PSRB meeting to consider the request.

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### Appendix C: Process Overview



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## Appendix D: Example of CCF



Records File Information: 6  
years after project close  
Management for File

Internal Use Only

N-FORM-11252-R004\*

Nuclear Refurbishment Change Control Form

Management for File Internal Use Only N-FORM-11252 003 **Nuclear Refurbishment Change Control Form N-MAN-0012-100001-PC-12 Program Change Management**  
**TO VIEW OR HIDE INSTRUCTIONS FOR FORM COMPLETION GO TO: START, WORD OPTIONS, DISPLAY, HIDDEN TEXT-CHECK BOX.**

Date: (YYYY-MM-DD) \_\_\_\_\_

CCF #: \_\_\_\_\_

### SECTION 1: INITIATE

<b>Project No.:</b>	<i>12345</i>	<b>Project Title:</b>	<i>Nuclear Work</i>
<b>Initiator:</b>	<i>Your Name</i>	<b>Initiating Organization</b>	<i>Your organization (example P&amp;M)</i>
<b>Change Title:</b>	<p><i>A brief title that is descriptive of the change:</i>  <i>Prefix + Short Title</i>  <i>Prefix include: Scope Transfer, Scope Addition, Scope Change, Scope Deletion, Contingency Drawdown, Contingency Return, etc....</i></p>		
<b>Description:</b>	<p><i>A key component for the evaluation of a CCF is the description of the change. A quality narrative aids in the approval and trending of the CCF.</i></p> <p><i>In a quality narrative, initiators need to explain what has changed and how the work is being managed to minimize impacts. Demonstrate that corrective actions are being taken and that SCR's, OPEX and Lesson Learned are being completed where necessary. Demonstrate that project risks are being reviewed with mitigation action plans in place. Discuss the state of contingency and this CCF's impact on contingency.</i></p> <p><i>A list of work packages being impacted by the change is not a description of change. Avoid explanations such as "poor estimate", changes are variances against an estimate that contained assumptions, explain what changed in the assumptions.</i></p> <p><i>Generic Format:</i>  <i>#. HEADING</i>  <i>&lt;Insert Narrative&gt;</i>  <i>&lt;Insert Statement&gt;, confirmed by &lt;insert name and position&gt;. [See attachment X]</i></p> <p><i>1. BACKGROUND</i>  <i>Narrative of how the change came to fruition.</i>  <i>Explain stakeholders involved</i>  <i>Explain who determined that a change was required.</i></p> <p><i>If fasttrack is sought: attach Unit Director concurrence email</i></p> <p><i>2. DESCRIPTION OF CHANGE</i>  <i>Describe what the change is.</i>  <i>Describe the situation before RQE</i>  <i>Describe the situation after RQE.</i></p> <p><i>3. SCOPE IMPACT</i>  <i>Using scope included in RQE as a basis, describe if the change involves a change in scope that deviated from the assumption made at RQE.</i>  <i>Describe the scope change, if one exists.</i>  <i>If no scope change is involved, state what the current scope is and that it has not changed.</i>  <i>If it's a scope transfer, state who is taking over and whether or not it's committed.</i></p> <p><i>Suggest to seek confirmation from, if applicable:</i>  <i>DA or Design Mgr (Design related)</i>  <i>Unit Director (Scope related)</i></p> <p><i>4. COST IMPACT</i>  <i>State RQE budget of Project.</i></p>		

\*Associated with N-MAN-0012-100001-PC-12, Program Change Management

N-TMP-10056-R011 (Microsoft® 2007)  
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	<p><i>State impact to RQE budget of Project as a result of this change</i>  <i>State what deliverables the extra budget is paying for.</i>  <i>State why extra funds is/is not required.</i></p> <p><i>Suggest to seek confirmation from, if applicable:</i>  <i>Cost Mgr (NR,NP)</i></p> <p><b>5. BASIS OF ESTIMATE of CHANGE</b>  <i>Discuss the results of the review and push back/cost mitigation attempts on OPG/Vendor estimates</i>  <i>Seek confirmation if applicable from,</i>  <i>NR/NP Estimating (Section 2)</i></p> <p><b>6. RISK DESCRIPTION</b>  <i>Risk realized, quote risk number:</i>  <i>Risks generated as a result of this change:</i>  <i>State cost uncertainty assumptions at RQE.</i>  <i>State any changes in cost uncertainty assumptions.</i></p> <p><i>Suggest to seek confirmation from, if applicable:</i>  <i>NR/NP Risk Section</i></p> <p><b>7. SCHEDULE IMPACT</b>  <i>State what the schedule impact is (even if none).</i>  <i>State impact to other bundle or functions' schedules</i>  <i>State impact to program critical path or project critical path.</i>  <i>State who will be monitoring the schedule of this change</i></p> <p><i>Suggest to seek confirmation from, if applicable:</i>  <i>Scheduling section, work control</i></p> <p><b>8. COMMERCIAL/CONTRACTUAL IMPACT</b>  <i>State if change impacts contractual terms and conditions</i>  <i>State any PCAs pending this approval.</i></p> <p><i>Suggestion to seek confirmation from, if applicable,</i>  <i>Contract Management, Supply Chain</i></p> <p><b>9. ADD OTHER HEADINGS HERE AS REQUIRED</b></p>				
<b>Reason:</b>	<p><i>The reason or cause of change should provide approvers with sufficient information to understand the business reasons of the change or the operational reason for change.</i></p> <p><i>Example of a business reason is scope change required due to an EC and an operational reason is an organizational change that requires a baseline adjustment.</i></p> <p><i>Other questions to consider:</i>  <i>Was there a risk being mitigated because of this change?</i>  <i>Did we save money because of this change?</i>  <i>Did we relieve schedule pressure because of this change?</i></p>				
<b>Classification:</b>	Choose an item. <i>Select Classification from drop-down menu.</i>	<b>Level:</b>	Choose an item. <i>Select Level from drop-down menu.</i>	<b>ROM \$K:</b>	<i>Enter Rough Order of Magnitude \$ Impact</i>

**SECTION 2: REVIEW & EVALUATE**

<b>COST IMPACT (ATTACH WORK PACKAGE CHANGE REPORT):</b>	<p><i>Provide a narrative on cost impact of the change and if a rebaseline request, the reason a cost rebaseline is required. Only approved if a major change in execution strategy, or multiple changes making the baseline no longer effective for the purposes of earned value. ATTACH WORK PACKAGE CHANGE REPORT.</i></p>	
Is a re-baseline of the Planned Value being	YES <input type="checkbox"/>	NO <input type="checkbox"/>

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requested for this change?		
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<b>ESTIMATE AT COMPLETION IMPACT:</b>	<i>Provide a narrative on the impact to the current approved EAC, currently Release Quality Estimate.</i>		
Is the EAC impacted by this change?	YES <input type="checkbox"/>	NO <input type="checkbox"/>	EAC \$:

<b>SCHEDULE IMPACT:</b>				<i>(Ensure Schedule is Updated)</i>	
Milestone/ Work Package ID	Description	Approved Date (mm/dd/yyyy)	Forecast Date (mm/dd/yyyy)	Requested Date (mm/dd/yyyy)	Variance Days
					0
					0
					0
					0
					0

<b>SCHEDULE REBASELINE IMPACT:</b>	<i>Provide a narrative on the impact to schedule, if a rebaseline request the reason a schedule rebaseline is required. Only approved if a major change in execution strategy, or multiple changes making the baseline no longer effective for the purposes of earned value.</i>		
Is a re-baseline of the schedule being requested for this change?	YES <input type="checkbox"/>	NO <input type="checkbox"/>	

<b>RISK IMPACT:</b> <i>Provide a narrative on risk realized or new risks due to this change.</i> <i>(Ensure RMO tool is Updated)</i>		
Risk ID	Description	Impact
123456	Risk Description from RMO	

<b>OPG/VENDOR ESTIMATE REVIEW:</b>	
Estimate Validation Required?	YES <input type="checkbox"/> NO <input type="checkbox"/>
AACE Estimate Class:	Estimate Accuracy Level:
Value of Vendor Estimate: \$	
Value of NR Estimating Estimate: \$	N/A <input type="checkbox"/>
Notes:	
	NAME DATE
PREPARED BY:	
REVIEWED BY:	

<b>REVIEW &amp; EVALUATION ISSUES/NOTES:</b>

**SECTION 3: DECISION**

Title	Name	Signature	Date (YYYY-MM-DD)	Approve	Reject
Initiator:					
Project Manager:				<input type="checkbox"/>	<input type="checkbox"/>

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Project Director:				<input type="checkbox"/>	<input type="checkbox"/>
CCB (Chair):				<input type="checkbox"/>	<input type="checkbox"/>
Additional Approvals:				<input type="checkbox"/>	<input type="checkbox"/>
Is a re-baseline approved for this change?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
Decision Notes:					

**SECTION 4: IMPLEMENTATION**

IDB:	<input type="checkbox"/>	RMO TOOL:	<input type="checkbox"/>	iTWO:	<input type="checkbox"/>
MPL:	<input type="checkbox"/>		<input type="checkbox"/>	P6:	<input type="checkbox"/>
ECOSYS:	<input type="checkbox"/>		<input type="checkbox"/>	AS7:	<input type="checkbox"/>



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**DARLINGTON REFURBISHMENT: SCHEDULE MANAGEMENT PLAN FOR INTEGRATED LEVEL 3 EXECUTION**

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**Darlington Refurbishment: Schedule  
Management Plan for Integrated Level 3  
Execution**

**N-MAN-00120-10001-SCH-11-R000**  
2014-04-04

Order Number: N/A  
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Revision Summary

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R000	2014-04-04	Initial issue.

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## 1.0 INTRODUCTION

### 1.1 Purpose

This document describes the Integrated Level 3 Darlington Refurbishment Schedule Management Plan (SM Plan). The purpose of the SM Plan is to provide guidance on how to develop, manage, and control the Integrated Level 3 Execution Schedule throughout the Refurbishment Execution life cycle. This covers the preparation and management of the execution plan from Breaker Open to Breaker Closed, including the integration of readiness activities.

### 1.2 Scope

The SM Plan identifies the process and procedures used to manage the schedule during the course of the Darlington Refurbishment Outage Execution. In addition to defining the schedule development approach, the plan defines who is responsible for tracking and reporting schedule progress, how schedule updates are received and incorporated, how variances and changes will be addressed, and how to baseline the schedule. The plan describes the project's schedule management tool. The plan also addresses the four execution segments, work types and work groups, taking into account Operation Authority, Nuclear Safety, Permit Strategy and Return to Service requirements.

### 1.3 Level 3 Schedule Development Timeline

The development of the Integrated Level 3 Execution Schedule will be iterative process with many inputs provided at different times. List and timeline of major revisions, deliverables and milestones required before the level 3 execution schedule is fully integrated is provided in Appendix F: Timeline of Critical Inputs Required for Development of IL3E Schedule

### 1.4 Guiding Principles

Establishing an accurate and realistic schedule is a critical planning step for a project/outage. The schedule is the main planning tool used to understand and communicate the status, interrelationships and dependencies among project activities and deliverables.

Schedule detail must be developed at an appropriate level to allow the project team to coordinate the work and communicate the plan, monitor project progress and cost performance, and use the data to make accurate forecasts, strategize and plan upcoming work.

The Integrated Level 3 Execution Schedule will:

- Be all inclusive of all work to be done during the execution window (all work groups)
- Be prepared and updated by the individual work groups and monitored by the Master Scheduler
- Be hours based
- Be one network (longest path) in a single P6 database
- Be resource loaded (histograms and work list tool) (user defined - examples; SDS qualified CT, Pipefitter Welder, BM Rigger, BM Welder)
- Be coded to roll up to the Level 2
- Be baselined

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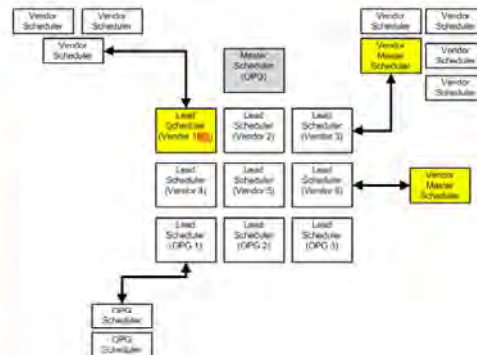
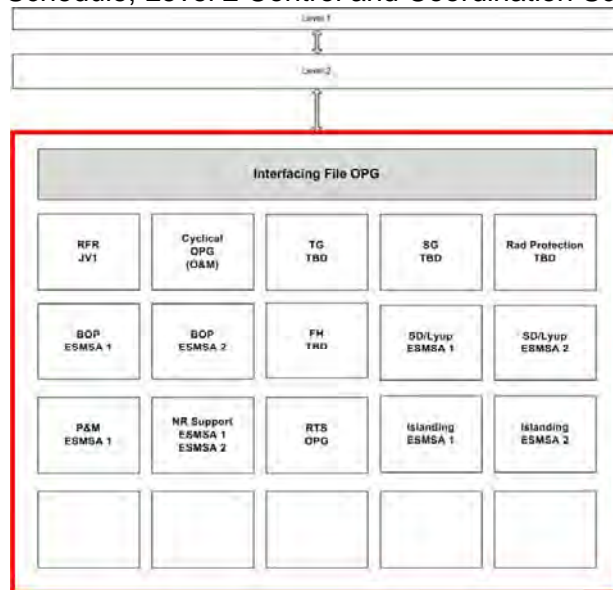
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- Have all integration activities (hand-offs) between work groups logically tied through an interface file under control of the Master Scheduler and subject to schedule change rules
- Contain appropriate detail to support Release Quality Estimate (RQE)
- Show support activities for all work groups (See Task Breakdown Table, Section 5.2)

There will be one P6 scheduling database controlled and managed by OPG. All work groups (OPG and vendor work groups) will work in the same P6 instance

- An OPG Assigned Master Scheduler is responsible to control and manage the unified P6 schedule.
- A Lead Scheduler will be assigned by each work group and will follow schedule process direction from the OPG Master Scheduler
- The work group Lead Scheduler has authority to update and revise his work group's schedule within the protocols specified by the Master Scheduler
- The Master Scheduler takes his direction from the Unit Director and Outage Manager

The structure of the schedule will include Milestones, Level 1 Program Integrated Master Schedule, Level 2 Control and Coordination Schedule and Level 3 Execution schedule



**Methodology:** Owner performing the role of General Contractor to integrate multi prime EPC and Owner directed resources for a multi year project.

**Bundle → Sub Bundle → File / Vendor (commercially independent)** working in owners P6 able to calculate Critical Path @L3 and fully integrated via OPG interfacing file.

**ESMSA Lead Scheduler may direct more than one bundle (commercially independent)**



## 2.0 PARTICIPANTS

### 2.1 Roles and Responsibilities

During the definition phase, OPG's role was that of the Design Authority and Project Manager. The Execution phase adds the role of General Contractor, Owners Engineer, and License Holder / Controlling Authority of a power reactor.

During the execution of the Darlington Refurbishment, OPG's role during execution includes the following:

- Shut down, de-fuel and lay-up the unit

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- Maintain control of the island/plant
- Ensure all aspects of safety are adhered to
- Perform Cyclical ,FIN and Contact Partner Support Work/Rehab
- Construction coordination & integration
- Schedule analysis and optimization
- Configuration control/management
- Commission and restart the unit
- Quality Oversight

Schedule-related responsibilities of staff and stakeholders involved in managing and controlling the project schedule are noted as follows:

**Responsibilities:**

- Director Planning and Controls – will approve the project's Schedule Management Plan. Responsible to establish and publish reports and metrics in support of Unit Director and other project stakeholders. Assign the Master Scheduler in order to provide the infrastructure required for the schedule development.
- Unit Director – will approve baseline schedule, and any significant changes through the schedule change control process. The Unit Director is ultimately responsible for the schedule and to complete the project according to the schedule. Accountable for unit scope management process. Accountable for development and implementation of Project Control Center (PCC) command and control processes. Accountable to identify report requirements and interpret/analyze reports and metrics. Accountable to establish and implement readiness review process.
- Outage Manager – Accountable for affirming, documenting and communicating all decisions relating to establishing and executing the critical path. Will be responsible for development of the Schedule. Accountable for identifying risks to the schedule and determining the appropriate risk management strategy. Accountable for work integration. Accountable for unit and segment forecasts. Responsible for managing outage scope. Responsible to implement PCC command & control process. Will review reports and metrics to identify and counteract schedule deviations. Responsible to implement readiness review process.
- Work Control Section Manager and Work Control Team Leaders – will be responsible for developing detailed logic for the execution of assigned outage work windows. Responsible to identify and resolve work integration issues within assigned work scope. Will identify to Project Managers any interfacing logic issues which might impact on a projects cost and/or schedule. Will document system window logic assumptions and assist Outage Manager with decision support information as required to help resolve project interface issues. Will identify risks and establish risk mitigation plans as appropriate.
- Project Manager – will oversee, provide input to the schedule and review schedule status reports provided by the Lead Scheduler. The Project Manager will also evaluate time-risk recommendations from the Lead Scheduler to avoid schedule issues. Accountable for project schedule and cost. Accountable for project readiness.
- Functional Managers – will notify the Unit Director and Lead Scheduler of workload changes that may affect the schedule. The Functional Manager will also review and approve time estimates provided by staff for the schedule.

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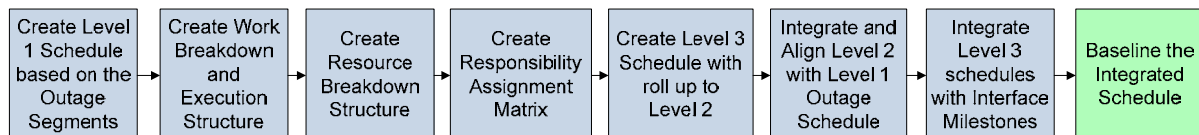
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- Work Group (OPG or Contractors) - Accountable for work quality. Responsible for developing detail schedule. Responsible for work cost. Responsible for work readiness. Responsible for work execution. Responsible to status the work. Will provide accurate time estimates for the beginning and completion of work as well as status reports on the achievement of those times. Will manage their internal activities to the timely accomplishment of the schedule, of which status shall be reported regularly notifying the Unit Director of potential or actual schedule variances. Will ensure resources are utilized efficiently and effectively such that down time is minimized and identify opportunities to utilize resources more effectively to the benefit of the project.
  - Master Scheduler – will report functionally to the Unit Director and will be accountable for the development of the unit and segment schedules. Will provide critical path analysis. Will integrate the work for the segment and unit schedule while managing and controlling the L3 interface file. Will publish reports and metrics on the work. Will raise upwards any integration or scheduling conflicts for resolution. Gives direction to Lead Schedulers on schedule logic and integration. Will maintain the scheduling tool and supporting documentation. The Master Scheduler will make recommendations to the Outage Manager to avert schedule variances that may adversely affect the project critical path, budget or expenditures
  - Lead Scheduler (Work Group) – Will develop unit and segment schedules for the work group. Will provide critical path analysis for the work group. Will integrate the work for the segment and unit schedules for the work group. Will status the schedule activities per work group's direction. Will publish reports and metrics for the work group
- Quality Assurance – will periodically audit scheduling practices to validate compliance with this Schedule Management Plan.

### 3.0 SCHEDULE DEVELOPMENT PROCESS

The schedule development process is comprised of multiple development steps. Each step taken generates a schedule subcomponent that can stand alone to inform the project team of that aspect of the final schedule. When integrated, it forms the basis for the approved working version of the final schedule known as the Baselined Schedule. Figure 1 depicts the order and the individual products generated during the schedule development process.

**Figure 1 - Schedule Development Process**



#### 3.1 Create Level 1 Schedule (PIMS-C)

The Level 1 Schedule is a visual representation of anticipated critical activities, milestones, and interfaces across the entire project/outage. Level 1 schedule is the Program Integrated Master Schedule (PIMS) that contains execution windows in the Refurbishment. Each Unit Outage will have its own PIMS. The Unit 2, Level 1 is called PIMS-C. It is developed by OPG during the Definition Phase to provide the project teams and Contractors with the earliest possible view of

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project's most critically timed activities. At this stage, the date for a critical activity may not be known, but the visual representation of the activity among all the activities on the chart will enable the team to conceptualize the relative flow of important events.

The PIMS displays both the project's expected flow of critical activities as well as the vertical integration of related deliverables from other existing or pending contracts. It displays what OPG is responsible for in parallel with the Contractor's responsibilities. It sets a clear expectation early on of critical timing between project deliverables and key events.

See Appendix C: Overview of Unit 2 -Darlington Nuclear Refurbishment Program

PIMS-C will be updated according to the schedules' milestones. With each progressive revision, more knowledge and optimization of the schedule will be incorporated. The nomenclature of the revisions will be Revision 'A' schedule, Revision 'B' schedule, Revision 'C' schedule and Revision 'O'. Revision 'O' will be the final revision before Breaker Open. In support of the Release Quality Estimate, an RQE revision will be issued. This revision will come after Rev B and incorporate the best available input from all stakeholders.

### **3.2 Outage Segments**

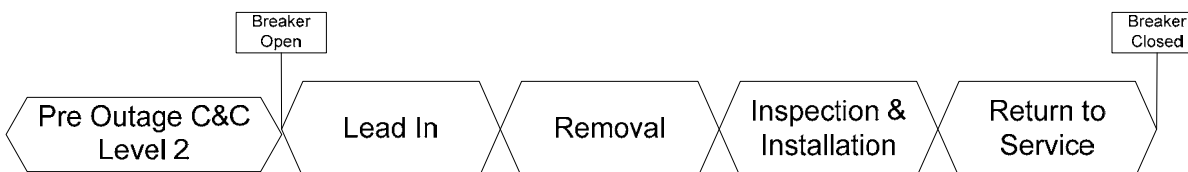
Due to duration of each Refurbishment Outage, there are complexities and data management considerations that are greater than previous outages or projects. In order to manage the volume of data in a logical fashion, Outage segmentations have been established. The segments were developed from the following rule set:

1. Segment needs to be big enough to have its own P6 project
2. Segment needs to be small enough not to threaten P6 capability with respect to the number of activities that can be in a single P6 file
3. Segment needs to be complex enough to warrant its own handling team
4. The end point for a Segment should be a natural logic node which marks the completion of a large number of activities. It may mark a major transition e.g. OPG to vendor, vendor to vendor work program, vendor to OPG. The intent is to minimize the number of activities that are carried from one phase to another in order to limit the number of interfacing milestones to only those required. To the extent possible work will be scheduled within a segment.

The benefits of breaking the Outage into Segments include:

- Maintain schedule integrity while reducing complexity
- Allows Planning & Scheduling Basis change
- Appropriate level of detail
- Strong reporting model
- Reporting frequency
- Establishes Integration Points (work horizon)
- Enables close-out of a P6 node

The segments are Lead in, Removal, Inspection & Installation and Return to Service



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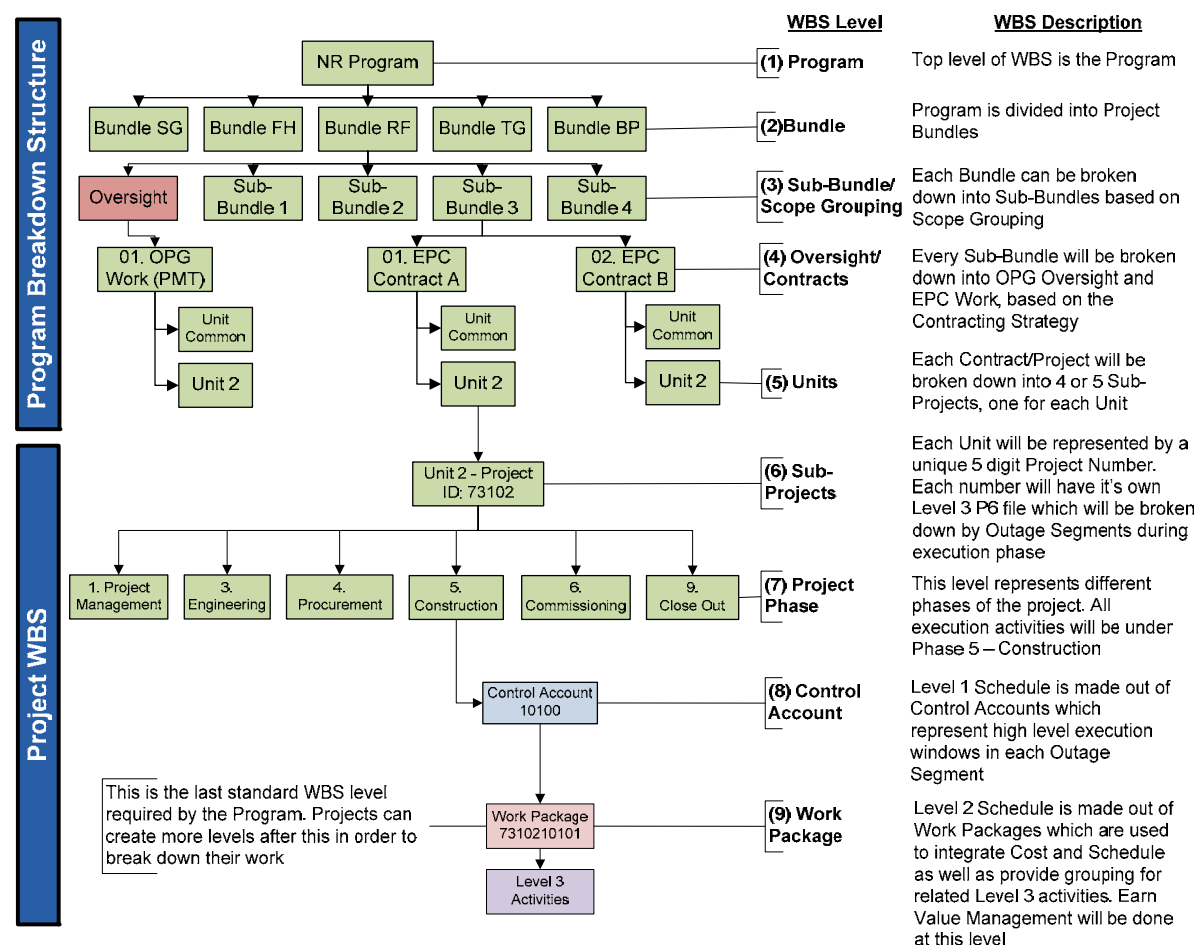
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### 3.3 Create Work Breakdown Structure (WBS)

The Darlington Refurbishment uses a deliverable-oriented work breakdown structure (WBS) to best reflect the scope of project (Reference WBS Guide NK38-GUID-09701-10006). The WBS is created by breaking down the project's main deliverable – e.g. Refurbishment of Unit 2 – into its sub components using a hierarchical -tree format and will be developed in parallel with L1 execution windows and aligned with work sequence. The upper levels of the WBS breakdown the deliverables into Control Accounts while the lower levels of the WBS depict the Work Package and activities and tasks.

Example of how the standard WBS has been implemented is in Appendix D

**Figure 3 – General Work Breakdown Structure**





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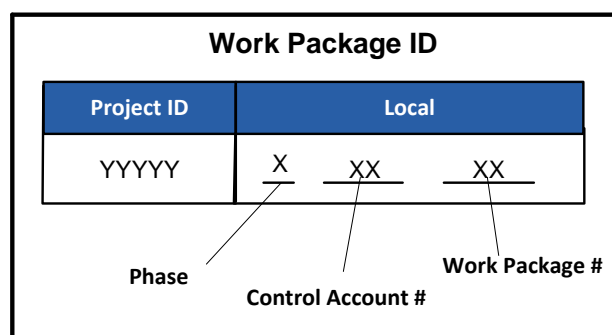
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## 3.3.1 WBS Element Numbering Methodology

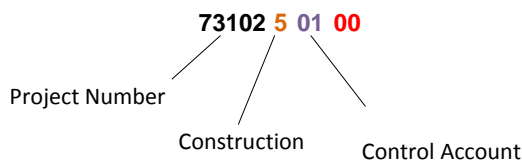
In order to successfully implement the Multi Level Scheduling Model we will utilize the WBS functionality in P6 to allow progress on lower level activities to roll up through the WBS to Work Packages and Control Accounts. To facilitate this structure and to create traceability between the WBS and the schedule and to distinguish between levels, all boxes on the WBS, known as “elements” will be numbered using the methodology shown in Table 1

**Table 1. Element Numbering Methodology**

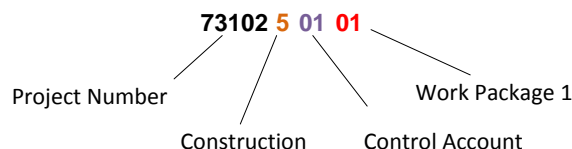
WBS Elements	WBS Path
NR Program	NR
Bundle BOP	NR.BP
Sub-Bundle Nuclear System	NR.BP.NS
EPC Contract 1	NR.BP.NS.01
Unit 2	NR.BP.NS.01.U2
Project 73592	NR.BP.NS.01.U2.73592
Construction	NR.BP.NS.01.U2.73592.5
Control Account 50100	NR.BP.NS.01.U2.73592.5.01
Work Package 50101	NR.BP.NS.01.U2.73592.5.01.01
Level 3 Activities	NR.BP.NS.01.U2.73592.5.01.01....



### Level 1 Schedule: Control Account - Activity ID



### Level 2 Schedule: Work Package - Activity ID



## 3.4 Create Resource Breakdown Structure

The Resource Breakdown Structure will be based on the Crew codes in Asset Suite 7. Crew codes will be used to estimate resources and provide resource demand curves. All level 3 activities will be resource loaded. Labour will be identified in hours. Commodities such as Pressure Tubes or Control Vales can also be included in the RBS. Common critical equipment such as the Turbine Hall Crane will also be included in the RBS in order to identify conflicts in requirements. All tasks identified in the L3 schedule will be estimated to identify resource requirements so that a resource histogram of the work identified in the L3 can be produced. Each contractor will be accountable to produce a resource histogram for Level of Effort work such as work performed in contractor shops and supervision. Total resource histograms will be a sum of the detailed tasks and the LOE estimates.

Full list of resources can be found on SharePoint: [Resource Breakdown Structure](#).

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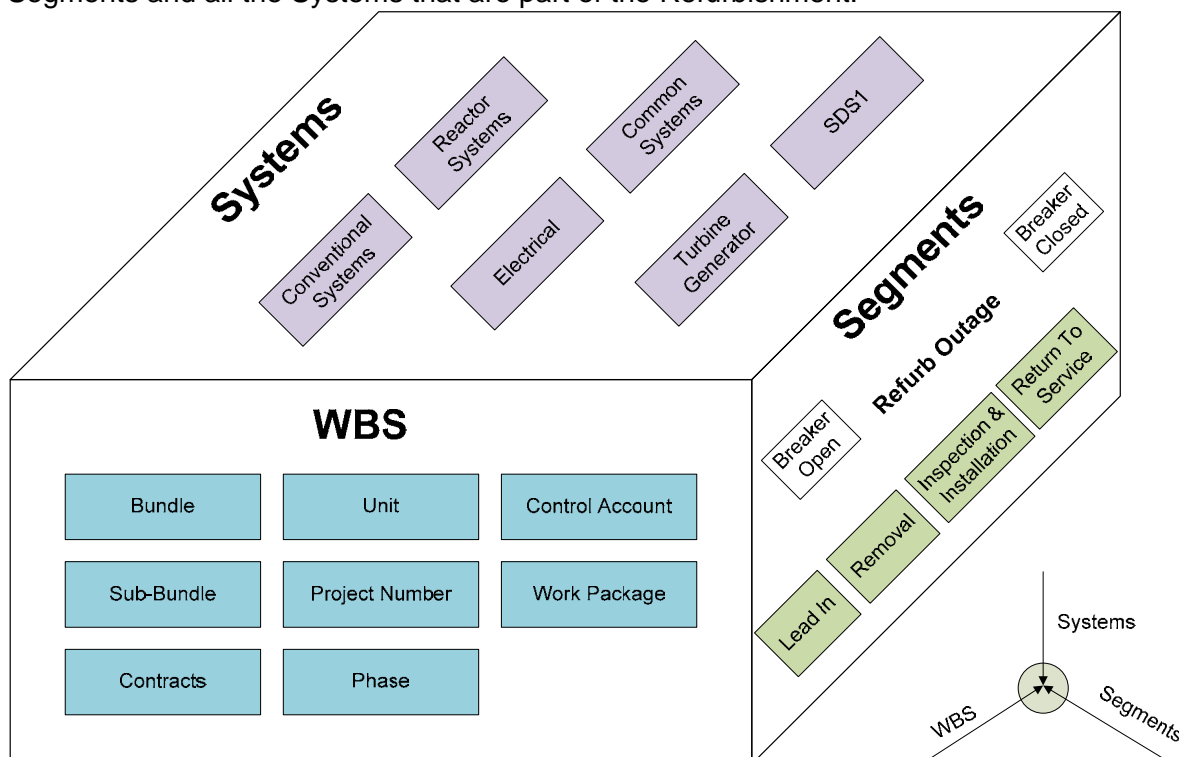
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## 3.5 Create and Integrate Schedule

The WBS serves as the outline structure for the schedule. The Execution Windows serve as identification of the unit condition which allows work to be scheduled safely and integrated. A coding structure in P6 will include a code for each Execution Window within the Outage Segments and all the Systems that are part of the Refurbishment.



The intersection of the WBS, Systems and the Execution Windows allows the schedule to be sorted and viewed by any combinations of these elements.

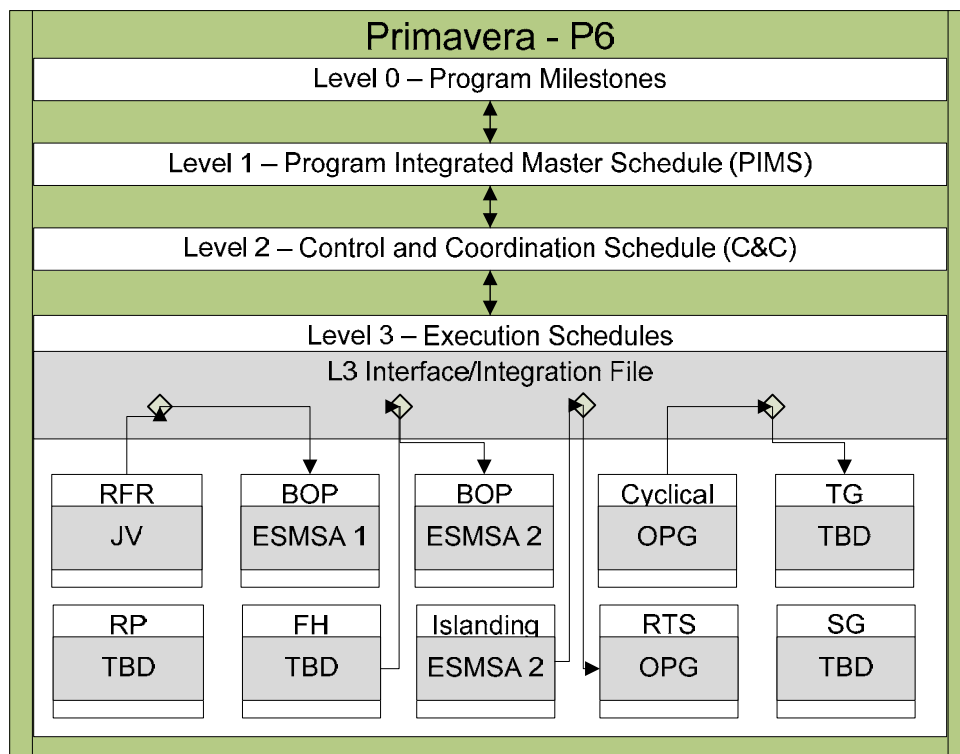
As part of the Multi Level Scheduling Model, NR Refurbishment will have different levels of the schedules that are integrated and aligned with each other using WBS Summaries, Activity Codes and Milestones, as described below:

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**Level 0 – Program Milestones**

- Program Milestones schedule including Program Release Milestones, Regulatory Milestones, Outage Preparation Milestones, and Outage Execution Milestones
- Level 1 execution schedule will be logically tied with Program Milestones

**Level 1 - Program Integrated Master Schedule (PIMS-C: First Unit Outage)**

- Level 1 execution schedule will be broken up by Outage Segments, Systems and RTS Phases/Nodes, following the standard WBS structure
- Master Scheduler will work with the vendor's Scheduling Leads to create the high level Control Accounts, based on the logic and execution windows defined by the Outage Manager
- Each Control Account will be a WBS Summary activity to allow roll ups from the Level 2 and Level 3 schedules
- Each Unit will have a separate PIMS P6 file
- PIMS will go through multiple revisions as more detail information becomes available. Revision '0' will be the final revision before Breaker Open.

**Level 2 - Control and Coordination Schedule (C&C)**

- Each Work Group/Vendor will develop number of Level 2 execution activities called Work Packages
- Work Package will be used to integrate schedule and cost, and for Earn Value Management
- All level 3 activities will roll up to Work Packages using the standard WBS, to allow progress tracking at a higher level
- Change Control is done at the Work Package level
- Level 2 will be used to manage float

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#### Level 3 – Detailed Execution Schedule

- All activities will be developed and updated in a single P6 instance, controlled and managed by OPG
- Activities will be created using standard WBS and broken into Segments and Systems
- Activities will be hourly based, resource loaded, and less than one week in duration. Longer duration activities will require additional monitoring mechanism (e.g. Work-Down Curve)
- All activities will roll up to Level 2 Work Packages using the WBS structure
- Activities will be generated using 2 methods:
  - o Manual Input by the Scheduling Leads
  - o Automatic upload of Work Orders from AS7 where each activity ID will be a Work Order and Task number.
- Each Level 3 P6 file will be owned and managed by a single Work Group/Vendor
- Standard P6 templates will be utilized to communicate the scheduling requirements for similar work across different Work Groups
- Activity Code dictionaries, resource codes and calendars will be established in OPG P6 instance and used by all the work groups
- All activities will be coded with the window segment and the system (SCI)

#### Level 3 Interface/Integration File

- All the integration activities (hand-offs) between Work Groups/Vendors will be logically tied through Interface Milestones
- The Interface Milestones will be created by the Master Scheduler and each Scheduling Lead will create logic ties between the milestones and their activities
- All the interfaces within the same Work Group will have direct ties between L3 activities
- Milestones will be created using standard WBS and broken into Segments and Systems

#### **3.5.1 Date, Sequence, and Link Activities**

There are four types of dependencies (logical relationships) used to create links between schedule tasks. The Finish to Start dependency is more commonly used for scheduling the Darlington Refurbishment.

- **Finish-to-Start (FS):** The initiation of the successor activity depends upon the completion of the predecessor activity.
- **Finish-to-Finish (FF):** The completion of the successor activity depends upon the completion of the predecessor activity.
- **Start-to-Finish (SF):** The completion of the successor activity depends upon the initiation of the predecessor activity.
- **Start-to-Start (SS):** The initiation of the successor activity depends upon the initiation of the predecessor activity.

Tasks are linked together and sequenced to identify the relationships between deliverables, sub-deliverables, activities, tasks, and subtasks. The following rules should be applied when creating task dependencies:

Tasks are linked together and sequenced to identify the relationships between activities. The following rules should be applied when creating task dependencies:

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Tasks are linked together and sequenced to identify the relationships between activities. The following rules should be applied when creating task dependencies:

- All tasks shall have at least one successor and one predecessor so there are no unlinked tasks.
- Start and Finish dates should not be entered when creating new tasks.
- For purposes of modeling the critical path, all dependencies should be linked to a detail task or deliverable and not to a summary task.
- Early dates (the earliest date on which a task can start or finish) are calculated in the forward pass of time analysis.
- Late dates (the latest date on which a task can start or finish) are calculated using backward pass time analysis.
- Constraints will be applied sparingly (only when required) in order to maintain a flexible, realistic schedule.

#### **3.5.2 Risk Estimate Duration**

To identify the time- risk associated with a critical or near critical activity or task, the Darlington Refurbishment and/or contractor staff should apply the Program Evaluation and Review Technique (PERT).

The formula is:  $PERT\ mean = (O + 4ML + P) \text{ divided by } 6$

Where:

O = Optimistic estimate

ML = Most likely estimate

P = Pessimistic estimate

The project team member performing the task will provide variables O, ML, and P to calculate an optimistic, most likely and pessimistic estimate that can be utilized in the Monte Carlo simulation. A schedule for both the most likely and the pessimistic will be maintained and risk mitigation strategies will be documented in the Risk Plan for those tasks on the critical path (Reference Risk Process N-PROC-LE-0017).

#### **3.5.3 Duration Guidelines**

As a general rule, the basis for resource estimation will be in hours. The task duration will also be in hours. Tasks of significant duration should be broken down into shorter duration tasks if possible to permit accurate assessment of work progression or they need to be supplemented with a metric/work down curve to identify status.

Standard resource calendars will be used in P6. All vendors and OPG will use the same suite of calendars.

#### **3.5.4 Validate Schedule**

##### Horizontal Schedule Review

A horizontal schedule review of the sequence of scheduled activities and logic ties is performed to ensure prerequisites or constraints are satisfied, including, but not limited to:

- Shutdown safety (e.g., redundant systems available, appropriate heat sink configurations).

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- Logical constraints (e.g., preparation work complete, isolations).
- Alignment of conventional equipment to support planned electrical evolutions.
- Satisfaction of required plant conditions (e.g., system pressure, temperature, and configuration).
- Confirmation that any operating or functional test (as-found test) required for PM WOs with an operability test required attribute are scheduled prior to the actual PM.

#### Vertical Schedule Review

A vertical slice of activities scheduled to be executed concurrently is reviewed to ensure the following:

- (1) Maintain Shutdown reactor safety (e.g., aggregate work/risk does not impair ability to control power, cool fuel or contain reactivity below an acceptable level).
- (2) Following the publication of Rev C Schedule's we will perform a risk analysis of WOs causing elevated risk.
- (3) Formulate oversight contingency or compensatory actions to mitigate both risk and possible duration extensions.
- (4) System conflicts do not exist that preclude completion of work as planned (e.g., conventional equipment alignments support planned electrical evolutions).
- (5) Sufficient resources are available (e.g., manpower, equipment, location) to complete the schedule as planned. This should include the evaluation of external resource commitments to other outages or projects.

Prior to the Reactor Safety Challenge Meeting an independent schedule review shall be completed to ensure defense in depth has been maintained throughout the outage.

- (1) The review should ensure that shutdown safety is maintained and shutdown risks are minimized.
- (2) The review should be completed by an independent licensed individual that has not been involved in the planning and preparation of the outage (e.g. a Fleet Peer).
- (3) Any outstanding actions from the independent review should be documented and reviewed at the Reactor Safety Challenge meeting.]

#### **3.5.5 Integrate Schedules**

An Integrated Level 3 Schedule is created after contract award and prior to Breaker Open. OPG and the Vendor will each prepare their schedules for integration into a single schedule - the Level 3. The Level 3 is the combined list of deliverables and tasks to be completed by OPG and Vendor, logically tied with defined duration. The combined schedule is based on OPG's Project WBS and the Vendor's scope of work.

The following steps are necessary to create the Integrated Multi-Level Scheduling Structure:

1. OPG will define all the Program Milestones based on the committed dates and create Level 0 Schedule
2. Outage Manager will define high level execution windows and system groupings for execution based on the Program Milestones, that will be represented as Control Accounts in Level 1 Schedule
3. Vendor will build a detail Level 3 schedule based on the Program Milestones and Control Accounts defined by OPG. Level 3 schedule will follow the standard WBS and will have all the mandatory activity codes like System, Equipment, Location, Unit, Work Order, MEC/EC Number etc. (See Scheduling Guide for full list of mandatory codes)
4. Vendor will summarize the Level 3 Schedules into Level 2 activities called Work Packages

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5. Master Scheduler will work with the vendors to integrate and align the Level 2 activities within the Control Accounts, refining the structure of Level 1 schedule based on the contractual commitments, constraints, coordination with other work groups and additional information that were not available during the initial planning phase
6. Master Scheduler will work with the vendors to identify and integrate any interfaces between Work Groups using the Level 3 Interface P6 File

The resulting Integrated Level 3 will be reviewed and approved by Unit Director after which it will be baselined.

Appendix E shows how multiple levels of the schedules are integrated together

### **3.6 Baseline Schedule**

Prior to commencing outage work and after OPG's schedule and the Vendor Contractor's schedule are integrated, reviewed, and approved, the schedule will be baselined.

Prior to breaker open, the Integrated Level 3 schedule will be going through multiple revisions as we develop and incorporate additional details. With each revision, we will create a new baseline. The plan is to have 4 major revisions: Revision 'A', 'B', 'C' and Revision 'O'. Revision 'O' will be the final revision before Breaker Open.

In support of the Release Quality Estimate, an RQE revision will be issued. This revision will come after Rev B and incorporate the best available input from all stakeholders.

To baseline the Integrated Level 3 schedule, the Master Scheduler saves the approved version in P6 and stores a copy in the project repository. New baseline dates are uploaded to the BI Reporting Engine, to be reflected on all the standard reports.

After Revision 'O', the baseline will be re-established only upon scope change as approved through the Change Control Process.

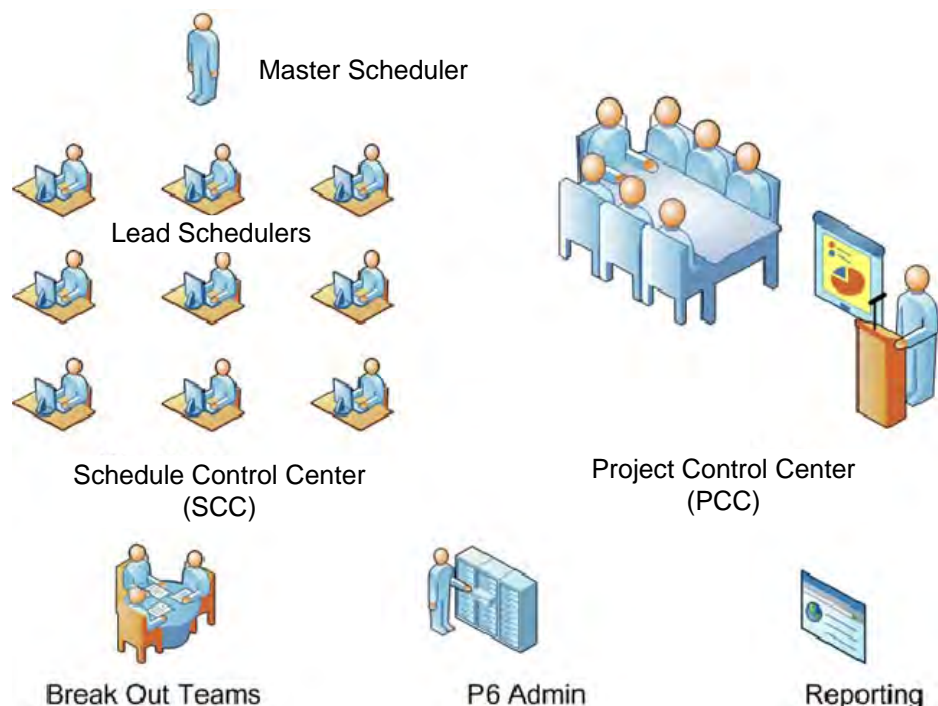
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## 4.0 SCHEDULE CONTROL CENTER (SCC)



To facilitate the collaboration between OPG and the Vendors in order to develop an Integrated Level 3 schedule, we are creating a Schedule Control Center (SCC) Room. This room will be located in a close proximity to the Project Controls Center (PCC), and will be equipped with multiple OPG workstations connected to a single P6 instance.

Each vendor will supply a Lead Scheduler who will be co-located with other vendors in the SCC room. Lead Schedulers will take direction from a Master Scheduler on how to develop and integrate their individual Level 3 schedules.

Everyone will be working in one P6 environment, using one set of standard codes, calendars and resource dictionaries. The environment will be supported by IT and a dedicated P6 administrator, who will managed security and code libraries based on the requirements set by the Master Scheduler.

All the Level 3 schedule updates should be coordinated from the SCC room to ensure the integrity of the integrated schedule and based on the PCC requirements.

SCC room will have Break Out areas for problem solving and meetings. There should also be access to flow sheets, area diagrams and SOW documents for reference.

Access to Asset Suit 7 will be available to the Vendors so they can status the work. The BI solution hosted on the OPG network will provide live reports to monitor schedule development and progress.



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### 5.0 SCHEDULING DEVELOPMENT TOOL

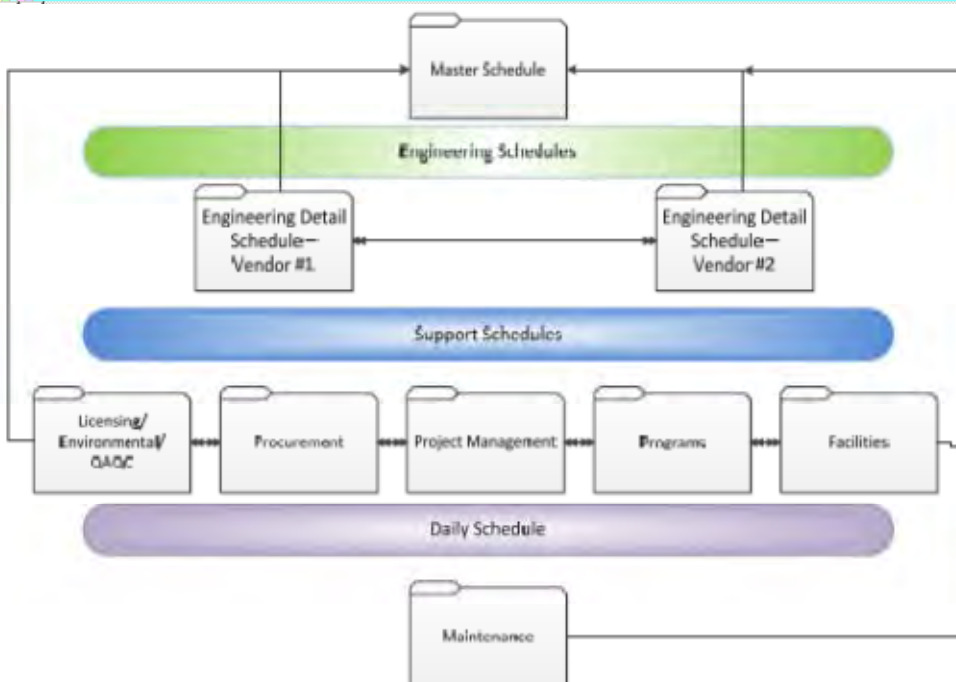
Primavera P6 will be used as the schedule development tool. Activities generated in the schedules will be downloaded from Asset Suit 7 (AS7) or they will be manually created based on the standard P6 templates/fragments.

#### 5.1 Scheduling Development Tool Description

Schedule data is compiled and updated in a scheduling tool to depict the time-sequenced flow of tasks, the actual work progress, and what remains to be completed. P6 is the standard schedule development tool used at OPG. P6 will interface with Work Management Tool (Asset Suit 7), Cost Management Tool (Proliance) and Estimating application (US Cost).

#### EPS Structure

NR	NUCLEAR REFURBISHMENT
NACT	Nuclear Refurbishment Active
PMSS	Level 0: NR Program Milestone Schedule
PIMS	Level 1: NR Program Integrated Master Schedule (Currently for Scenario Analysis)
PCCS	Level 2: NR Program Coordination & Control Schedules (C&C Schedules)
PDPS	Level 3: Nuclear Project Detailed Production Schedules
FUN	Functional Work By Divisions
BUN	Project Bundles Level 3 Schedule
TGB_L3	Turbine Generator Bundle
SGB_L3	Steam Generator Bundle
FHB_L3	Fuel Handling Refurb Bundle
DFB_L3	Defuelling Bundle
FSP_L3	FH Specialised Project Bundle
BOP_L3	BOP Bundle
ISL_L3	Unit Islanding Bundle
SDN_L3	Shutdown, Layup & Services Bundle
RSF_L3	Refurb Additional Facilities Bundle
FIP_L3	Facilities and Infrastructure Project Bundle
CCM_L3	Cyclical Maintenance Project Bundle
CSU_L3	Commissioning, Startup and Handover to Station Bundle (most work by OPG)



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### EPS Structure for OPG and Vendor's schedules

+	ML0	Level 0: Program Milestone Schedule
+	ML1	Level 1: Program Integrated Master Schedule
+	ML2	Level 2: Program Coordination & Control Schedules
-	ML3	Level 3: Project Detailed Production Schedules
-	RFR L3	RFR Level 3 Schedules
-	RFR OPG	RFR OPG Work Level 3 Schedules
-	RFR OPG_U0	RFR OPG Work U0 -- 73105
	73105	RFR OPG Work U0
+	RFR OPG_U2	RFR OPG Work U2 -- 73106
+	RFR OPG_U1	RFR OPG Work U1 -- 73107
+	RFR OPG_U3	RFR OPG Work U3 -- 73108
+	RFR OPG_U4	RFR OPG Work U4 -- 73109
+	RFR SNC_MR	RFR SNC Major Retubing Work
-	RFR SNC_MU	RFR SNC Mockup Project
-	RFR SNC_U0	RFR SNC Mockup U0 -- 73111
	73111	RFR SNC Mockup U0
-	RFR SNC_TL	RFR SNC Tooling Project
-	RFR SNC_U13	RFR SNC Tooling U0 -- 73112
	73112	RFR SNC Tooling U0
+	DFL3	Defueling Level 3 Schedules

## 5.2 Task Breakdown

The development of a Level 3 Schedule that integrates the schedules of numerous contractors including some OPG work groups requires a degree of standardization. An analysis process has been used to determine what user groups will need to be in the schedule and the results are shown in Task Breakdown Table. OPG and contractors are expected to use this table to establish the tasks that will appear in the Level 3 schedule.

### 5.2.1 How to use Task Breakdown Table

What belongs in the schedule? - The table identifies a number of possible tasks (e.g. submit PC1, Prepare permit) in a subject area (e.g. Work Protection). The next three columns are labeled Always, Sometimes, and Never.

Always means always. For reasons that have to do with plant status control, management of critical and near-critical path, resource assignment etc, we have determined that these tasks must be in the schedule and must be shown at level 3.

Never means never. If, for reasons of its own, a contractor wishes to include these activities in its own P6 schedule they are at liberty to do so, but they must be coded so that they are NOT brought into the OPG layouts of P6 in which tasks are being integrated. OPG is conscious of the need to limit the total tasks brought into the project in order to ensure the manageability of project updates, and hence we will not be including "never" tasks in our schedule.

Sometimes has the following interpretation:

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A “sometimes” task may be included in the schedule because contractor’s scheduler needs it there for internal coordination purposes or

A “sometimes” tasks may be brought into the schedule at the request of the OPG Master Scheduler or Work Control Team Leader (WCTL) to facilitate broader scale coordination of work. Normally the requirement to add additional tasks will be identified in Task Analysis Meetings (TAMs) as system window logic is being established.

The next three columns in the table are labeled Direct P6, AS7 and Either. These labels describe how activities get into P6. There are two means available for a contractor to populate the P6 schedule with the tasks as defined above. The first is to directly inject the task into P6. The second is to add the task to the Work Order in Asset Suite 7(AS7) through the use of the assessment functions of that program. Most tasks can be placed into the P6 schedule using either method and contractors are encouraged to use whichever is most effective. A small number of exceptions are identified in table below.

Work Type	Activities	Always	Sometimes	Never	P6	AS7	Either
<b>Work Protection</b>	<b>Submit PC1</b>			X			
	<b>Prepare Permit</b>			X			
	<b>Apply Permit</b>	X				X	
	<b>Walk &amp; Accept permit</b>		X				X
	<b>Apply Lock-out/Tag-out</b>		X				X
	<b>Test device under permit</b>		X				X
	<b>Surrender a permit</b>			X			
	<b>Remove a permit</b>	X					X
	<b>Adjust/Test beyond boundary point</b>	X					X
	<b>Build scaffold</b>	X					X
<b>Scaffolding</b>	<b>Modify a Scaffold</b>		X				X
	<b>Approve Engineered Scaffold</b>			X			
	<b>Remove scaffold</b>	X					
	<b>Manage Scaffold materials</b>			X			
	<b>remove insulation</b>	X					X
<b>Insulation</b>	<b>store insulation</b>			X			
	<b>Dispose of old</b>			X			

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Work Type	Activities	Always	Sometimes	Never	P6	AS7	Either
	insulation						
	Install insulation	X				X	
	manage Insulation materials			X			
Radiation Protection	request rubber area			X			
	establish rubber area	X					X
	remove rubber area	X					X
	perform unique rad survey		X				X
	perform routine rad survey			X			
	Install or remove shielding		X				X
	High Hazard work Oversight	X					X
	provide rad support	X					X
	Perform materials survey for release from station		X				X
	Schedule use of decontamination facilities			X			
	Material Surveys at zone boundaries		X				X
	Radiography	X					X
Trades work	repair/replace	X				X	
	erect a safe work boundary			X			
	electrical disconnect		X				X
	electrical reconnect		X				X
	mechanical disconnect		X				X
	mechanical install		X				X
	calibrate device		X				TBD

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Work Type	Activities	Always	Sometimes	Never	P6	AS7	Either
	Apply/remove grounds		X				X
Hoisting and Rigging	use a crane (or other common service equipment eg loading bay, FMMA equipment, turbine stands)			X			
	maintain or otherwise disable a crane	X					X
	Manage rigging equipment			X			
	Operate Plant devices		X			X	
	Install or remove a TCR		X			X	
Painting/Sealing	Paint or floor seal a room or area		X				
Supply Chain Issues	Order Material			X			
	Schedule Material Required At Site		X				X
	Receipt Inspection			X			
	material from supplier			X			
	Mat'l prepared and delivered (staged)		X				TBD
	remove parts hold			X			
	AFS Declaration	X			X		
	CCD declaration	X			X		
Engineering	Remove Eng Hold			X			
	Approve Eng drawing			X			
	AFS documentation			X			
	OLW review			X			

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Work Type	Activities	Always	Sometimes	Never	P6	AS7	Either
	Review/approve Inspection results		X				X
	Online Wiring			X			
Miscellaneous	Work Outside the Const'n Island (Other units)	X				X	
	Work Outside the Protected Area		X				X
	Security Point Access for Deliveries	TBD	TBD	TBD			
	Equipment Sampling (Chem Lab)		X			X	
	Training			X			

## 6.0 SCHEDULE INPUT MONITORING

### 6.1 Compare Schedule Status to Time Status Reports

Level 3 schedules will be resource loaded with hours for OPG and Vendor work. The total hours loaded at Level 3 activities will be rolled up to Level 2 (Work Package). Total hours will be compared to the estimates done at the Work Package level and all the Actual hours will be collected at this level using financial systems called Tempus and Oncore.

BI (Business Intelligence) Reports will be available to compare plan hours versus actual hours. The SPI and CPI will be calculated at the Work Package level and when issues are identified at Level 2, more detail analysis of Level 3 activities will be initiated. Level 2 and 3 activities will also be monitored against a baseline to identify any work that is not progressing as planned or is ahead of schedule so we can take advantage of the early completion or initiate a recovery plan as required.

### 6.2 Monitor Vendor's Schedule

Schedule health and integrity will be monitored on level 3 schedules developed by all the Work Groups. Standard scheduling templates with minimum number of activities and all the mandatory codes for different work types will be provided. BI reports will be developed to monitor the compliance.

ACUMEN FUSE application will be used to analyze schedule quality and look for issues like missing logic, hard constraints, negative float, number of lags or areas where there is insufficient level of detail, before vendors schedules are integrated within the Program Integrated Master Schedule (PIMS)

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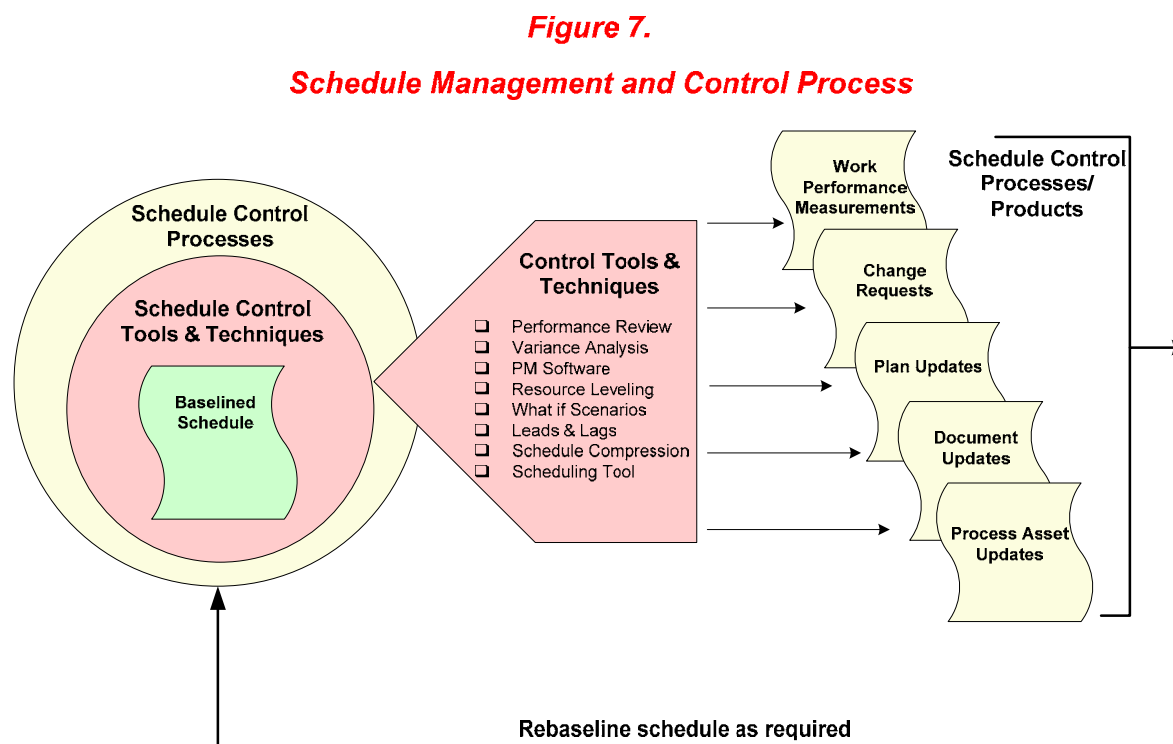
Monitoring vendor's schedules will be ongoing activity and all the issues will be communicated through Master Scheduler to the Lead Schedulers located in the SCC room. It will be Master Scheduler's responsibility to ensure that all the corrective actions have been resolved in a timely manner and that both Outage Manager and Unit Director are aware of the issues.

## 7.0 SCHEDULE MANAGEMENT AND CONTROL

Schedule management and control begins when the Level 3 is first baselined. This initial baseline establishes the project's scope and sets the expectation for how and when the scope will materialize. Any proposed changes to the scope will drive a schedule change management process. At this point, changes happen only if there is a change in requirements.

Schedule control addresses anticipating or correcting schedule variance. To do this, control tools and techniques are used to detect and forecast serious deviations from the baseline.

Figure 7 depicts a high-level representation of the schedule management and control process used by the Darlington Refurbishment.



As actual completion dates are monitored against the baseline, control tools and techniques are applied to anticipate, avoid, and mitigate time loss as well take advantage of extra time due to early completions.

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### **7.1 Schedule Control Techniques**

Schedule control processes serve to minimize schedule changes. Control techniques are designed to reveal the status of the schedule and suggest corrective action to bring the project back on schedule. A number of techniques will be used on Level 3 schedules developed by OPG and contractors. For a list of Schedule Control Techniques that will be used in the Darlington Refurbishment see Appendix B

Schedule Planning Analysis takes place early in the project when the WBS is formulated. The scheduling team will use P6 to run What-if Scenarios to align the project owner's vision of the project with the likely timeframe for completion. What-if Scenarios will again be run when a new completion date must be determined as a result of a requested change to the WBS during the course of the project...

### **7.2 Schedule Control Products**

Schedule Control Products such as Work Performance Measurement Data, Change Requests, Plan Updates, Process Asset Update, and Project Document Updates will result from applying schedule control techniques.

Planning and Controls (P&C) will facilitate the development of these products but it will be the Bundle/Project Team's responsibility to prepare, review or update the product and take the necessary correct actions, e.g. To submit a Change Request or to review the Performance Reports or to update the Schedule Baseline.

### **7.3 Schedule Change Request Process**

Schedule changes may be driven by unanticipated work, new scope or when forecast is so far from the baseline that all the monitoring tools are no longer providing meaningful information. The change control process will be done at the Work Package level. If schedule analysis reveals an unfavorable impact to Work Package End Date or total resource hours projected, then a work Package Change Control process will be initiated.

Change Control process specifies different thresholds when a proposed change is considered an approved variance, a baseline change or full re-baseline of the schedule. Different levels of approves are required, based on the type of change.

Every change request will be reviewed to evaluate impact on Program Milestones, downstream activities, interfaces with other work groups and resource requirements.

The Master Scheduler monitors the Level 3 by reviewing and incorporating updates on a weekly basis. The Schedule Change Management Process is applied when:

- New tasks or deliverables cause baseline milestones or Work Package End Date to slip
- The project scope is changed
- A new constraint impacts the planned delivery date of the final project deliverable
- A directed change has occurred

### **7.4 Update Schedule**

Level 3 schedules will be updated daily or weekly during the execution phase based on the Outage Segment requirement. Asset Suite 7 tasks will be updated automatically with an interfaces process. Activities created manually will be updated by the Lead Schedulers sitting in the SCC room. Daily updates will include actualizing activities and entering percent complete.



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The Data Date will be moved as required to support the process of generating integrated T-0 schedule.

Based on the daily status updates in Level 3 schedules, the Master Scheduler will analyze the schedule accuracy, float, extra time and overruns with respect to impact on interfaces across work group or execution windows within segments.

#### **7.5 Establish New Schedule Baseline**

Prior to breaker open, the Integrated Level 3 schedule will be going through multiple revisions as we develop and incorporate additional details. With each revision, we will create a new baseline. Revision '0' will be the final revision before Breaker Open and that will be the baseline for execution.

After Breaker Open, in order to change the baseline, work group will have to follow the Change Control Process. Once the change is approved as baseline change and all the impacts on downstream activities have been analyzed, effected baseline will be restored and updated in P6.

Every time a baseline is updated, a copy of the baseline is retained in P6 before any changes are made.

#### **7.6 Archive Schedule Change Support Materials**

A Change Control Form (CCF) is required for any change request. Supporting documentation and analysis is assembled by the project teams and submitted for review to Planning & Controls group. All the information is stored in SharePoint and recorded in Change Control Log. See the Change Control procedure to get the full list of requirements.

### **8.0 SCHEDULE STATUS REPORTING**

NR Refurbishment will use the BI Reporting solution for all the reporting requirements. The BI reports are located on the OPG network in the SharePoint environment. P6 data, including current schedules and the baseline schedules, will be downloaded every night into the BI data warehouse.

All the reports required in the BI will be defined and developed prior to Breaker Open. Existing reports used during outages will be leveraged and new reports will be created based on Refurbishment requirements and industry standards/practices/templates.

#### **8.1 Monthly Project Reports**

Schedule status reporting is accomplished via four monthly reports:

- Project Master Schedule (Gantt Chart)
- Monthly Project Report (Internal and External)
- Sponsor Monthly Project Report
- Contractor Dashboards
- Bundle Dashboards

#### **8.2 Monthly Metrics and Trend Analysis**

Reports that specifically detail the status of the schedule including completion status of tasks, activities, deliverables, and milestones as compared to the baselined plan include:

- Planned vs. Actual Task Completions

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- Estimate to Complete (ETC)
- Critical Path Analysis

#### **8.3 Weekly Metrics and Trend Analysis**

- Weekly CNO Package
- Schedule Adherence Report
- Schedule Variance by Activity
- New tasks added (or deleted) since last reporting period
- Outage Segment Dashboard
- Project Dashboards

#### **8.4 Daily Reports and Metrics**

- Break Plan
- Plan of the day
- T-0 Plan
- List of tasks that were completed or not completed

#### **8.5 Schedule Oversight Reports**

Reports used to analyze current status and identify potential or actual issues include:

- Project Milestone and Deliverables Reports
- Task Lead Oversight Reports
- Oversight Reports
- Tasks with Negative Float Reports
- Contractual Product Status Reports
- Late or At Risk Task Reports

### **9.0 SCHEDULE CLOSING**

P6 production database will be monitored by P6 administrator who will ensure that the number of active activities do not cause any performance issues. Completed schedules representing early phases of the projects/segments will be archived. Historical data will be available through custom solution.

#### **9.1 Closing Reports**

The Schedule Manager will provide input into the final schedule-related reports generated by the IPOC. These reports include:

- Post Implementation Evaluation Report (PIER)
- Federal Closeout Report

#### **9.2 Archive Schedule Data and Tools**

Archived activities will be in another P6 instance available for review and analysis. Custom P6 Viewer that combines information from two separate P6 instances will be available. Archived schedules will also be available in XER format.

BI Data Warehouse will have all archived and active schedules available for reports and metrics.

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**Appendix A: Glossary & Acronyms**

ACRONYM/TERM	DESCRIPTION
Archive	An Archive is a secure repository of Configuration Items often stored offsite for additional security. Archiving is a process of storing Configuration Items in a secure manner. The purpose of archiving is to provide recoverability to a past state. Although the process for creating an archive is similar to that of taking a baseline, the method of storage for both is different. Whereas baselines are maintained in easily accessible media for reference during the project lifecycle, archives are stored on secure media.
Baseline (also: Project Schedule Baseline)	Approved project schedule that serves as the basis for measuring and reporting schedule performance.
Change	Change and clarifications to any configured item including operational requirements and contract requirements.
Change Control	The tracking and management of proposed changes to an item's format, content, version and/or configuration. Change control applies to many different project office functions (e.g. requirements management, project management, quality management, contract management, etc.) as well as contractor delivered products.
Sub-Contractor	The external service provider that will develop, or otherwise supply a service to or component of a project deliverable. (See Vendor)
Deliverable	A work product produced by a contractor or consultant in accordance with the terms of their contract. It is measureable, tangible, verifiable outcome, result, or item that must be produced to complete a project or part of a project.
ETC	Estimated Time to Complete
FSR	Feasibility Study Report
Integrated Level 3	A schedule of tasks to be completed by both the Vendor and OPG staff.
IT	Information Technology
Managers	The Department staff that oversee other department staff and are generally responsible for workload management.
Milestone	Identifiable point in a project or set of activities that represents a reporting requirement or completion of a large or important set of activities.
Vendor	The contractor who has primary responsibility for developing or integrating the given system, or the primary contractor performing work on the system.
Project Management Body of Knowledge (PMBOK)	Information Technology project management supported by a discipline and a formal body of knowledge that defines a project from inception to implementation.

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ACRONYM/TERM	DESCRIPTION
Project Participant	Individuals that are either dedicated project staff or individuals that provide executive level sponsorship and support.
Project Schedule	Time-sequenced plan to accomplish activities or tasks used to direct and control project execution. Usually shown as a milestone chart, Gantt or other bar chart, or tabular listing of dates.
Project Work Breakdown Structure (Project WBS)	The Project WBS is a hierarchical tree diagram that depicts the first three levels of the work breakdown structure beginning with level 1 that shows the project's main deliverable (the final system) followed by level 2 – the major deliverables that make up the level 1 deliverable, followed by level 3 – sub-deliverables to the major deliverables. "Deliverable" may be a contracted deliverable of major work product.
Request for Proposal (RFP)	The RFP used to solicit proposals from the bidding community based on a set of defined requirements. The requirements may be general in nature allowing the bidders to propose a solution and the specific products to be used. The RFP describes the problem requirements, contractual terms, and required format for the proposal responses. The RFP also includes the specific criteria which will be used to evaluate the received proposals. The project works with DGS to ensure the RFP meets all appropriate state guidelines and regulations.
Resource Breakdown Structure (RBS)	A hierarchical structure of resources by resource category and resource type. The RBS may be organized by functional organizations.
Schedule Management	The process of developing, managing, and controlling the project schedule or integrated master schedule.
Stakeholder	(1) Individuals and/or groups who are involved in or may be affected by project activities. (2) The people who have a vested interest in the outcome of the project.
System Implementation	System implementation includes the activities of the project office and Vendor to deploy the new system into the target environment or production. This includes but is not limited to, the installation of equipment, the installation of software, the rollout of new or modified business processes, and the delivery of supporting documentation. Implementation is complete upon system acceptance by the department's maintaining organizations, and when the system is deemed "In production". Since the project may be developed, implemented, and transitioned in iterations, these processes may be repeated and overlap between iterations.
Work Breakdown Structure (WBS)	A deliverable-oriented hierarchical grouping of project elements that organizes and defines the total scope of the project. Each descending level represents and increasingly detailed definition of the project work.

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**Appendix B: Schedule Control Techniques**

<b>Technique</b>	<b>Definition</b>
Performance Reviews	Performance reviews measure, compare, and analyze schedule performance such as actual start and finish dates, percent complete, and remaining duration for the work in progress.
Scenario Analysis	Allows decision makers to explore the implications of several alternative future states thus avoiding the danger of single-point forecasts. Conducted in a nonthreatening group setting, participants express beliefs, challenge assumptions, and alter their viewpoints to ultimately arrive at a strategic direction that is flexible and will remain so as actual events unfold.
Forward-Pass Analysis	Calculation of early start dates and early finish dates for uncompleted portions of all network activities. Determined by working forward through the network logic from the project's end date.
Backward-Pass Analysis	Calculation of late finish dates and late start dates for uncompleted portions of all network activities. Determined by working backward through the network logic from the project's begin date.
Bottom-Up Estimating	Cost, work, or resource estimate derived by first estimating the project's individual elemental tasks at the lower levels of the WBS and then aggregating those estimates at successively higher levels of the WBS. For cost estimates, the project manager typically includes indirect costs, general, and administrative expenses, profit, and any reserves when calculating the total project cost. This form of estimating is more accurate than making one large estimate.
Top-down Estimating	Approximating the size (duration and cost) and risk of a project (or phase) by looking at the project as a whole and comparing it to previously performed similar projects. The comparison may be made directly using "analogous estimating," through an algorithm as in "parametric estimating," or from the memory of estimating experts. Upon establishing an overall estimate for the project, sub-divide the estimate down through the levels of the WBS, for example, development will be 50% of the total, testing will be 25% etc; then sub-divide development and testing into their components and so on.
Critical Path Method	Predicts project duration by analyzing the sequence of activities (network path) that has the least amount of scheduling flexibility (i.e. float). Early dates are calculated by a forward pass using a specified start date. Late dates are calculated by a backward pass starting from a specified completion dated (usually forward pass's calculated early finish date for the project.)
Monte Carlo Simulation	A technique in which the project team leader or project team computes and/or quantifies the complete and total project cost and/or project schedule a number of times through the use of input values that have been selected at random through the careful utilization of probability distributions or potential costs and/or potential durations. The purpose of utilization of the Monte Carlo analysis is for the sake of calculating a defined distribution scenario of possible total costs associated with the project as well as a range or possible completion dates of the project.
Resource Histogram	Vertical bar chart used to show resource consumption and availability by time period. Also called, resource loading chart.
Resource Leveling	1) Practicing a form of network analysis in which scheduling decisions (start and finish dates) are driven by resource management issues such as limited

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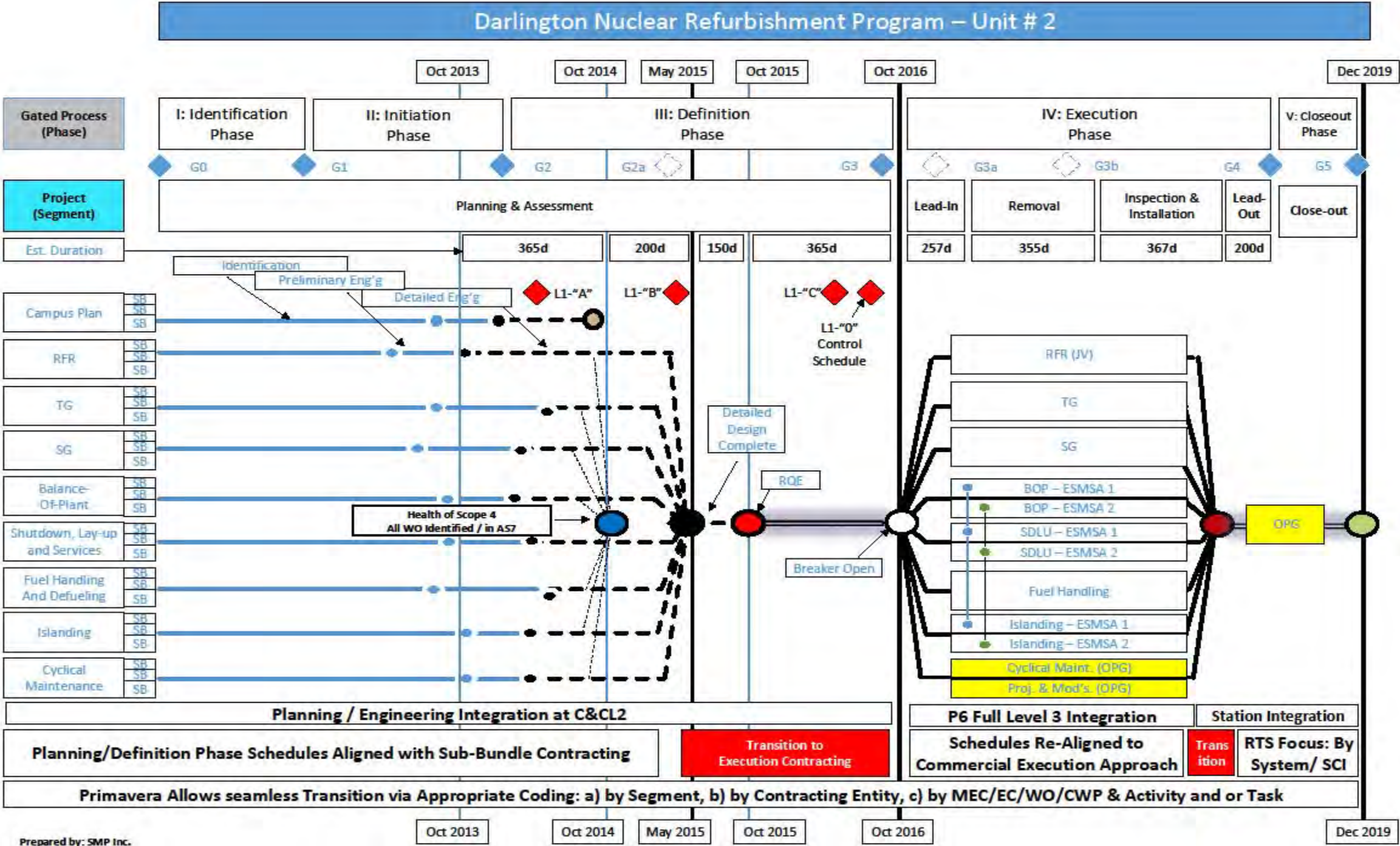
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Technique	Definition
	resource availability or changes in resource levels.  2) Evening out the peaks and valleys of resource requirements so that a fixed amount of resources can be used over time.  3) Ensuring that a resource is maximized but not used beyond its limitations.
Variance Analysis	The goal is to determine the causes of a variance (that is to say, the difference between an expected result and an actual result).
Schedule Compression	Shortening of the schedule without reducing the project scope. Often requires an increase in project cost.
Crashing	Taking action to decrease the total project duration by adding resources (human and material) to the project schedule without altering the sequence of activities. The objective is to obtain the maximum duration compression for the least cost.
Fast Tracking	Compressing the project schedule by overlapping activities normally performed in sequence, such as Design and Build/Construction.
Free Float & Total Float (or Slack)	Free float is the amount of time an activity can be delayed without delaying the early start of any immediately succeeding activities. Also called, secondary float. Total float is the amount of time an activity from its early start without delaying the project end date. Derived by subtracting the early start from the late start or the early finish from the late finish and may change as the project progresses and as changes are made to the project plan. Also called slack, float, and path float.
Adjust Leads and Lags	Lead: A modification of a logical relationship that allows an acceleration of the successor activity such as when a task has a finish-to-start dependency with a ten-day lead, the successor activity can start ten days before the predecessor activity has finished. Lag: A modification of a logical relationship that directs a delay in the successor activity such as when a task has a finish-to-start dependency with a ten-day lag, the successor activity cannot start ten days after the predecessor activity has finished. Adjusting leads and lags is used to find ways to bring project activities that are behind into alignment with the plan.

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Appendix C: Unit 2 -Darlington Nuclear Refurbishment Program



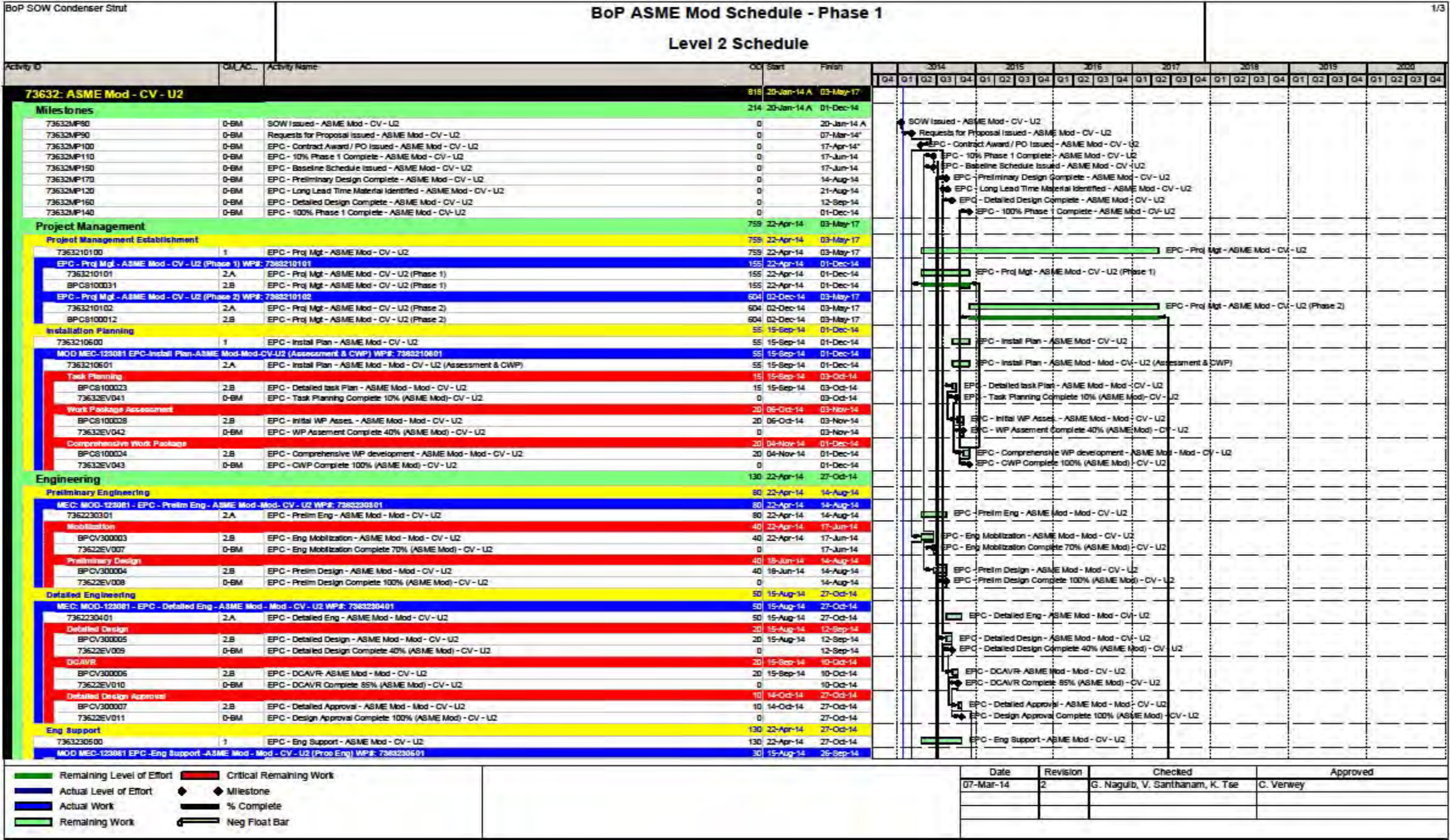


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Appendix D: Implementation of Work Breakdown Structure (WBS)



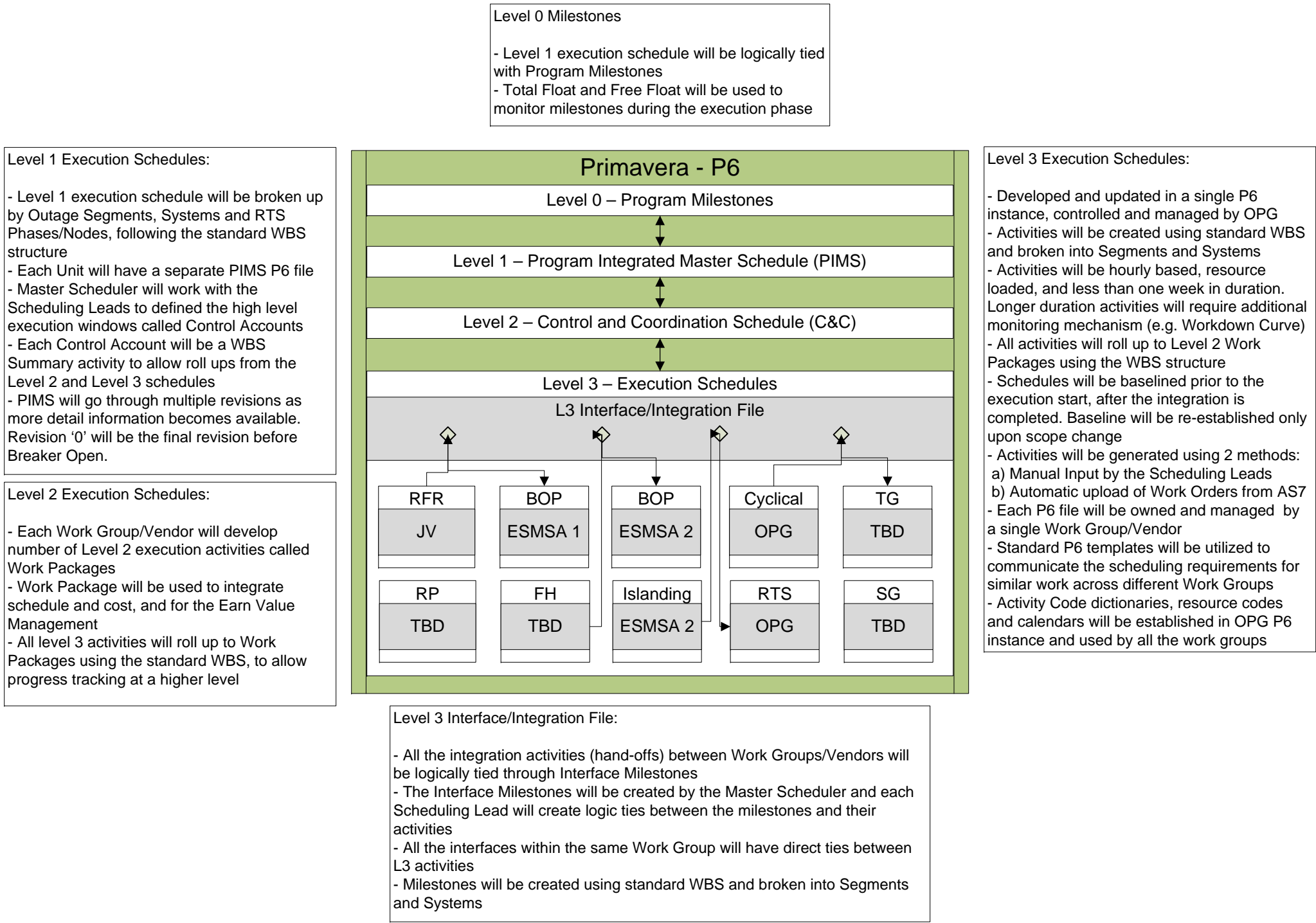


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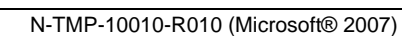
Appendix E: Integrated Multi-Level Scheduling Structure



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### Timeline of Critical Inputs Required for Development of IL3E Schedule

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**Title:**           **OPG BUSINESS MODEL**

**Policy Statements:**   The **OPG Business Model** defines how OPG operates its business. It includes the company's mission statement, values and expected behaviours - the elements that are central to OPG's culture.

It sets out how OPG plans its business and sets targets. It identifies the controls that are in place to address the key risks faced by the company. It codifies the company's matrix organization and summarizes the key accountabilities of OPG's operating units and functions.

It also gives direction to the design and scope of the operating unit and function management systems that direct the planning and execution of work within OPG and the achievement of the company's business goals.

**Approval:**    President and CEO

**Date:**        July 21, 2015

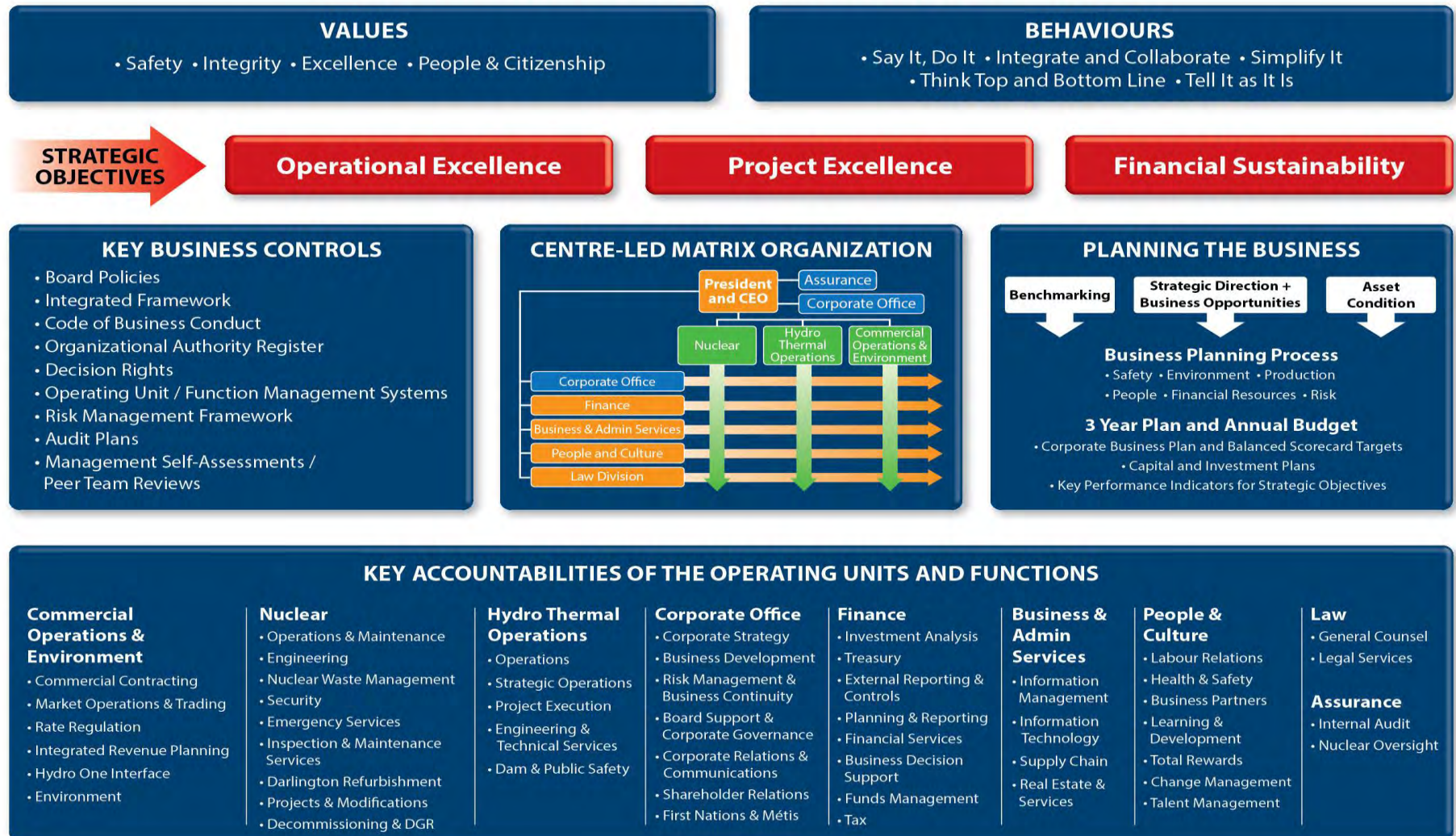
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**OPG BUSINESS MODEL**

## OPG BUSINESS MODEL

**Mission: To be Ontario's low cost electricity generator**



## Policy

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Title:  
**OPG BUSINESS MODEL**

### OPG BUSINESS MODEL:

#### Mission:

**To be Ontario's low cost generator.**

We will achieve our mission by reliably and cost-effectively producing electricity from our diversified generating assets, while operating in a safe, transparent and environmentally responsible manner. We will also leverage the skills and experience of OPG staff by pursuing new business opportunities and additional sources of revenue without jeopardizing our core business.

#### Values and Behaviours:

OPG's values are critical to the success of the organization. They guide our behaviour and decision making.

Our key values are ***safety, integrity, excellence and people & citizenship***.

Staff performance is another key to the success of OPG. The company has identified five staff behaviours that will ensure our effectiveness and efficiency.

- **Say It, Do It** - demonstrate personal accountability to deliver results and hold others accountable
- **Simplify It** - create the most straightforward path to execution
- **Think Top and Bottom Line** - look for ways to improve efficiencies, eliminate waste, maximize revenue and make money
- **Integrate and Collaborate** - break down the silos and work together in support of OPG's mission
- **Tell It as It Is** - Demonstrate open and direct communication to everyone with the intention of making things better

These values and expected behaviours are described in the OPG Code of Business Conduct. All OPG employees are expected to understand their obligations under the Code and conduct their day-to-day work in adherence with the Code. The Chief Ethics Officer ensures that the Code is effectively implemented within OPG.

#### Planning the Business:

OPG plans its business through an annual strategic planning process and through an annual business planning process. These two processes are used to set long and short-term business objectives, priorities and targets in the areas of financial performance, operations, business development, project execution, supporting strategic objectives, health and safety and environmental performance.



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The key inputs into these planning processes are: operational and financial benchmarking data; an environmental scan of strategic developments, including an identification and assessment of new business opportunities and industry dynamics; cost and operating projections; and, generation asset condition and expected investment needs.

The strategic planning process is co-ordinated by the Corporate Office and involves the entire Enterprise Leadership Team (ELT). The process includes the discussion of strategic issues throughout the year and culminates in a strategic retreat with the OPG Board in the early fall. At the retreat, the ELT presents the strategic issues and opportunities facing the company and makes recommendations to the Board. Based on decisions taken at the retreat, a strategic planning context and direction is developed that serves as an underpinning for the OPG Business Plan and related strategic initiatives.

OPG's current strategic objectives are **operational excellence, project excellence and financial sustainability**. As part of its strategic planning process, OPG will use Key Performance Indicators (KPIs) to track its progress in achieving these objectives.

The business planning process is co-ordinated by Finance through the provision of business planning instructions which are issued to the operating units and functions in the spring of the year. Based on these instructions, the operating units and functions prepare three year business plans and longer term, less detailed business projections. The operating unit and function business plans are reviewed by the CEO and CFO, typically in September. Once approved, these business plans are integrated into an overall corporate business plan which is approved by the OPG Board and OPG's Shareholder, normally in December.

The key corporate targets from the approved OPG Business Plan are included in an annual Corporate Balanced Scorecard, which is used to assess the company's overall performance for the coming year.

The approved operating unit and function business plans provide the unit/function's budget and establish their performance objectives/targets for the year. The performance of the operating units and functions is assessed against their approved business plans on an ongoing basis.

Each month, the operating units and functions are required to report on their performance against their approved plan as part of the Key Results process. This process also allows for any needed re-direction by the President and CEO. The Key Results are also presented to the entire OPG senior leadership team to promote alignment on the company's priorities.

Biweekly, the Enterprise Leadership Team (ELT), composed of the President and CEO and certain direct reports, meets to seek input on issues with business-wide impact and to communicate corporate direction.

### Key Business Controls:

OPG has developed an **Integrated Framework** to describe how the company's governance, management systems, risk processes and assurance function interact to guide the operation of OPG. The integrated framework ensures that the company is operated in an effective and

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efficient manner, and within approved limits and requirements (see Appendix B – Integrated Framework).

OPG's governance begins with Board Policies that authorize the delegation of certain authorities to senior management, address statutory obligations, and give high-level direction to the operation of the company. The Board also approves a Code of Business Conduct that sets out the required standards of conduct for all OPG employees.

OPG maintains an Organization Authority Register (OAR) which sets out the authority delegated to staff for approval of financial transactions.

OPG has adopted a matrix organizational structure with centre-led functions supporting operating units. It has developed **Decision Rights** to indicate where and how key business decisions will be taken under the matrix organization (see Appendix A - Decision Rights).

Each operating unit and function is required to have a **Management System** sufficient to meet its specific accountabilities. The Management System shall be designed to efficiently and effectively achieve the goals and objectives of the particular operating unit and function. It shall reflect the Management System design principles set out below.

OPG has an Enterprise Risk Management Framework for identifying, assessing and managing risks to achieving its operating and strategic objectives and targets. Each operating unit and function leader is required to identify and report through the Business Unit Risk Self Assessment (BURSA) process the key risks and hazards facing their business unit, the mitigation that they have in place, and remediation plans to reduce the impacts should mitigation be ineffective.

Using the results of the BURSA process and an analysis of relevant external events, the Chief Risk Officer, identifies and assesses Enterprise Level Risks which are reviewed on a regular basis with ELT and the OPG Board. The OPG Board also approves a set of Risk Tolerance Metrics which are used to guide business decisions. The operating unit and function leaders are required to manage the risks in their business in accordance with the framework and the Risk Tolerance Metrics.

OPG provides assurance to the Board and Management on the effectiveness of its management systems and the controls over key business and operating risks through **Internal Audits, Nuclear Oversight Audits and Assessments, Management Self-Assessments** and other **Third Party Reviews** (e.g. WANO, INPO, ISO 14001, etc).

The Internal Audit Charter, which guides the work of OPG's Internal Audit function, and the annual internal audit plan are approved by the OPG Board. The annual assurance plan will identify the specific audits and Nuclear Oversight audits and assessments to be conducted in the coming year based on key risk areas, legal and regulatory requirements, and reflect the planned Management Self-Assessments and third party reviews.

**Management Self-Assessment** is a self-checking process designed and maintained by management that is directed to identifying opportunities for improvement in management systems, controls and performance. It can involve benchmarking, peer reviews, and various forms of independent evaluation.

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Operating units and functions are encouraged to perform management self-assessments to support the achievement of business objectives and facilitate effective risk management, based on the applicable needs of the group, as assessed by the business unit leader.

Operating units and functions are required to respond, as appropriate, to deficiencies and improvement opportunities identified in internal audits, Nuclear Oversight audits and assessments, third-party reviews and their own self-assessments.

### **Organizational Design and Key Accountabilities:**

OPG has adopted a **Centre-led Matrix Organization** design with centre-led **Functions** supporting **Operating Units**.

The centre-led functions are generally accountable for developing and maintaining functional excellence, setting standards, and providing cross-company services.

The **Corporate Office** function is responsible for supporting the CEO and OPG Board in risk management, corporate strategy, developing new business opportunities, and communications and stakeholder relations. Its specific accountabilities include the requirement to:

- Manage the OPG Business Model that all operating units and functions will follow;
- Manage the corporate strategy process and develop the strategic planning context and direction, which includes corporate strategic objectives and priorities, KPIs, supporting initiatives and capital investment guidelines;
- Manage corporate business development activities, including development activities related to new generation opportunities and services, acquisitions and divestitures;
- Manage OPG's risk management framework and provide oversight of enterprise-level risks, credit, market, and commodity exposures, and establish an enterprise wide business continuity program;
- Provide support to the OPG Board and Board Committees through the Board Secretary function, including planning agendas, maintaining the corporate minute book, developing Board and Shareholder instruments required under the OBCA and the Memorandum of Understanding;
- Provide a centre of excellence on corporate governance, including developing and maintaining OPG's governance for joint ventures and wholly owned subsidiaries;
- Manage corporate relations and communications, including relationships with industry stakeholders, local communities, all levels of government, and First Nations and Métis communities. Manage external and employee communications, media, speechwriting, advertising, social media, digital communications, and reputation and issues management.



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The **Finance** function is responsible for determining OPG's financial strategies and providing financial stewardship to help OPG achieve its business and operating objectives. Finance provides strategic support, business partnering support to OPG's business units, and ensures that OPG fulfills its fiduciary responsibilities. Finance's specific accountabilities include the requirement to:

- Provide strategic and business decision support, analysis of opportunities and risks, and effective financial challenge to enable business units to achieve their objectives;
- Manage the business planning and performance reporting processes to proactively identify financial issues, develop robust financial plans and to monitor progress against financial objectives;
- Ensure investment decisions and contracts are supported by sound financial and business analysis;
- Ensure the integrity of OPG's financial reporting and compliance with external reporting obligations, accepted accounting practices, and taxation laws;
- Ensure that adequate controls are in place, commensurate with risk and cost, to manage revenues, costs, cash and expenses and protect assets against loss, theft, destruction, alteration or unauthorized access;
- Provide cost effective treasury services including financing, cash management, and pension and nuclear fund management;
- Provide efficient financial services, including accounts payable and receivable, accounting and transaction processing.

The **Business & Administrative Services** function is responsible for supply chain, IT/CIO, information management and real estate and services. Its specific accountabilities include the requirement to:

- Manage OPG's supply chain to procure goods and services and dispose of surplus material to meet the operating needs of OPG consistent with the OAR, the Code of Business Conduct, approved financial management and control standards, and all applicable legal and regulatory requirements;
- Manage OPG's vendors and vendor relationships including quality management, commercial management and performance management;
- Develop and manage the company's information technology (IT) systems to ensure that they can securely, reliably and cost-effectively meet the company's needs;
- Direct the management of OPG's recorded information over its entire life cycle to ensure that it is complete and accurate and available when required; and, to ensure that it is kept secure and protected against unauthorized use, destruction, modification or loss;

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- Acquire, manage, maintain and dispose of real estate to support the company's goals and objectives while meeting the requirements of OPG's policies and procedures and any applicable legal and regulatory requirements.

The **People & Culture** function is responsible for labour relations, health and safety standards, compensation and benefits, training, talent management and succession planning. Its specific accountabilities include the requirement to:

- Manage all labour relations activities to ensure compliance with collective agreements, labour legislation, and to ensure policies for non-represented staff are applied in a manner consistent with the intent of the policies;
- Develop and maintain a health and safety management system that all operating units and functions will follow;
- Develop and manage a compensation and benefits program to achieve the company's business objectives;
- Provide conventional and nuclear training for OPG employees;
- Take steps to attract, develop and retain staff with the talents required to meet the company's needs;
- Co-ordinate succession planning to ensure that critical skills and business knowledge are maintained and to ensure that corporate leadership requirements are met;
- Support the operating units and functions in planning and implementing significant change.

The **Law** function is responsible for providing legal advice and support across the organization to help OPG achieve its business goals and objectives. Its specific accountabilities include the requirement to:

- Provide general counsel services;
- Provide a range of internal legal services;
- Retain, as required, external legal resources.

The **Assurance** function is responsible for providing a systematic disciplined approach to independently assess the effectiveness of OPG's risk management framework, management systems and controls. Its specific accountabilities include the requirement to:

- Develop and execute its internal audit plan;
- Perform nuclear oversight audits and assessments.

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The operating units are accountable for achieving operations and project management excellence, maintaining and expanding their operating assets, and complying with established standards.

The **Nuclear** unit is responsible for the safe, efficient operation of OPG's nuclear plants to achieve the approved business plan targets as well as execution of projects for the OPG Nuclear fleet including the refurbishment of Darlington. Its specific accountabilities include the requirement to:

- Effectively execute operations and maintenance activities at OPG's nuclear stations to achieve the approved business objectives;
- Provide engineering services and support to the nuclear business;
- Provide inspection and maintenance services and decommissioning services for nuclear reactors;
- Provide a range of support services to the nuclear business unit including nuclear regulatory affairs, radiation safety, environmental assessment, and business planning and improvement;
- Manage nuclear waste and used fuel in accordance with all legal and regulatory requirements;
- Effectively develop and manage the low and intermediate deep geologic repository (DGR) project to achieve the company's business objectives;
- Provide oversight of the Nuclear Waste Management Organization (NWMO) as a contractor to OPG in the development of the DGR;
- Implement OPG-wide security strategies, measures and practices to protect employees, contractors and members of the public, and OPG's property and equipment from risks associated with employee wrongdoing, crime, terrorism, sabotage, unauthorized diversion, misuse or other relevant cause of loss or harm;
- Ensure that an effective response can be made, across OPG, to address emergencies affecting the safety or health of employees and contractors, property and equipment, the environment or members of the public.
- Effectively execute the Darlington Refurbishment project to achieve the targets and deliverables set out in the project plan;
- Manage projects and modifications across the nuclear fleet to achieve the timelines and budgets set out in the approved business cases or project plans;
- Manage vendor contracts for the delivery of project related services.

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The **Hydro - Thermal Operations** unit is responsible for the safe and reliable operation of the company's hydro and thermal generating stations as well as executing on new generation projects. Its specific accountabilities include the requirement to:

- Effectively execute plant operations and maintenance activities to achieve business unit targets;
- Provide engineering and technical services to support the operation of the hydro-thermal generation fleet;
- Ensure that hydro-thermal projects are executed to achieve the target and business objectives set out in the approved business cases;
- Undertake dam and public safety activities to ensure that the public is protected and that all legal and regulatory requirements are met;
- Provide strategy and business support to the hydro-thermal business unit to ensure that its activities are effectively planned and co-ordinated.

The **Commercial Operations & Environment** unit is responsible for optimizing the market value of OPG's portfolio of assets, developing the corporate generation and revenue plan, commercial contracting, regulatory affairs and the environment. Its specific accountabilities include the requirement to:

- Develop an integrated revenue plan for OPG as part of the annual business planning process, including all market related modeling and analytics, reflecting short and long term generation plans (including fuel requirements), commercial contracting and trading strategies, and short and long term rate strategies;
- Integrate and coordinate the use of OPG's assets into the IESO administered market through all time frames in order to optimize OPG's return, while adhering to all legal, regulatory and station constraints;
- Conduct electricity commodity trading in the Ontario/Interconnected markets to generate revenue including managing and delivering on various service agreements with OPG Energy Trading, Inc. (OPGET);
- Conduct commodity hedging for the generation portfolio;
- Manage positions/trade fuel and emission allowance/reduction credits for the benefit of OPG's assets;
- Negotiate and manage commercial energy contracts such as electricity supply agreements, non nuclear fuel agreements, and legacy interconnected counterparties, environmental attributes, generation, and Bruce Lease agreements;
- Manage the heavy water and isotope sales programs;

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- Manage the interface with Hydro One, all economic, reliability, and market regulators and all market operators that OPG deals with, including making all necessary applications and submissions;
- Develop and maintain an environmental management system and manage the interface with government environmental agencies.

### Management System Design Principles:

Each Function will have a management system sufficient to meet its specific accountabilities.

Each Operating Unit will have a management system sufficient to meet its specific accountabilities that will integrate the applicable management system elements developed by the interfacing Function.

Every management system will be based on the principles of Plan - Do - Check - Act and embrace continuous improvement in support of OPG's business and strategic objectives.

Management systems will be designed to:

- Meet the requirements established by OPG's governance, external legal and regulatory requirements and business objectives;
- Reflect OPG Decision Rights (see Appendix A – Decision Rights);
- Support a nimble, scalable organization that drives individual accountability and gets the most out of employee skills and experience;
- Reflect that operating safely is the overriding priority for activities performed at OPG's facilities;
- Foster high levels of performance and reliability and deliver value for money;

Be consistent with OPG's Integrated Framework (see Appendix B – Integrated Framework).

## Policy

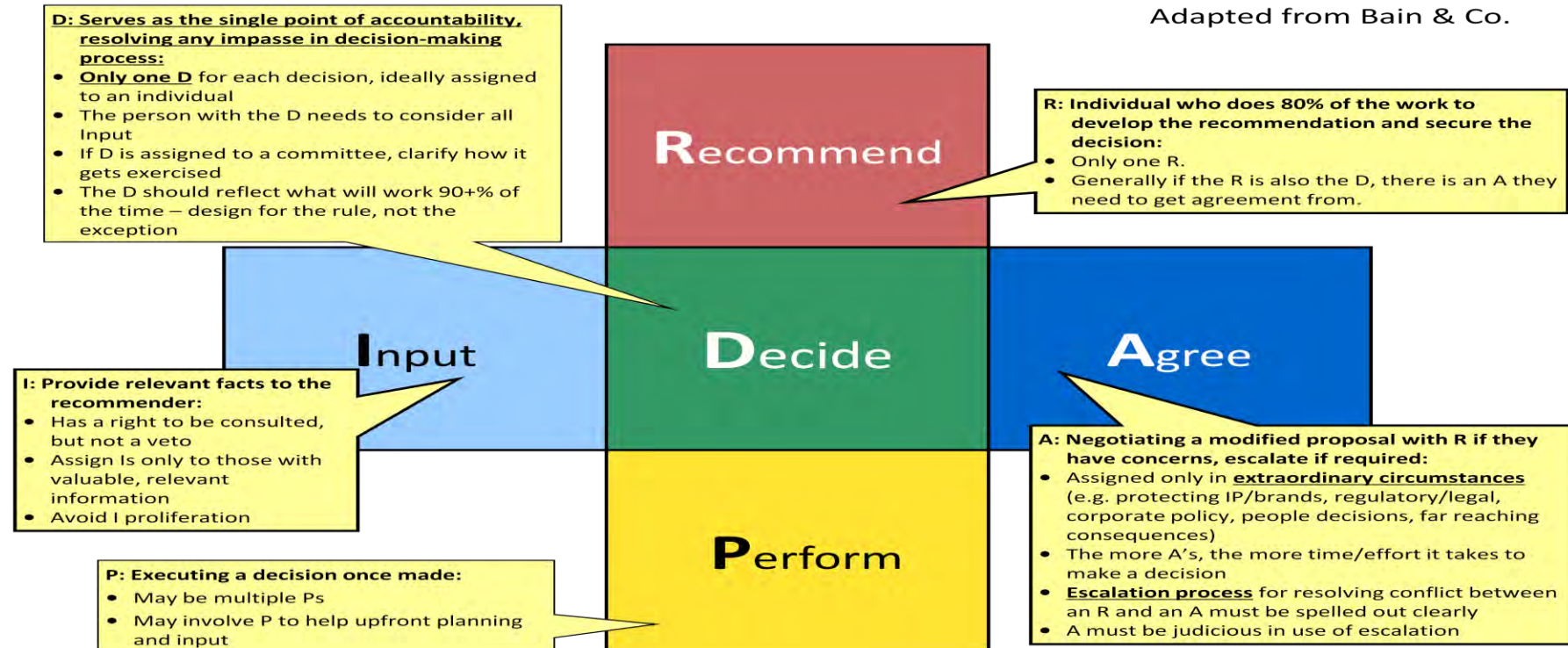
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## Appendix A: Decision Rights

### Decision Rights Definitions

Adapted from Bain & Co.



### Decision Rights Table Legend:

BAS – Business and Administrative Services, BU – Business Unit, CAE – Chief Audit Executive, CBD – Corporate Business Development CFO – Chief Financial Officer, COE – Commercial Operations & Environment, CRO – Chief Risk Officer, CS – Corporate Secretary, CSP – Corporate Strategy & Planning, ELT – Executive Leadership Team, IT – Information Technology, KPI – Key Performance Indicators, OAR – Organizational Authority Register, P&C – People and Culture, SC – Supply Chain

Operations includes Nuclear, Hydro-Thermal Operations and generation aspects of COE. Operations assumes a decision process involving the stations within the Business Unit.

Functions include Finance, People and Culture, Business and Admin Services, and Law. It also includes centre-led portions of Corporate Office, (e.g. Stakeholder Relations), and COE (e.g. Environment).

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### Centre-led Functional Policy, Staffing, and Service Levels

Decision Areas	CEO	ELT	Corporate Office	Operations	Functions
Establish functional policy	D	I	I	P	R
Establish required service levels				I/A	R/D/P
Set and measure performance objectives for embedded functional resources				I/A	R/D/P
Establish service delivery approaches/mechanisms				I	R/D/P
Establish budget for functional support				I/A	R/D/P
Select embedded, key functional resources to support the business				I/A	R/D/P
Define promotability and career plans for embedded functional resources				I	R/D/P
Set compensation for embedded functional resources				I	R/D/P

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**Governance and Management Systems**

Decision Areas	Board	CEO	ELT	Corporate Office	Operations	Functions
Set Board Policies and Code of Business Conduct	D	I	I	R	I/P	I/P
Design Management System (including risk mgt) - Functions				I/P A/P (1)	I/P	R/D
Design Management System (including risk mgt) - Operations				A/P (2) I (3)	R/D	
Set Governance for Wholly-Owned Subsidiaries	D	I	I	R/P (CS)	I	I
Set Governance for Joint Ventures	D	I	I	R/P (CS)	I	I
Determine OPG risk appetite and tolerance	D	I	I	R (CRO)	I/P	I/P
Identify, assess and classify strategic/enterprise-wide risk		I	A	R/D/P	I	I
Determine mitigation strategies for strategic/enterprise-wide risks		D	I	I/P	R/P	R/P
Determine Annual Internal Audit Plan (including test for reliance)	D	I/A	I	I	I	R (CAE)

Notes: (1) CRO A/P as requisite Middle Office function in Treasury operations, (2) CRO A/P as requisite Middle Office function in Trading Operations, (3) CRO I on design of oversight framework for major projects.



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**Strategy and Capital Allocation**

Decision Areas	Board	CEO	ELT	Corporate Office	Operations	COE	Functions
OPG Business Model		D	I	R/P	I	I	I
Corporate Strategy	D	R	I	P (CSP)	I	I	I
Shareholder/Stakeholder Strategy				R/D/P	I/A	I/A	I/A
Generating Unit Strategy				A	R/D/P		
Functional Strategy				A	I/A	I/A	R/D/P
OPG Generation Plan		D	I	I	I/A	R/P	I
Capital <sup>(1)</sup> Allocation to Business Units / Major Projects		D		R	I	I	I A (Finance)
Capital <sup>(1)</sup> Allocation within Business Unit				I	R/D	I	R/D I (Finance)
Company Level Business Development		D		R/P	I/P	I/P	I/P A(Finance)
IT Investment		D		I	I	I	R/P (BAS) A(Finance)
Business Case Approvals (D-based on OAR)		D		R/D I (2)	R/D	R/D	R/D A(Finance)
BU/Function Business Plan				I (3)	R/D/P	R/D/P	R/D/P A(Finance)

**Notes:** (1) For Capital Projects, Operations Maintenance & Administration Projects, Minor Fixed Assets, Internal Provision Projects. (2) CRO I on business case risk assessment for projects > \$40M. (3) CRO I on risk sections of the BU/Function business plans.

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**Targets**

Decision Areas	CEO	ELT	Corporate Office	Operations	COE	Functions	Other
Strategic KPIs and Long Term Targets	D	I	R/P	I	I	I	A (P&C Finance)
OPG Business Plan Targets	D		I/A	I/A	I/A	I/A	R/P (Finance)
BU/Functional Targets				R/D/P	R/D/P/A	R/D/P	A (Finance)
Day-to-Day Generation Dispatch				I/A (1)	R/D/P		
Conventional Safety Targets				I/A/P	I/P	I/P	R/D/P (P&C)
Environmental Targets				I/A/P	R/D	I/A/P (BAS)	

**Notes:** (1) Delegated A authority to stations based on public safety.

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**Qualifications and Training**

Decision Areas	CEO	ELT	Corporate Office	Operations	Functions	P&C
Leadership Training	D	I	I	I	I	R/P
Line Training Qualification Requirements				D/P	D/P (SC)	R/I/A
Line Training Content				I/A/P		R/D/P
Training Schedule				I/A(1)		R/D/P
Line Hiring Requirements				R/D/P		I/A

Notes: (1) Training Schedule is owned at the station, Station is I/A.

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## Supply Chain

Decision Areas	CEO	ELT	Corporate Office	User/ Customer	SC	Law
Make/Buy decisions (1 framework, not every decision based on \$ value)				R/D	I/A/P	
Development and implementation of Contracting Approach for major services and projects				I/D	R/P/A	I
Determining Vendor Requirements (includes setting criteria)				R/D	A/P	
Vendor selection for major services contracts and projects			I (CRO)	D	R/P	
Vendor Selection (routine/commodity)			I (CRO)	I/A	R/D	
Establish demand levels				R/D	A/P	
Establishing appropriate inventory levels				R/D	A/I/P	

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## Appendix B: Integrated Framework

### B.1.0 GOVERNANCE

#### Definition

OPG Governance is defined as Board policies that establish the parameters for management of the company.

Governance in general is driven by legal requirements, regulatory requirements, and/or OPG's strategies and objectives. Our culture and approach to risk and risk management inform how we interpret those requirements and determine the degree to which we establish governance, risk management and management systems, and provide assurance.

#### Accountabilities

The Corporate Office is accountable for establishing and maintaining Board policies.

Operating Units and Functions are accountable for establishing and maintaining implementation of those policies specific to their areas of responsibility.

#### Principles for Governance

##### 1. Integrated governance framework

Governance is part of an integrated OPG framework that includes elements of governance, risk management, management systems and assurance. The framework uses common language and definitions across the company and has clear linkages and interdependencies across all elements. Governance will establish clear policies and requirements and specific requirements for management systems. Management systems will define how those requirements are to be met and business objectives will be achieved; management will hold individuals accountable for following the management systems.

The integrated framework is designed to support the needs of the Board and OPG Leadership by providing clear expectations and guidance that ensure the enterprise is meeting the policies and requirements in an efficient manner and providing assurance that risk is being adequately managed.

##### 2. Necessary, unique and distinctive

Governance should be established judiciously.

Any new governance policies should be unique and distinctive from existing governance and/or regulatory requirements. If existing governance does not adequately address OPG's requirements, the priority should be to revise those policies and requirements over establishing additional governance.

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### 3. Clear mandate

Board policies must have a direct link to an established board mandate (e.g. strategic planning, risk management, internal controls, succession planning, ethics, etc.), OPG's interpretation of legal and regulatory requirements, legal agreements, or be essential in achieving OPG's strategies and objectives.

### 4. Business rationale

There must be a reasonable business rationale for establishing any new governance, or raising/lowering expectations in existing governance. Requirements established in governance must be cost effective and lead to more profitable and sustainable operations, serve to reasonably ensure legal and regulatory compliance, or mitigate strategic risk to the company.

### 5. Specific accountabilities

Each policy will have a Sponsoring Executive. The sponsoring executive is responsible for developing the business rationale and to ensure the policy is implemented in a reasonable manner. The governing policy will establish clear definitions and accountabilities throughout the organization.

### 6. Documented and Current

All governance policies and requirements shall be documented. Documentation should be kept simple and concise. Board policies will aim to be one page in length. Documentation should include who has accountability for maintaining the governance.

Governance policies and requirements should be reviewed on a periodic basis for relevance and effectiveness, and the frequency of this review should be identified within the governance document. Policies should be reviewed annually. The review will result in a decision to do one of three things. 1. Maintain the governance policy and requirements as is. 2. Modify the governance policy and requirements. 3. Discontinue the governance policy and requirements. The owner of the governance policy and requirements should execute the review process.

## B.2.0 RISK MANAGEMENT

### Definition

Risk Management is forward looking identification, assessment, mitigation and monitoring of risks and is undertaken in an effort to improve the likelihood for positive outcomes. OPG's Enterprise Risk Management Framework defines the principles for identifying, assessing, managing, monitoring, and reporting risks which are integrated into OPG's governance, management systems, and assurance in order to support the achievement of OPG's strategic and business plan objectives. Robust risk assessments and management self assessments are a key principle underlying successful management systems, and are distinct from assurance.

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### Accountabilities

In collaboration with the OPG Board of Directors and the Enterprise Leadership Team, the Corporate Office is accountable for establishing, maintaining and improving the Enterprise Risk Management Framework including, but not limited to, risk appetite and tolerance. Corporate Office is also accountable for providing independent, middle office oversight and reporting of all OPG market and credit risk exposures.

Risk Management is the responsibility of management and an integral part of OPG's culture and organizational processes, including decision making. Operating Units and Functions are accountable for managing the risks specific to their areas of responsibility.

Although Risk Management and Assurance both assist in the achievement of strategic and business plan objectives, they are separate and distinct activities. Assurance reviews the effectiveness of the risk management framework and activities, as well as the management system in general.

### Principles for Risk Management

#### 1. Integrated governance framework

Risk Management is part of an integrated OPG framework that includes elements of governance, risk management, management systems and assurance. The framework uses common language and definitions across the company and has clear linkages and interdependencies across all elements. Governance will establish clear policies and requirements and specific requirements for management systems. Management systems will define how those requirements are to be met and business objectives will be achieved; management will hold individuals accountable for following the management systems.

The integrated framework is designed to support the needs of the Board and OPG Leadership by providing clear expectations and guidance that ensure the enterprise is meeting the Policies and Requirements in an efficient manner and providing assurance Risk is being adequately managed. Risk Management should assist in making informed choices, prioritizing actions, and distinguishing among alternative courses of action.

#### 2. Alignment with risk appetite and tolerance

Risk Management activities as well as business activities and decisions should be guided by OPG's risk appetite and tolerance. Risk appetite is the amount and type of residual risk that an organization is willing to pursue or retain in pursuit of value or organizational objectives. Risk tolerance defines the acceptable range of negative impacts from residual risks, and can be influenced by legal or regulatory requirements.

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### 3. Systematic, dynamic and iterative response to change

Risks should be identified, assessed, and managed based on the Enterprise Risk Management framework (processes, criteria, etc.) to ensure consistent, comparable, and reliable results. Risk Management activities should be adaptable, continually sensing and responding to changes. As external and internal events occur, risks should be monitored and changes (i.e. new and emerging risks; increasing or decreasing risk, etc.) should be addressed.

### 4. Frequent communication

There should be constant dialogue with internal and external stakeholders regarding risks, including frequent reporting at various levels of the organization in order to support timely decision making on risk management.

### 5. Specific accountabilities and training

Risk Management accountabilities should be clearly outlined in governance so that each employee is aware of their role in risk management. Supervisors will ensure training and guidance is provided to individuals with risk management accountabilities.

## B.3.0 MANAGEMENT SYSTEMS

### Definition

OPG's management systems define how work gets done in order to meet the requirements established by relevant OPG governance and to achieve business objectives. They are comprised of strategy, structure, processes, procedures, metrics, and people and include all elements of Plan - Do - Check - Act.

### Accountabilities

Operating Units and Functions are accountable for establishing management systems necessary to achieve their accountabilities. The Operating Units and Functions management systems will establish controls that manage the risk within the OPG risk appetite and tolerance, specify how work is accomplished in order to support achievement of the strategic or business objectives, and comply with governance requirements.

Management is accountable for ensuring that all individuals follow the management system.

### Principles for Management Systems

#### 1. Integrated governance framework

Management systems are a part of an integrated OPG framework that includes elements of governance, risk management, management systems, and assurance. The framework uses common language and definitions across the company and has clear linkages and interdependencies across all elements. Governance will establish clear policies and requirements and specific requirements for management systems. Management systems will



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define how those requirements are to be met and business objectives will be achieved.

The integrated framework is designed to support the needs of the Board and OPG Leadership by providing clear expectations and guidance that ensure the enterprise is meeting the policies and requirements in an efficient manner and providing assurance that risk is being adequately managed.

### 2. Simple and Concise

Management systems should be simple and concise, with clear accountabilities and written in plain language with the user in mind. The management system should focus on the things that are necessary to comply with governance, to effectively run the business, and to achieve business objectives.

The management system will include mandatory requirements when necessary, and otherwise allow flexibility in how requirements are met.

The management system will describe the desired objectives and outcomes. It shall be recognized that outcomes describe not only quantifiable results, but conformance to expected behaviours.

### 3. Incorporate Plan - Do - Check - Act

Management systems should include all elements of Plan - Do - Check - Act (PDCA) and embrace a continuous improvement mindset in support of business and strategic objectives. The PDCA cycle should be the basis for achieving the desired objectives and outcomes and identifying opportunities for improving the approach to achieving the objectives and outcomes.

### 4. Integrated into routine work

All elements should be integrated into routine work and should be consistent with the way the organization functions on a routine basis.

- **Plan**, when appropriate, should be linked and integrated with regular business planning routines, relevant governance, and required risk assessments.
- **Do** should be integrated into accomplishment of routine work.
- **Check** should include self-assessment and management reporting.
- **Act** should correct, reinforce and validate current processes or lead to improvement opportunities.

### 5. Risk-based

The scale and rigour of the management system should be based on the defined level of tolerance of the risk associated with the activity being performed.

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### 6. Documented and Current

The management system shall be documented.

Management system performance should be reviewed periodically by the owner of the management system for relevance and effectiveness. The results of the review will be reported to the leaders of the Functions and Operating Units.

### B.4.0 ASSURANCE

#### Assurance Definition

OPG's assurance programs assess governance, management systems and controls to provide reasonable, assurance to the Board and Management that there are governance and management systems in place to plan and control the work of the company and that they are effective in meeting the company's objectives.

Assurance is accomplished through a combination of internal audits, assessments and third party audits that the Chief Audit Executive (CAE) has determined meets the requirements set forth in this policy for audit reliance.

#### Audit Definition

An audit is a process used to independently assess the effectiveness of governance, management systems and controls in achieving OPG business objectives.

Internal audit plans and scope are based on business unit or functions objectives and the assessment of risks to achieving those objectives. Internal audits are those completed by OPG Assurance (i.e. Internal Audit and Nuclear Oversight).

#### Accountabilities

The CAE establishes an Annual Internal Audit Plan for OPG that is approved by the Audit and Finance Committee of the Board of Directors.

The CAE will work with Operating Units and Functions to develop a plan for integration of, or reliance on, third party audits (e.g. external ISO certifications) and on management monitoring and self-assessment processes, based on accepted practice, and integrate those approved third party audits into the audit plan.

The Operating Units or Functions may schedule third party audits. For reliance purposes, the scheduling of third party audits and self-assessment processes must be coordinated with the CAE and the CAE establishes that the third party audit meets the reliance criteria.

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## Principles for Assurance

### 1. Integrated governance framework

Assurance is part of an integrated OPG framework that includes elements of governance, risk management, management systems, and assurance. The framework uses common language and definitions across the company and has clear linkages and interdependencies across all elements. Governance will establish clear policies and requirements and specific requirements for management systems. Management systems will define how those requirements are to be met and business objectives will be achieved; management will hold individuals accountable for following the management systems.

The integrated framework is designed to support the needs of the Board and OPG Leadership by providing clear expectations and guidance that ensure the enterprise is meeting the Policies and Requirements in an efficient manner and providing assurance that risk is being adequately managed.

### 2. Objective, impartial, and independent

Audits must be objective, impartial, and independent, and the audit process must be both systematic and documented.

### 3. Emphasis on Higher Risk/Consequences

Internal audits are risk-based and generally concentrate on areas with higher risk exposure.

### 4. Appropriate Audit Integration and Reliance

OPG Assurance will integrate third party audits into the audit plan as appropriate.

OPG Assurance may rely appropriately on third party audits and management self-assessment processes that meet the following criteria: 1) Independence, 2) Technical competence and due professional care, 3) Relevance of audit objectives and scope, 4) Elements of practice, and 5) Communication of results and remediation.

The level of independence of a third party auditor is determined by a number of factors including: 1) The contractual terms, and 2) The relationship to the audited entity. The level of independence of an internal self-assessment process is determined by the nature of the relationship between the assessor and audited entity and process owner.

When the CAE establishes that the reliance criteria are met, OPG Assurance may place appropriate reliance on other assurance activities in developing its assessment of the particular Operating Unit or Function. The audit results, including those that meet reliance criteria, are reported in an integrated manner to Management, the Audit and Finance Committee of the Board and to other committees of the Board of Directors as appropriate.

### 5. Greater Reliance on Management Systems and Individual Accountability

OPG will focus less on “after the fact” auditing and place an increased emphasis on individual

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accountability and robust management systems. Management's ongoing monitoring and self-assessment of management systems, where implemented, will enable this. OPG Assurance may place appropriate reliance on robust management self-assessment processes where they meet the reliance criteria explained above, resulting in an effective balance of internal review and independent assurance activity.



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# Nuclear Standard

## TITLE

### OVERSIGHT OF SUPPLEMENTAL PERSONNEL

## AUTHORIZATION

SINGLE POINT OF CONTACT: D. Popovic  
Director, Projects and Modifications

DOCUMENT OWNER: A. Rob  
Vice-President, Projects and Modifications

## DOCUMENT RELATIONSHIP

Applicability:	Nuclear
Receives Authority from:	N-PROG-AS-007, Project Management

Document is Related to Pressure Boundary ☐ Document Requires CNSC Notification ☐

## PURPOSE

This standard provides the criteria and expected behaviours for the oversight of supplemental personnel executing work within Ontario Power Generation – Nuclear (OPG-N). Oversight of supplemental personnel is an important and critical consideration to ensure project deliverables and objectives are achieved safely and with a high level of quality.

This standard receives its authority from N-PROG-AS-0007, Project Management.

## DATES (YYYY-MM-DD)

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Nuclear Standard

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Usage Classification: Reference	Sheet Number: N/A	Page: 2 of 9

Title:  
OVERSIGHT OF SUPPLEMENTAL PERSONNEL

EXCEPTIONS

None

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<b>OVERSIGHT OF SUPPLEMENTAL PERSONNEL</b>

### 1.0 DIRECTION

This standard provides the oversight principles and requirements to be applied to work packages initiated and/or executed within OPG by supplemental personnel. Oversight is the independent assessment necessary to ensure a common understanding of the attributes, principles, and performance standards for performing work successfully and effectively. Additionally it includes the appropriate due diligence required to ensure all contractual obligations are met. This standard is intended to provide guiding principles for the determination of Supplemental Personnel Oversight within the wide range of categories for these personnel.

Two general classifications of workers are considered:

- A. Workers that are integrated into the station workforce with supervisory and management requirements left to OPG staff.
- B. Transient workers involved with managed task work where the contractor assumes the accountability for the management and supervision of workers.

Oversight is applicable but not limited to:

- Safety
- Quality
- Cost and schedule performance
- Solution effectiveness
- Risk management
- Value for money
- Regulatory and environmental compliance
- Human performance
- Planning
- Engineering
- Procurement suppliers and contractors
- Installation and construction activities

Oversight is based on a proactive and graded, risk based approach. The means by which the different executing organizations implement this standard may vary based on business requirements.

### 1.1 PRINCIPLES

The guiding principles for attaining high levels of performance will be adapted to the classification of the personnel utilized, and shall include the following;

1. OPG line management retains the responsibility for ensuring nuclear safety and cannot delegate this responsibility to supplemental personnel.
2. The performance standards and expectations for the conduct of work activities by supplemental personnel are the same as those high performance standards expected of OPG staff.



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3. Supplemental personnel, when directly supervised by OPG, understand and use the same OPG processes for performing work activities. Supplemental workers performing managed task activities may utilize their own processes only after qualification and acceptance by OPG.
4. Supplemental personnel who perform work independently (under their own supervision) are qualified to criteria commensurate with OPG standards.
5. Good industrial safety performance of supplemental personnel cannot be assumed.
6. The roles and responsibilities of the supervisor (OPG or a supplemental supervisor) are clearly defined and vigorously implemented for supervising supplemental personnel.
7. A close, interdependent relationship between supplemental and OPG personnel is established that generates a spirit of cooperation.

## 1.2 Key Supplemental Personnel Process Objectives

Excellent performance of supplemental personnel is achieved through the following underlying process objectives and key attributes: Refer to N-INS-00120-10026, Supplemental Personnel Oversight, Appendix B for the process flow diagram.

- (a) Standards and expectations are thoroughly communicated and understood by supplemental personnel.
- (b) OPG (service organizations and station line managers) clearly identify and reinforce accountabilities for supplemental personnel performance.
- (c) Supplemental personnel understand roles and responsibilities specific to the tasks they are performing.
- (d) Supplemental personnel understand the significance of the work they are performing to nuclear safety and station reliability. The technical competencies of supplemental personnel who perform work for OPG are verified and are appropriate for the tasks.
- (e) Supplemental personnel know, understand, and demonstrate use of event free tools and that they are expected to stop and ask questions when unsure.
- (f) The responsibility in OPG for the monitoring and oversight of supplemental personnel is identified clearly and is performed effectively.
- (g) Supplemental personnel exhibit proper industrial safety and human performance behaviours.
- (h) An effective means of feedback exists that promotes continual improvement in supplemental personnel performance.

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- (i) The amount and frequency of oversight shall be applied strategically using a graded approach based on complexity, risks, and performance. The level of oversight shall be modified to reflect the current performance and changes in the risk profile. Examples where increased levels of oversight may be required include:
- Areas that include new processes or technology activities of high consequence to safety, quality, cost or schedule
  - Critical evolutions or changes
  - Where suppliers are new or have performed less than expected on previous work activities
  - Fabrication by sub-contractors
  - Where nuclear safety or operation may be impacted
  - Work activities where there is evidence of negative trends, e.g. safety, quality, cost, or schedule, performance
  - Where industry OPEX indicates there is a higher level of risk

## 1.3 OVERSIGHT OF SUPPLEMENTAL PERSONNEL

1.3.1 The same rigor as used within OPG is applied to oversight of all supplemental personnel including:

- Contractors who perform work on site
- Contractors who perform work off site such as engineering modifications, analysis, component fabrication, equipment refurbishment, and testing
- Utility personnel from an industry alliance who perform work on site such as a shared resource during outages
- Utility personnel who may work part time such as switchyard personnel or roving teams

1.3.2 Oversight shall be proactive to support early detection of potential issues and to ensure effective and timely implementation of corrective actions. Refer to N-INS-00120-10026 Supplemental Personnel Oversight for the process details. Methods of proactive oversight include but are not limited to:

- Establishing and communicating expectations and targets
- Conducting regular status meetings
- Look ahead planning and strategy execution

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- Conducting challenge and preparedness meetings
- Performing direct observation, surveillance and assessments
- Utilizing trend analysis and performance metrics
- Tracking and timely resolution to issues
- Prompt escalation of issues not resolved

## 2.0 ROLES AND ACCOUNTABILITIES

### 2.1 Contract Owner

- Provides oversight of the contract from initiation to closeout
- Ensures proper resources are available to manage and monitor the contractor for quality and efficiency
- Ensures all procedural and work practices are followed and achieved by supplemental personnel
- Ensures Performance (cost, schedule, safety, etc) goals are met

### 2.2 Contract Management Team

Administers and monitors the supplemental personnel to:

- Ensure on a daily basis that all regulatory requirements are met during the execution of the work
- Exercise the delegated authority to stop all work for unsafe acts or potential environmental hazards
- Establish an interdependent relationship between supplemental and station personnel that is based on a spirit of cooperation
- Ensure on a daily basis the contractor's workplace activities are carried out in a safe and productive basis.

## 3.0 TRAINING AND QUALIFICATION

- 3.1 Staff providing oversight for supplemental personnel shall be qualified in accordance with Training Qualification Document (TQD) N-TQD-510-00001, Supplemental BTU Direct Hire and Contract Management Training and Qualification Description.

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### 4.0 DEFINITIONS AND ACRONYMS

#### 4.1 Definitions

Supplemental personnel – Are persons who conduct work or provide services on or off site to OPG-N who are not full-time OPG-N site personnel. These include any of the following:

- contractor personnel who perform work on site
- contractor personnel who perform off-site work, such as engineering modifications, component fabrication, equipment refurbishment, and equipment testing
- personnel from another location within OPG or from an industry alliance who perform work on site, such as shared resources during outages
- personnel from within OPG who may only work part time at the station, such as switchyard personnel, diving and other water services, environmental services, and roving valve teams
- personnel from another location who perform work off site, such as corporate engineering support

#### 4.2 Abbreviations and Acronyms

<b>OPG-N</b>	Ontario Power Generation, Nuclear

### 5.0 BASES, RECORDS AND REFERENCES

#### 5.1 Bases

None

##### 5.1.1 References

Performance References

##### 5.1.2 N-PROG-AS-0007, Project Management

Developmental References

N-INS-00120-10023, Contractor Management Process  
N-STD-AS-0028, Project Management Standard  
N-STD-AS-0029, Contract Management Standard  
N-STD-AS-0030, Project Oversight Standard  
N-STD-AS-0031, Field Engineering Standard

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INPO AP-930, Supplemental Personnel Process Description, Rev 2, Issued 12-09  
N-PROG-MA-0004, Conduct of Maintenance  
OPG-PROC-0160, Contractor Safety Management

## 6.0

### REVISION SUMMARY

- This is a **new** document.



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# Ontario Power Generation Procedure

## TITLE

**PROCESSING ADMINISTRATIVE GOVERNANCE DOCUMENTS**

## AUTHORIZATION

SINGLE POINT OF CONTACT: Richard Collyer  
Section Head, Governance & Services  
Information Management Program Authority, CIO

DOCUMENT OWNER: Shelley Tucker  
Senior Manager  
Information Management & Program Authority, CIO

## DOCUMENT RELATIONSHIP

Applicability:	OPG Wide
Receives Authority from:	OPG-PROG-0001, Information Management

Document is Related to Pressure Boundary ☒ Document Requires CNSC Notification ☐

## PURPOSE

This procedure establishes controls for preparation, review, and approval of governance documents. This includes superseding and obsoleting governance documents and removing documents from governance.

## DATES (YYYY-MM-DD)

PDF Creation Date:	2016-06-30
Compliance Date:	Immediate

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#### EXCEPTIONS

For non-governance controlled documents, refer to OPG-PROC-0019, Records and Document Management.

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### 1.0 DIRECTION

Governing documents include Policies, Charters, Programs, Procedures, and Standards. Forms, Instructions (INS), Lists, Manuals, Qualification Guides (QG), Templates, and Training and Qualification Descriptions (TQD) may also be deemed governance documents by the Document Owner. A governing document stipulates philosophy, mandatory rules, regulations, licensing requirements, and management controls, in order to implement business processes.

Criteria for choosing the correct document type and format are provided in OPG-STD-0001, Requirements for Administrative Governance Documents.

Computer Assisted Learning (CAL) 76186, Governance, is suggested for all employees that are new to the Governance process or require refresher training.

Refer to OPG-INS-08133-0001, Submission, Approval, and Issuance of Documents Using Smart Form, for instructions on performing the actions relating to Smart Form throughout this document.

Document Owners and delegates should be identified in accordance with the [Governance Ownership](#) database on the Governance website.

For TQDs, QGs and Training INSSs, refer to N-PROC-TR-0021, Training and Qualification Description, Development and Approval Process, for additional requirements on the routing of OPG-FORM-0001, Governance Management Record (GMR).

### 1.1 Initiation

#### 1.1.1 Submitter or Author should perform **one** of the following:

- (a) If a **new** governing document, or **revision** to an existing governing document, is required, complete Section A of OPG-FORM-0001, and forward to the Document Owner (or delegate).

**Note:** To confirm there is no existing governance that may already address the need, it is good practice to execute a search (using PowerSearch tool).

- (b) If a **review date** for an existing governing document is approaching, but revision may not be required as the document is still accurate, complete OPG-FORM-0051, Governance Document Review Checklist, by proceeding to Section 1.11.
- (c) If a **change** is required to an existing governing document, but does not necessitate an immediate revision, create and progress a Document Change Request (DCR) in Asset Suite in accordance with OPG-INS-00700-0001, Document Change Request Data Administration.
- (d) If **reducing governance** by superseding, obsoleting or changing the classification to a non-governance controlled document, refer to Section 1.10.

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- 1.1.2 Document Owner (or delegate) should review the GMR and perform the following:
- (a) If in agreement with the proposed change, perform **one** of the following, as applicable:
    - (1) **New** document:
      - (i) When using Smart Form application, reserve new governing document number.
      - (ii) When not using Smart Form application, forward approval with OPG-FORM-0001 to the OPG Governance mailbox to have a new governing document number reserved.
    - (2) **Revision** to existing document required:
      - (i) When using Smart Form application, check out and retrieve or receive the editable electronic copy.
      - (ii) When not using Smart Form application, forward approval with OPG-FORM-0001 to the OPG Governance mailbox to check out and request the editable electronic copy.
  - (b) If not in agreement, reject the GMR, inform Submitter or Author, and/or cancel DCR if created.

## 1.2 Development

1.2.1 Submitter or Author should perform the following:

- (a) Prepare draft document, using latest revision of applicable template, as follows:

- OPG-TMP-0001, OPG Governance Document
- OPG-TMP-0004, Form - Portrait, Landscape & Tag
- N-TMP-10017, Approved Roles.

**Note:** Re-templating to the most recent revision of the template is mandatory for **intent** revisions. Minor revisions and non-intent revisions do **not** require re-templating.

- (b) For a new centre-led Program document owned by a centre-led organization that supports N-CHAR-AS-0002, Nuclear Management System, complete N-FORM-11604, Nuclear Quality Program Checklist.
- (c) If applicable, verify bases (licensing, legal, regulatory, and quality assurance) requirements are identified and satisfied.
- (d) Review any existing related documentation including DCRs, minor revisions, Station Condition Records, operating experience, and benchmarking activities assigned to Document Owner for inclusion in draft. Refer to OPG-INS-00700-0001 for further direction relating to DCRs.

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- (e) Determine whether the document supports the implementation of the Nuclear Pressure Boundary Certificate of Authorizations by referring to N-LIST-01913.11-10001, Nuclear Pressure Boundary Governing Documents, and return to this procedure.

If the document is related to Pressure Boundary:

- (1) Select the “Document is related to Pressure Boundary” checkbox on OPG-FORM-0001, OPG-TMP-0001, and in Smart Form application if used.
  - (2) Include OPGN - CDS & ST -NUCLEAR as a mandatory reviewer of the document for all changes.
- (f) Determine whether the document requires Canadian Nuclear Safety Commission (CNSC) notification, approval, or requires an amendment to a licence by referring to N-LIST-00531-10002, OPG Documents Referenced in Licence Conditions Handbook.

If the document requires CNSC notification or approval, identify on OPG-FORM-0001, OPG-TMP-0001, and in Smart Form application if used.

**Note:** Document changes requiring **CNSC Approval** (as identified in N-LIST-00531-10002) that involve an adverse impact on any facility’s licensing basis, or require a licence amendment should be discussed with Manager, Nuclear Regulatory Affairs .

- (g) Ensure document complies with the requirements of OPG-STD-0074, Accessibility for Ontarians with Disabilities Act Integrated Accessibility and Customer Service Standard.
- (h) Ensure document association to parent document is valid and approved by Document Owner. The parent document is required to direct use of child.
- (i) Ensure consistency with role documents (N-MAN-08131-10000 series). If role document requires a revision, refer to OPG-PROC-0166, Organization Design Change, for direction.
- (j) Ensure decision rights are followed in accordance with OPG-POL-0033, OPG Business Model.
- (k) Assess impact of document revision to the following:
  - N-LIST-08130-10023, CSA N286-05 to OPGN Governance Cross Matrix
  - N-LIST-08130-10025, CSA N286-12 to OPGN Governance Cross Matrix

Contact the Document Owner of the applicable N-LIST, if applicable.

- (l) Ensure document header is updated to current revision number and appropriate watermark is applied to the document.
- (m) For Minor Revisions, ensure “Compliance” field on the first page of document is updated to “Immediate”.

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- 1.2.2 Submitter or Author may apply structure and minimum content requirements established in OPG-GUID-08130-0001, Writing Guide for Administrative Governance Documents.

**Note:** Appropriate Information Management Services mailbox may be contacted for forms due to their specialized formatting features.

## 1.3 Implementation and Communication Planning

Identifying a compliance date is mandatory for all types of revisions. Communication Plan information is mandatory for new, intent revisions, and reducing governance only.

- 1.3.1 Submitter or Author should complete Section C of OPG-FORM-0001 including:
- Compliance Date** is by which applicable Business Units or Facilities should be complaint. Date(s) should align with compliance date(s) on document. Input as Immediate or YYYY-MM-DD.
  - Communication Plan** including:
    - What** is changing or needs to be communicated?  
(e.g., process requirements, accountabilities, training, organization, etc.)
    - Who** are the change stakeholders that need to be informed?  
Include Roles and Accountabilities impacted by the change.
    - How** are stakeholders to be informed?  
(e.g., e-mail, classroom training sessions, roll-outs, stand downs)
    - When** are stakeholders to be informed or activities to be completed?  
(e.g., 30 days after issue, etc)
    - Who** is the Responsible Manager to ensure completion of each line action below?  
Prepare Action Tracking request and assignments as required.

## 1.4 Review

- 1.4.1 The level and extent of review should depend on the scope or complexity of the change or its potential impact on safety as determined by Document Owner. Document Owner shall indicate reviewers that may be significantly impacted by the change. Reviewers shall be listed in Section D of OPG-FORM-0001. (Suggest 10 business days for review period).

**Note:** Board approved Policies shall be sent to OPG Governance for review.

- 1.4.2 Sending document(s) for review is mandatory for new documents, intent revisions and reducing governance only.
- Mandatory reviewers shall include:
    - OPG GOVERNANCE
    - RIMGOVREVIEWS

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- OPGN CDS & ST (for documents on N-LIST-01913.11-10001, all new documents supporting N-CHAR-AS-0002, all new Programs where N-FORM-11604 has been completed, and for revisions if applicable)

(b) Additional reviewers should include:

- Document Owner or SPOC of the authorizing document.
- At least one stakeholder for each affected facility or organization.
- Interfacing Program Owners or LOB SPOCs where there are Bases applicable to that organization.
- Impacted positions identified in Roles & Accountabilities section.
- Key stakeholders based on Recommend, Agree, Perform, Input, Decide (RAPID) Model (OPG-POL-0033).
- If document is related to Training, include Manager, Training, Planning and Design.
- Peer Team members.

1.4.3 Submitter or Author should forward draft document and OPG-FORM-0001 (refer to Appendix A, Review Process E-mail Samples), for review as follows:

**Note:** Alternate methods for obtaining stakeholder review comments may be conducted (e.g., face-to-face, e-mail, SharePoint Document Workspace [refer to OPG-INS-08180-0004, Technical Review from a SharePoint Document Workspace]).

- (a) Include reviewers identified in Section D of OPG-FORM-0001.
- (b) Recommend that reviews be returned within 10 business days.
- (c) For revisions to TQD, QG, and Training INS documents, refer to N-PROC-TR-0021 for additional requirements pertaining to review and communication planning.

1.4.4 Each reviewer identified in Section D of OPG-FORM-0001 should:

- (a) Review content of document appropriate to area of expertise, for example:
  - Business impact
  - Compliance to regulatory and licensing requirements and commitments
  - Technical content
  - Format
  - Records.

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- (b) Review communication plan outlined in Section C of OPG-FORM-0001 to assess business impact and adequacy of planned communication or change management activities.

### 1.5 Comment Disposition

This section is mandatory for new, intent revisions, and reducing governance only.

#### 1.5.1 Submitter or Author should perform the following:

- (a) Disposition reviewer comments, ensuring significant comments are discussed with reviewer.
- (b) If required, arrange for Document Owner or delegate to resolve stalemate comments.
- (c) Record disposition of reviewer comments in Section D of OPG-FORM-0001. Do not use “no comment” as it could be misinterpreted. Instead, use wording such as “comments incorporated”, “no comments received”, “reviewed and no comments”, “comments received and rejected with explanation”.
- (d) File significant comments in an Approved Information Management System (AIMS) as a record, e.g., Asset Suite, or include as Additional Files if using Smart Form application.

### 1.6 Validation

For new (R000) documents and intent revisions with extensive changes, Submitter or Author should perform the following:

- (a) Assign a Validator who is familiar with process but not Authorization Authority, SPOC, Reviewer or Author, to ascertain whether steps may be performed as written and:
  - Are technically correct
  - Are specific and not ambiguous
  - Accomplish their objective
  - Are in logical order.

**Note:** Validation may be performed in a flexible way as deemed by Document Owner or delegate (e.g., walkthrough, comparison, table top).
- (b) Confirm the requirement described in N-LIST-08130-10023 or N-LIST-08130-10025 continues to be met. File a DCR on N-LIST-08130-10023 or N-LIST-08130-10025 if required.
- (c) Once comments are received from Validator, complete Section E of OPG-FORM-0001.

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## 1.7 Approval

### 1.7.1 Submitter or Author should perform the following:

- (a) Finalize OPG-FORM-0001, Sections A through F as applicable.
- (b) If applicable, finalize and have approved N-FORM-11604 filed in AIMS or include as Additional Files if using Smart Form application.
- (c) Prepare approval package (e.g., native file, Portable Document Format [PDF], and associated OPG-FORM-0001). Ensure completeness, accuracy, and acceptability for use as follows:
  - (1) For intent or non-intent revisions of documents, ensure document is in final format (i.e., no watermark, and in PDF or some other acceptable non-editable format).
  - (2) For minor revision, ensure document is watermarked with 'CHANGE' and tracked changes are visible.

**Note:** If the extent of the changes cause the document to become illegible revision bars may be used in place of Track Changes.

- (3) Disposition outstanding DCRs ensuring status is either at Approved, Modified, or Active status for incorporation. Refer to OPG-INS-00700-0001.
- (d) If document is listed in N-LIST-00531-10002 and requires **Prior Written Notification** or **Written Notification**, prepare CNSC notification in accordance with the sample e-mail in Appendix B, Sample E-Mail for Documents Requiring Prior Written Notification / Written Notification to the CNSC.

**Note:** Document changes requiring **CNSC Approval** (as identified in N-LIST-00531-10002) that involve an adverse impact on any facility's licensing basis, or require a licence amendment should be discussed with Manager, Nuclear Regulatory Affairs.

- (e) For revisions to TQDs, QGs, and Training INS documents, refer to N-PROC-TR-0021 for additional requirements pertaining to the approval stage.

### 1.7.2 Once approval package and applicable inclusions are finalized, Submitter or Author should perform **one** of the following:

- (a) When using Smart Form application, upload approval package with applicable inclusions, and release for approval.

**Note:** For forms, ensure that the "Filling in Forms" and password protected copy is loaded to the Electronic Document Management System (EDMS) link and an unprotected copy is loaded to the Native Files link on the Asset Suite Upload screen. This will ensure that future revisions will be editable.

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- (b) When **not** using the Smart Form application, prepare and forward routing e-mail including approval package with applicable inclusions for electronic approval and authorization of the document. Refer to Appendix C, Sample E-Mails for Authorization of Documents.

#### 1.7.3 Document Owner (or delegate) shall perform the following:

- (a) Review approval package for completeness, accuracy, and acceptability for use.
- (b) For documents listed in N-LIST-00531-10002 requiring **Prior Written Notification** or **Written Notification**, review CNSC notification e-mail in accordance with the sample e-mail in Appendix B.
- (c) For documents requiring **Prior Written Notification** or **Written Notification to the CNSC**, proceed to Subsection 1.7.5.

If required, confirm there is no adverse impact on a nuclear facility's licence basis, or that appropriate CNSC approvals are being obtained in accordance with N-PROC-RA-0047, Communications with the Canadian Nuclear Safety Commission

- (d) For Programs, proceed to Subsection 1.7.4.
- (e) For all other documents, proceed to Subsection 1.7.6.

#### 1.7.4 Authorization Authority (for Programs) shall perform the following:

- (a) Review approval package for completeness, accuracy, and acceptability for use.
- (b) For documents listed in N-LIST-00531-10002 requiring **Prior Written Notification** or **Written Notification**
  - (1) Review CNSC notification e-mail in accordance with the sample e-mail in Appendix B.
  - (2) Forward approval package to Manager, Nuclear Regulatory Affairs or submit using Smart Form application.
- (c) If not listed in N-LIST-00531-10002, proceed to Subsection 1.7.6.

#### 1.7.5 Manager, Nuclear Regulatory Affairs shall perform one of the following:

- (a) Submit document for CNSC notification or ensure any required requests for approval or licence amendment are submitted as required.
- (b) Indicate CNSC notification or approval is complete by attaching supporting documentation to approval package and forwarding approval package back to Document Owner or Authorization Authority by e-mail or forward using Smart Form application.



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1.7.6 Document Owner (or delegate) or Authorization Authority should perform one of the following:

- (a) When using Smart Form application, approve and release.
- (b) When not using Smart Form application, indicate **approval** in e-mail (i.e., using the word “approved” or “authorized”) and forward approval package to OPG Governance mailbox for issuance.

## 1.8 Issuance

1.8.1 Governance staff should complete the following:

- (a) Perform final quality check.
- (b) Ensure document is linked to the Governance Framework and to Governance Ownership list.
- (c) Perform any actions noted in Section F of OPG-FORM-0001.
- (d) Initiate applicable distribution.
- (e) If applicable, Governance staff shall update Governance Ownership list with changes to Document Owner or SPOC to align with issued document.

## 1.9 Communication Plan Execution

When notified that document has been issued, Responsible Manager or delegate shall perform the following:

- (a) Execute the communication activities as documented in Section C of OPG-FORM-0001.
- (b) Advise OPG Governance mailbox when communication activities have been completed.

## 1.10 Reducing Governance

Reducing governance refers to superseding, obsoleting, or changing the classification to a non-governance controlled document.

Where documents identify the following as Bases, ensure that any alteration or removal of Bases components of the documents is considered prior to removal:

- CSA N286-05, Management System Requirements for Nuclear Power Plants, or
- CSA N286-12, Management System Requirements for Nuclear Facilities, or
- N-LIST-01913.11-10001

1.10.1 Submitter or Author should complete OPG-FORM-0001 and forward to Document Owner (or delegate).

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- 1.10.2 Document Owner or delegate should review request and perform the following:
- (a) If **not in agreement** with the request, reject request and return OPG-FORM-0001 to Submitter or Author.
  - (b) If **in agreement** with the request, assign an Author to perform the following:
    - (1) Execute a search using PowerSearch to identify any governance documents impacted by the removal. File DCRs as appropriate in accordance with OPG-INS-00700-0001.
    - (2) Forward OPG-FORM-0001 to reviewers, as noted in Section D, to assess the impact of document removal on their processes or organization.
      - (i) Refer to Appendix A.1.0 or A.2.0 for samples of review e-mails.
      - (ii) If document is to be superseded by a document from a different program area, include mandatory reviewers from both program areas.
      - (iii) Record disposition of reviewer comments in Section D of OPG-FORM-0001.
    - (3) Disposition any pending DCRs against document being superseded or obsoleted in accordance with OPG-INS-00700-0001.
    - (4) If document is listed in N-LIST-00531-10002, prepare CNSC e-mails in accordance with Subsection 1.7.1(d).
- 1.10.3 Document Owner or delegate or Authorization Authority (for Programs) shall forward approval package by e-mail or submit using Smart Form application in accordance with Subsection 1.7.3 or Subsection 1.7.4.
- 1.10.4 If required, Manager, Nuclear Regulatory Affairs shall perform steps identified in Subsection 1.7.5.
- 1.10.5 Document Owner or delegate or Authorization Authority should perform one of the following:
- (a) When using Smart Form application, approve and release.
  - (b) When not using Smart Form application:
    - (1) Indicate **approval** in e-mail (i.e., using the word “approved” or “authorized”) and forward approval package to OPG Governance mailbox for issuance.
 

**Note:** If Smart Form application has **not** been used, assigned Document Custodian shall perform any actions noted in Section F of OPG-FORM-0001.
    - (2) Notify Submitter or Author and OPG Governance mailbox.

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- 1.10.6 Governance staff should remove superseded documents, obsoleted documents, or documents removed from governance from the Governance Ownership list and the Governance Framework.

#### 1.11 Monitoring Governance Document Review Cycles

When the end of a document review cycle is approaching, OPG-FORM-0051, Governance Document Review Checklist, should be used to determine if the document is accurate or should be revised. A completed OPG-FORM-0051 is required as evidence that the document has been reviewed, deemed to be accurate, and that revision is not required as follows:

- 1.11.1 Document Owner should monitor quality and effectiveness of program requirements to ensure each governance document is reviewed and, if necessary, revised and issued within the established review cycle.
- 1.11.2 Document Owner or delegate should complete OPG-FORM-0051 for each governance document, within the established review cycle, to determine if document is accurate or if revision is required as follows:
- (a) If revision is required, discard OPG-FORM-0051 and revise document in accordance with Subsection 1.1.
  - (b) If revision is **not** required, submit OPG-FORM-0051 to OPG Governance mailbox for approval.
    - (1) When using Smart Form application, upload OPG-FORM-0051 and release for approval.
    - (2) When not using Smart Form application, submit OPG-FORM-0051 to OPG Governance mailbox for approval.
  - (c) OPG Governance should update Last Reviewed Date in Asset Suite.
- 1.11.3 Document Owner (or delegate) should request changes in review cycle as follows:

**Note:** The default review cycle is 2 years for a governance document but shall not exceed 5 years. Policies are typically 1 year while some Forms may be up to 5 years.

- (a) Complete OPG-FORM-0001, Sections A and F.
- (b) Forward completed OPG-FORM-0001 with Document Owner approval to OPG Governance mailbox for updating in AIMS.

- 1.11.4 To update the Governance Ownership list when a revision is not being performed, the Document Owner, SPOC, or delegate should forward approval to OPG Governance mailbox with requested change.

**Note:** For Document Ownership changes, obtain approval from both the **new** Document Owner and the **previous** Document Owner (where applicable).

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## 2.0 ROLES AND ACCOUNTABILITIES

### 2.1 Authorization Authority

#### 2.1.1 Approves Programs, as follows:

- (a) For Nuclear documents, this role is delegated by the Nuclear President & Chief Nuclear Officer (CNO) to Senior OPG Executives who are accountable to ensure integrity of N-CHAR-AS-0002 is maintained. Refer to N-PROG-AS-0001, Managed Systems.
- (b) For all other LOBs, Programs are approved by Vice-President or higher.

### 2.2 Manager, Nuclear Regulatory Affairs

2.2.1 Communicates licensing requirements to applicable Document Owners.

2.2.2 Communicates changes to applicable governance documents to CNSC.

### 2.3 Document Owner (or Delegate)

Document Owner is the position-holder who has the accountability for content, accuracy, and execution of a governance document. Typically the Document Owner is the Business Unit Leader (e.g., Manager or higher, could be Program Owner). Role may be delegated.

2.3.1 Ensures governance documentation is acceptable for use.

2.3.2 Maintains quality and effectiveness of governing document requirements.

2.3.3 Ensures external requirements such as licensing, regulatory, and legal and internal commitments (e.g., quality assurance, records) are included within business unit governance.

2.3.4 Ensures applicable Corporate policies are met.

2.3.5 Resolves significant comments and compliance statements with the best interests of the Corporation in mind.

### 2.4 Senior Manager, Information Management Program Authority

Ensures Nuclear Management System activities performed under OPG-PROC-0001 and OPG-STD-0001 are in compliance with N-PROG-AS-0001.

### 2.5 Single Point of Contact

2.5.1 Ensures governing document content is complete and accurate, and external requirements and internal commitments are satisfied.

2.5.2 Provides clarification of document content for user community.

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#### 2.6 Responsible Manager

Oversees communication and implementation of process changes including reinforcement and monitoring activities.

#### 3.0 DEFINITIONS AND ACRONYMS

##### 3.1 Definitions

Refer to the Lexicon of Records Management Definitions at Powernet > Business Functions > Information Management > IM Program Authority > [Lexicon of Records Management Definitions](#)

##### 3.2 Abbreviations and Acronyms

<b>AIMS</b>	Approved Information Management System
<b>CAL</b>	Computer Assisted Learning
<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>CNO</b>	Chief Nuclear Officer
<b>DCR</b>	Document Change Request
<b>EDMS</b>	Electronic Document Management System
<b>GMR</b>	Governance Management Record
<b>INS</b>	Instruction
<b>LOB</b>	Line of Business
<b>PDF</b>	Portable Document Format
<b>RAPID</b>	Recommend, Agree, Perform, Input, Decide
<b>SPOC</b>	Single Point of Contact
<b>TQD</b>	Training and Qualification Description
<b>QG</b>	Qualification Guide

#### 4.0 BASES, RECORDS AND REFERENCES

##### 4.1 Bases

None

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## 4.2 Records

The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.

Record Created	Associated Form Number	QA Record? Y/N	Records Management System Filing Information/Retention
Electronically approved document (PDF file)	OPG-TMP-0001	Y	Indexed in AIMS. Retention: Permanent RRC: ADM-0012 SCI: 08120
E-mail authorizing governance document (non-Smart Form authorization only)	N/A	Y	Indexed in AIMS as an attachment to the PDF of the official governance document. For forms, indexed in the Records Module. Retention: Permanent RRC: ADM-0012 SCI: 08120 Smart Form approval is retained in Smart Form application.
Completed Governance Management Record	OPG-FORM-0001	Y	Indexed in AIMS as an additional file to the official governance document. Retention: Permanent RRC: ADM-0012 SCI: 08120
Form – Portrait, Landscape or Tag	OPG-TMP-0004	Y	Indexed in AIMS. Retention: Permanent RRC: ADM-0012 SCI: 08120
Governance Document Review Checklist (evidence of document review where revision not required)	OPG-FORM-0051	Y	Indexed in AIMS. Facility-CORR-08130-xxxxxx Retention: 6 years RRC: ADM-0014
Electronically approved document (PDF file)	N-TMP-10017	Y	Indexed in AIMS. Retention: Permanent RRC: ADM-0012 SCI: 08120
Significant Comment disposition	N/A	N	Indexed in AIMS as an additional file to the official governance document. Retention: Permanent RRC: ADM-0012 SCI: 08120
Document Ownership Change Requests	N/A	N	Retained by Governance. Retention – 2 years, indexed in AIMS
Communications from Manager, Nuclear Regulatory Affairs	N/A	Y	Indexed in AIMS Facility-CORR-00531-xxxxx Retention: Permanent RRC: REG-0003

## 4.3 References

### 4.3.1 Performance References

CAL 76186, Governance

N-FORM-11604, Nuclear Quality Program Checklist

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N-LIST-00531-10002, OPG Documents Referenced in Licence Conditions Handbook

N-LIST-01913.11-10001, Nuclear Pressure Boundary Governing Documents

N-LIST-08130-10023, CSA N286-05 to OPGN Governance Cross Matrix

N-LIST-08130-10025, CSA N286-12 to OPGN Governance Cross Matrix

N-MAN-08131-10000 series - Role Documents

N-PROC-RA-0047, Communications with the Canadian Nuclear Safety Commission

N-PROC-TR-0021, Training and Qualification Description Development and Approval Process

N-TMP-10017, Approved Roles

OPG-FORM-0001, Governance Management Record

OPG-FORM-0051, Governance Document Review Checklist

OPG-GUID-08130-0001, Writing Guide for Administrative Governance Documents

OPG-INS-00700-0001, Document Change Request Data Administration

OPG-INS-08133-0001, Submission, Approval, and Issuance of Documents Using Smart Form

OPG-POL-0033, OPG Business Model

OPG-PROC-0166, Organization Design Change

OPG-PROG-0001, Information Management

OPG-STD-0001, Requirements for Administrative Governance Documents

OPG-STD-0074, Accessibility for Ontarians with Disabilities Act Integrated Accessibility and Customer Service Standard

OPG-TMP-0001, OPG Governance Document

OPG-TMP-0004, Form - Portrait, Landscape & Tag

#### 4.3.2 Developmental References

AP-907-005, Procedure Writers' Manual produced by the Procedure Professionals Association

CSA N286-05, Management System Requirements for Nuclear Power Plants

CSA N286-12, Management System Requirements for Nuclear Facilities

I-PROC-AS-0002, Technical Document Control

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N-CHAR-AS-0002, Nuclear Management System

N-FORM-11448, Significant Change Management

N-INS-08400-10026, Nuclear Peer Team Terms of Reference

N-PROC-AS-0019, Action Item Management

N-PROC-AS-0028, Development, Review and Approval of Technical Procedures

N-PROG-AS-0001, Managed Systems

N-STD-AS-0002, Procedure Use and Adherence

N-STD-AS-0024, Change Management

OPG-INS-08180-0004, Technical Review from a SharePoint Document Workspace

OPG-MAN-08100-0001, Template Creation and Maintenance

OPG-MAN-08100-0002, Form Creation and Maintenance

OPG-PROC-0019, Records and Document Management

OPG-PROC-0178, Controlled Document Management

OPG-PROG-0001, Information Management

## 5.0 REVISION SUMMARY

This is an **intent** revision.

- Extensive rewrite for clarification of Governance processes.
- References and titles updated throughout.
- Replaced “Initiator” and “Assigned Author” with “Submitter or Author” throughout to align with Smart Form.
- Replaced Director, Nuclear Regulatory Affairs and Stakeholder Relations, with Manager, Nuclear Regulatory Affairs throughout per request from Nuclear Regulatory Affairs.
- Removed requirement for OPG Governance to review requests to reserve or check-out governance documents (previously Section 1.1.4) (DCR 134551).
- Removed requirement for Document Owner, SPOC or delegate to request change to Governance Ownership list (previously Section 1.9.4) (DCR 133370)
- Section 1.1.1: Clarified process for review cycle changes (DCR 131609)



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- Section 1.2.1 (i): Replaced reference to N-PROC-AS-0068 with OPG-PROC-0166 (DCR 132062)
- Section 1.7.2 (a): Added clarification for protecting forms when using Smart Form application (DCR 132840)
- Section 1.9 (b): Added requirement for Responsible Manager (or delegate) to advise OPG Governance mailbox when communication activities have been completed (per action from Internal Control Over Financial Reporting (ICOFR) audit, November 2015) (DCR 133356)
- Section 1.2.1 (a): Removed outdated link to Information Management website (DCR 133725)
- Section 3.1: Replaced list of definitions with link to Records Management Lexicon.
- Section 4.3.2: Replaced reference to N-PROC-AS-0003 with OPG-PROC-0178 (DCR 133045).
- Appendix B: Consolidated CNSC notification sample emails in Sections A.5.0 and A.6.0 per request from Nuclear Regulatory Affairs.

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### Appendix A Review Process E-Mail Samples

#### A.1.0 SAMPLE E-MAIL FOR REVIEW

**To:** List of Reviewers (refer to OPG-FORM-0001, Section D, Review.)

**Cc:** At a minimum, document approvers

**Subject:** COMMENTS DUE [insert date] on [insert document number, revision, and title]

Please review the attached document(s) and associated OPG-FORM-0001.

Provide comments to [insert Name] by [insert date].

**[Attach the following files.]**



(If desired, provide a gap analysis or details on scope of change[s]).

#### A.2.0 SAMPLE E-MAIL FOR REVIEW OF TEMPLATES

**To:** List of Reviewers (refer to OPG-FORM-0001, Section D, Review.)

**Cc:** At a minimum, template approvers

**Subject:** COMMENTS DUE [insert date] on [insert template number, revision, and title]

Please review the template(s) and associated OPG-FORM-0001.

To access the template for testing, open **Word**, click the **Office Button**, **New**, **My Templates**, then select the **Test Area** tab. The template file is named [file name].dotm.

Provide comments to [insert Name] by [insert date].

**[Attach the following file.]**



(If desired, provide a gap analysis or details on scope of change[s]).

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#### Appendix B Sample E-Mail for Documents Requiring Prior Written Notification / Written Notification to the CNSC

OPG Proprietary

**[Insert pdf of document from approval]**

CD # **[FACILITY]-CORR-00531-[xxxxxx]**

CNSC Staff's Prior Written Notification/Written Notification of Document Changes: **[document number]**, **[document title]**, R**[xxx]**

Dear Messrs. (CNSC Director, Regulatory Programs [more than one Director may apply]):

The purpose of this e-mail is to provide prior written notification/written notification (which ever applies as per N-LIST-00531-10002) to CNSC staff of revision Rev **[xxx]** to **[document number]**, **[document title]**.

Rev **[xxx]** will be issued on or about **[nominal 30 days from prior written notification vs notifications which are issued shortly after notification]**. This written notification is in accordance with the Pickering, Darlington and DWMF (which ever applies) licence condition which requires OPG to give written notification of changes made to the documents submitted to support the licence application.

OPG has revised this document to: **[select as applicable. If none apply, provide other.]**

- incorporate identified enhancements
- implement changes to the scope of a program
- implement changes to incorporate regulatory changes to standards or codes
- reflect organizational changes and/or changes to other governance
- **[other]**

Specific changes are described in the Revision History section of the document. **[If not included due to major re-write, provide a brief summary of major changes.]**

As this revision was performed in accordance with OPG document change management requirements, OPG maintains this revision:

- Has no adverse impact on the health and safety of persons, security, the environment, or Canada's international obligations.
- Has no adverse impact on the licensing basis and have no impact on the limits stated in the Safety Report.

Please update the Pickering, Darlington and DWMF LCHs accordingly (select applicable facility LCHs).

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### Appendix C Sample E-Mail for Authorization of Documents

**Note:** If Smart Form application has been used, approval routing list is created inside the application and all associated documents and files, e.g., forms, are attached through the Smart Form.

+++++

#### C.1.0 SAMPLE E-MAIL FOR AUTHORIZATION OF DOCUMENTS NOT REQUIRING LICENCE AMENDMENT OR CNSC NOTIFICATION (NON-SMART FORM)

**To:** SPOC (Refer to Governance Ownership list on Governance website. Do **not** include all approvers.)

**Subject:** AUTHORIZATION of [insert document number, revision, and title]

Please review the attached for completeness, accuracy, and acceptability for use. Do **not** forward documents to anyone **not** on routing list as DRAFT watermark has been removed.

**[Insert documents: PDF, native file, associated OPG-FORM-0001, and formal dispositioned comments, if required.]**



#### **Step 1: [SPOC]**

- If satisfied, forward this e-mail to [insert Document Owner name], with cc to [insert Author's name].
- If not satisfied, reply to [insert name] with your comments.

#### **Step 2: [Document Owner]**

- If satisfied, forward e-mail OPG Governance mailbox or Authorization Authority for Programs only, with cc to [insert Author's name] stating approval or authorization to issue.
- If not satisfied, reply to [insert name] with your comments.

#### **Step 3: [Authorization Authority]** – (for Programs only)

- If satisfied, forward e-mail OPG Governance mailbox, with cc to [insert Author's name] stating approval or authorization to issue.
- If not satisfied, reply to [insert name] with your comments.

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#### C.2.0 SAMPLE E-MAIL FOR AUTHORIZATION OF DOCUMENTS REQUIRING LICENCE AMENDMENT OR CNSC NOTIFICATION (NON-SMART FORM)

**To:** SPOC (Refer to Governance Ownership list on Governance website. Do **not** include all approvers.)

**Subject:** AUTHORIZATION of [insert document number, revision, and title]

Please review the attached for completeness, accuracy, and acceptability for use. Do **not** forward documents to anyone **not** on routing list as DRAFT watermark has been removed.

**[Insert documents: PDF, native file, associated OPG-FORM-0001, formal dispositioned comments, if required, and letter sent to CNSC.]**



##### **Step 1: [SPOC]**

- If satisfied, forward this e-mail to [insert Document Owner name], with cc to [insert Author's name].
- If not satisfied, reply to [insert name] with your comments.

##### **Step 2: [Document Owner]**

- If satisfied, forward e-mail Manager, Nuclear Regulatory Affairs or Authorization Authority for Programs only, with cc to [insert Author's name].
- If not satisfied, reply to [insert name] with your comments.

##### **Step 3: [Authorization Authority] – (for Programs only)**

- If satisfied, forward e-mail Manager, Nuclear Regulatory Affairs with cc to [insert Author's name].
- If not satisfied, reply to [insert name] with your comments.

##### **Step 4: [Manager, Nuclear Regulatory Affairs]**

- Arrange for licence amendment or CNSC notification.
- Attach documentation identifying notification or licence amendment process is complete and document ready for issue.
- Forward e-mail package, with all attachments, to [insert Document Owner or Authorization Authority (for Programs only) name].

##### **Step 5: [Document Owner or Authorization Authority]**

- Forward e-mail package to OPG Governance mailbox, with cc to [insert Author's name] stating approval or authorization to issue.

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#### C.3.0 SAMPLE E-MAIL FOR AUTHORIZATION OF TEMPLATES (NON-SMART FORM)

**To:** SPOC (Refer to Governance Ownership list on Governance website. Do **not** include all approvers.)

**Subject:** AUTHORIZATION of [insert template number, revision, and title]

Please review [insert template number] for completeness, accuracy, and acceptability for use.

To access the template for testing, open **Word**, click the **Office Button**, **New**, **My Templates**, then select the **Test Area** tab. The template file is named [file name].dotm.

[Insert documents: Associated OPG-FORM-0001 and formal dispositioned comments, if required.]



##### Step 1: [SPOC]

- If satisfied, forward this e-mail to [insert Document Owner name], with cc to [insert Author's name].
- If not satisfied, reply to [insert name] with your comments.

##### Step 2: [Document Owner]

- If satisfied, forward e-mail OPG Governance mailbox, with cc to [insert Author's name] stating approval or authorization to issue.
- If not satisfied, reply to [insert name] with your comments.



Manual

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Title:

**PROJECT COMMUNICATIONS**

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## Project Communications

**N-MAN-00120-10001-COM-R000**  
2013-01-01

Order Number: N/A  
Other Reference Number:

## Internal Use Only

Prepared by: Nienke Smith  
Manager, Project Infrastructure  
Nuclear Refurbishment

Approved by: Gary Rose  
Director, Planning & Control  
Nuclear Refurbishment

Approved by: Riyaz Habib  
Director, Miscellaneous Projects  
Projects & Modifications

**Manual**

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Revision Summary

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### 1.0 DIRECTION

This process provides guidelines on communications regarding Ontario Power Generation (OPG) Nuclear Projects for internal and external audiences (i.e. the public, community, industry and other stakeholders and contractors), the Canadian Nuclear Safety Commission (CNSC) and other regulatory agencies. The project manager must ensure that all project communication are as clear and precise as possible in order to reduce the incidence of misinterpretation and outdated information being used as current, which may lead to delays, errors and rework. To facilitate this, a communication plan should be developed. Communication planning essentially entails identifying the audience of the information and when that information should be received.

This manual complies with N-STD-AS-0028, Project Management Standard.

### 1.1 Internal Communications

Open communication is essential for timely decision-making, efficient execution of project work and error prevention. The audience for internal communications includes:

- (a) OPG executive management
- (b) Project stakeholders
- (c) Project team members
- (d) OPG supporting organizations (e.g. Design, Supply Chain, Operations)
- (e) Contractors and suppliers
- (f) OPG personnel not directly involved in the Project.

#### 1.1.1 General Direction

All communications should be complete, accurate and timely. Internal communications generally do not require the development of a communication strategy or communication plan, except where noted.

Major events (e.g. key project announcements, schedule changes, process changes) may require the development of an event specific communication plan. Event specific communication plans should be reviewed and approved by the appropriate authority defined by the business unit prior to issue.

#### 1.1.2 Ontario Power Generation Executive Management

A central organization should determine and document the communication expectations and requirements to coordinate internal communications between the project and OPG executive management. Roles and responsibilities should be clearly identified in the strategy to ensure timely and accurate project submissions to the OPG Board of Directors, and other board and executive committees.

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### 1.1.3 Project Team Communications

Project team members will adopt the most effective interface method (face to face, e-mail, telephone conference, memoranda, small group discussion, etc.) to ensure that the latest information is available to the required project team members whose work will be affected. Face-to-face is the most effective and preferred method, but should be followed up with documentation. Information that should be communicated includes, but is not limited to:

- Safety and quality issues/concerns
- Environmental and regulatory constraints
- Risks and associated changes
- Design issues and changes
- Progress reports
- Issue / action logs
- Meeting minutes

Projects should develop a communications plan as a part of the Project Management Plan (PMP) and the Contract Management Plan (CMP), if applicable. The communication plan should include strategies on performance reporting (including quality and safety), how to facilitate problem solving, conflict avoidance and issue resolution, etc.

#### 1.1.3.1 Communications with Program or Portfolio Stakeholders

Projects often involves stakeholders that are not directly involved in the project, but are accountable for reporting the performance of the projects in an aggregated program or portfolio. Project managers are accountable to ensure that the applicable and accurate information is conveyed to program and portfolio managers for distribution to program and portfolio stakeholders.

#### 1.1.3.2 Project Team Communication Methods

Project team communication methods include, but are not limited to:

- (a) Planning and progress meetings involving key project team members, stakeholders and supporting groups for planning, reviewing performance, changes, issues and corrective action plans.
- (b) Lessons learned meetings, at appropriate points to review lessons learned, and implement continuous improvements.
- (c) Face-to-face / Audio or Video conference discussions and presentations.
- (d) Intranet and SharePoint sites dedicated to the project for project team communications, access to latest files and work flow.
- (e) Meeting minutes, including actions for monitoring and completion

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- (f) Manager's briefing cards.
- (g) Reports.
- (h) E-mails.
- (i) Blogs & team discussion boards
- (j) Posters

### 1.1.3.3 Project Issue Management

Project issues may be identified through monitoring and reporting, team discussion, meetings, normal system surveillance, or oversight of vendor activities. Upon identification of an issue, it should be communicated to the appropriate authority and stakeholders as required. This should include any corrective actions that have been put in place or are planned.

Communication also involves the timely escalation of issues and implementing corrective actions. The roles and responsibilities of project issues identification and the list of authorities and stakeholders for notification should be documented in the communications plan.

### 1.1.4 Communications with Project Contractors and Suppliers

Projects should have a communications plan for contractors and suppliers. Communications with contractors and suppliers should include:

- Progress and performance reports
- Issue/ action logs
- Submittals
- Change requests
- Meetings
- Emails

Verbal communication with contractors and suppliers should be followed up with documentation. For more information on the transmittal of records and documents with project contractors and suppliers, refer to N-MAN-00120-10001-RDM-03, Nuclear Projects Supplier Document Submission.

## 1.2 External Communications

External project communications include the sharing of information with the public and external stakeholders and audiences.

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### 1.2.1 CNSC and Other Regulatory Agency Communications

All communications with the CNSC or other regulatory agencies should be processed in accordance the appropriate OPG standards and policies and channeled through senior management and OPG Regulatory Affairs.

### 1.2.2 Communication with the Public

All methods and forms of external communications to the public, by or on behalf on the project including written, oral, and electronic communications should be processed in accordance the appropriate OPG standards and policies and channeled through senior management and OPG Public Affairs.

## 2.0 DEFINITIONS AND ACRONYMS

### 2.1 Definitions

None

### 2.2 Abbreviations and Acronyms

<b>CMP</b>	Contract Management Plan
<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>NR</b>	Nuclear Refurbishment
<b>OPG</b>	Ontario Power Generation
<b>PMP</b>	Project Management Plan

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### 3.0 RECORDS AND REFERENCES

#### 3.1 Records

- 3.1.1 Any controlled documents which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0003, Controlled Document Management.
- 3.1.2 Any records which may be produced as a result of this document should be managed in accordance N-MAN-00120-10001-RDM, Nuclear Projects Records and Document Management.
- 3.1.3 The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.

Record Created	Associated Form Number	QA Record Y/N?	Filing Information/Retention (Asset Suite Type/Sub-Type)
Project Communication Plan	N-TMP-10010	N	Issued in Asset Suite as Record Doc Type = PLAN  Doc No. D or P or, N-PLAN-SCI-XXXXX  Retention = T20 for NR

#### 3.2 References

##### 3.2.1 Performance References

N-STD-AS-0028, Project Management Standard  
N-STD-OP-0002, Communications  
N-PROC-AS-0003, Controlled Document Management  
N-PROC-AS-0042, Quality Assurance Records

##### 3.2.2 Developmental References

NK054-PROC-0065, Internal and External Communication Management

### 4.0 REVISION SUMMARY

This is a new document.

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**PROJECT CONTROLS**

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**Project Controls**

**N-MAN-00120-10001-PC-R000**  
2013-01-01

**Internal Use Only**

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### 1.0 DIRECTION

This manual complies with N-STD-AS-0028, Project Management Standard. Projects shall have control processes established to track, review, and regulate the progress and performance of the projects.

#### 1.1 Introduction

- 1.1.1 Project Controls are developed and implemented to monitor project performance in order to identify whether or not work is being executed per plan, as well as to provide early detection of potential issues and risks.
- 1.1.2 Project performance monitoring is achieved through key performance indicators and established baselines. These are recorded in documents such as the Project Management Plan (PMP), Gate approval package, approved Business Case Summary (BCS), and organizational and project reporting.
- 1.1.3 The planned work is managed as outlined in the Project Management Plan. The project team collects, monitors and reports on project data and deliverables on a regular basis. Project performance is regularly monitored and analyzed for trends and signs of risk to planned completion. This is achieved by comparing baseline deliverables with actual progress achieved. To facilitate baseline comparison, key performance indicators should be established for:
- Safety
  - Quality
  - Scope
  - Cost
  - Schedule
- 1.1.4 Project controls are applied to a project throughout its entire life cycle. A baseline for scope, cost and schedule is established when funding is approved at a decision gate for that particular scope. As the project progresses through the life cycle, a new baseline will be established to reflect the latest approved plan and funding release.
- 1.1.5 Deviations from the approved plan may arise, for examples, as a result of project performance, changes to scope, realization of known or unforeseen risks, etc. A change control process is used to manage, document and authorize changes to the baselines as required. Authorized changes may or may not result in a baseline revision.
- Change control is to provide information to the decision makers who are responsible for approving a change request. Change control is not intended to realign a project plan due to poor performance.
- 1.1.6 Certain aspects or phases of a project may be managed on behalf of OPG by external contractors. Contractors will use their project controls processes to monitor and control project work but should be aligned with the requirements of this manual. OPG

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will provide oversight in accordance with the contract management plan, and the contract terms and conditions.

## 2.0 PROJECT CONTROLS

Project control is the process of tracking, reviewing, and regulating the progress to meet the performance objectives of the project.

If performance issues, trends or risks are discovered during project execution, they must be investigated, understood and mitigated to maintain the baseline. The key is to detect such issues as early as possible, understand the potential impacts, and take appropriate steps to mitigate, as part of risk mitigation. Mitigation includes preventative and/or corrective actions to minimize the impact on the deliverables at risk.

Tools such as the following can be utilized to detect issues:

- Reports and metrics
- Progress meetings
- Documents
- Quality assurance and control plans
- Change requests
- Risk reviews

### 2.1 Cost Controls

Project Manager is accountable for ensuring that regular cost monitoring and control processes are defined, implemented and diligently used by project team members and contractors. Active cost monitoring and controlling activities will include:

- 2.1.1 Using standard project reporting to monitor cost performance. The key function of cost monitoring is to determine any *variance* between the actual costs and the plan in order to flag any areas for concern.

Regular monitoring provides early detection of potential and actual cost overruns, under spending, incorrect estimates, accounting errors, and cash flow trends. Monitoring frequency will depend on the phase the project. For example, more frequent monitoring may be necessary during crucial work execution periods such as outages, high-profile or critical projects.

- 2.1.2 Reporting and communicating the cost trending analysis, cost performance results and any corrective actions to the project team, sponsors and stakeholders.
- 2.1.3 Developing sufficient cost detail to allow for effective monitoring of project cost performance. The costs, the Work Breakdown Structure (WBS), and the cost or control accounts must be aligned in order to have a direct comparison to assist in detecting any issues.
- 2.1.4 Ensuring proper project cost or control accounts are setup in OPG systems.

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- 2.1.5 Ensuring planned value (or budget) is accurately allocated to and actual cost is collected in the cost or control accounts to support measurement of cost performance.
- 2.1.6 Ensuring accrual is captured in the actual costs.
- 2.1.7 Identifying incorrect, inappropriate, or unauthorized charges and implementing corrective actions to rectify.
- 2.1.8 Performing cost trend analysis and forecasting the Estimate At Completion (EAC) and cash flows. Forecasting is performed to assess if the EAC is still within the approved budget. This assessment is used to initiate any corrective action and recovery plans required to mitigate and resolve identified project cost issues. If warranted, change requests shall be initiated.
- 2.1.9 Projects often encounter changing conditions and issues as they are executed. The cost impacts of these changing conditions on the project budget and cash flow must be evaluated to support the project in managing the issues. If warranted, change requests shall be initiated.

## 2.2 Schedule Controls

- 2.2.1 The project schedule shows what activities are to be done, who will undertake them, and when they will be done in relation to other activities. Schedule development, management are described in N-MAN-00120-10001-SCH, Scheduling Process.
- 2.2.2 The current project schedule is updated, reported and communicated on a regular basis to show activity progress, overall progress, and actual milestone achievement dates. Comparison of the current schedule to the baseline provides the schedule variance and metrics that are used to flag and identify areas of concern and risks. These areas of concern must be understood and if necessary corrective actions implemented so that projects are completed within the committed time frame and approved budget. Updated schedule data can also be used for forecasting cost and time at completion and will identify whether or not the project is on track to meet its commitments.
- 2.2.3 In addition to reflecting the current status of the project, the update process allows for the detection and correction of possible errors (or incorrect assumptions) embedded in the schedule.
- 2.2.4 Important deliverables that are at risk of being missed must be resolved with the accountable individual and/or department to minimize cost and schedule impacts to the project. If an issue is not resolved, it should be escalated quickly within the organization to communicate impacts and obtain support to resolve the issue.
- 2.2.5 Schedule Baseline Change

Schedule baseline changes must be implemented through a controlled and documented process. The process prescribes when changes are allowed and the

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level of approval required. It is important to maintain the previous history of the project schedule either in the revised baseline, or as an archived copy.

Schedule baseline change processes should allow for activity changes that do not affect the overall project schedule and committed milestone dates. These can include changing activity descriptions, adding additional detail to facilitate tracking completion of certain deliverables or insignificant activity logic changes.

## 2.3 Key Performance Indicators

- 2.3.1 Key Performance Indicators are performance metrics established to assist in demonstrating performance achievements in safety, quality, scope, cost and schedule. The intent of monitoring these metrics is to identify performance gaps or trends early, allowing for timely implementation of recovery plans and corrective actions in order to maintain the project plan or at least minimize the impacts. It will also identify when initiation of change requests may be required.

Typical areas addressed by Key Performance Indicators include:

- (a) Safety – nuclear safety; conventional safety; radiological protection; and environmental compliance;
  - (b) Quality – human performance (e.g. rework), equipment or materials (e.g. failed inspections); and installation (e.g. defects);
  - (c) Scope (e.g. number of scope changes; design change revisions);
  - (d) Schedule – life-to-date and projected “at-completion” milestone adherence;
  - (e) Cost – life-to-date and projected “at-completion” performance; contingency and management reserve management;
  - (f) Value for Money using Earned Value Management (e.g. Schedule Performance Index, SPI and Cost Performance Index, CPI).
- 2.3.2 For monitoring to be effective, any performance gaps or *variances* identified need to be investigated and understood. Analysis should be performed on an ongoing and routine basis to determine the causes of temporary and permanent *variances* and trends. The results of the analysis should be documented in project reports.
- 2.3.3 If performance is not meeting expectations, analysis should be conducted to determine appropriate corrective actions to be taken if contingency plans do not already exist as part of the Risk Management Plan process to determine if a mitigation plan is required (refer to N-MAN-00120-10001-RISK, Nuclear Projects Risk Management Process).
- 2.3.4 The SCR program is a useful source of data. The benefit of using the SCR system is the information can be readily compiled to review and identify trends, and corrective actions taken can be documented.

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- 2.3.5 Frequency of Key Performance Indicator reporting will depend on the requirement of the project phase and the frequency of data updates. For examples, actual cost information is available weekly whereas schedule progress updates may not be performed as frequently.
- 2.3.6 Earned Value Management (EVM)
- a) EVM is a method used to objectively measure project cost and schedule performance relative to the project baseline. The application details of EVM are provided in N-MAN-00120-10001-SCH-07, Earned Value Management.
  - b) EVM metrics can assist in identifying performance issues that need further investigation and potentially a recovery plan if the baseline plan is to be maintained or the impacts minimized. It is also an effective tool for prioritizing work and resources.
  - c) Two important Key Performance Indicators are used in EVM – Schedule Performance Index (SPI) and Cost Performance Index (CPI). Generally speaking, an index value less than 1.0 indicates performance below baseline targets.  
  
CPI less than 1.0 indicates a potential for cost overrun because the actual cost of the activity or project exceeds the earned value for that activity or project. SPI less than 1.0 indicates the activity or project is behind schedule.
  - d) A CPI or SPI greater than 1.0 indicates the project or activity is performing better than planned. Generally this is desirable however, it may be an indicator that estimates were too conservative or actual costs are not being allocated correctly. It may also represent an opportunity to re-prioritize resources to other project areas which may be underperforming.
  - e) The project team should monitor and analyze CPI and SPI and the trends. The goal is to understand the causes and potential impacts of activities under or over performing. Investigation may uncover errors (e.g. accounting) or risks that can be corrected early to prevent larger effects to the project. Corrective action and recovery plans are often required to restore the project plan or at least reduce the impacts.

## 2.4 Forecasting

- 2.4.1 Forecasting is performed by analyzing the work performed against the work planned, identifying trends, analysing remaining work and determining the impact of performance on the estimated cost and schedule going forward.
- 2.4.2 Forecasting cost shall take into consideration the committed costs, the actual execution efficiency for the work performed and the planned efficiency for the remaining work.
- 2.4.3 Similarly, schedule forecasting is required to predict the completion dates of activities and milestones.

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- 2.4.4 The Project Manager is accountable for having the forecast updated as necessary to reflect the latest status and expected performance of the project. Effective forecasting can be achieved when experience and objective judgement are applied together with consideration of risks and the usage of quantitative forecasting techniques, such as Earned Value technique. A number of forecasting methods are provided in Appendix A.

## 2.5 Contingency Monitoring and Control

- 2.5.1 The need to access *Contingency* and *Management Reserve* should be identified through periodic risk monitoring and forecasting. The project organization shall have a process to manage *Contingency* and *Management Reserve* drawdown. This process shall define and document the authority of approval required to access the *Contingency* and *Management Reserve*, and the impact on project baselines.
- 2.5.2 The owner(s) of the *Contingency* and *Management Reserve* shall ensure that the *Contingency* and *Management Reserve* usage is monitored closely to determine if sufficient funds remain available to address future known and unknown risks. Control and monitoring of *Contingency* and *Management Reserve* includes understanding the reason for the allocation, the amount required, the total value authorized, and the amount of *Contingency* and *Management Reserve* funds remaining available.
- 2.5.3 *Management Reserve* will be managed at the program or portfolio level.

## 2.6 Change Control

- 2.6.1 Change Control is the process of reviewing all change requests, approving changes and managing changes to the deliverables, documents and the baseline scope, costs, and schedule. Change Control is implemented to maintain the integrity of the baseline and control scope and cost creep.

Change Control process includes the following change management activities:

- (a) Reviewing, analyzing impacts and approving change requests promptly.
  - (b) Managing and communicating the approved changes.
  - (c) Incorporating approved changes into project documents.
  - (d) Reviewing, approving and implementing all recommended corrective and preventive actions.
  - (e) Coordinating changes across the entire portfolio or program.
  - (f) Documenting the complete impact of change requests.
- 2.6.2 Specific criteria will be used to provide guidance on when a Change Request is required, when a change to baseline will be allowed, and what levels of approval are required. Generally, Change Requests are required when the proposed changes have material impacts on the baseline.

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- 2.6.3 Only *Directed Changes* are allowed to amend the baselines. Generally, re-baselining is only considered if a change proposal is caused by situations that are beyond the project managers' or work program owner's control.
- 2.6.4 When a re-baseline is warranted, the existing baseline will be modified to establish a new control baseline. The original baseline will always be kept for audit purposes.

Examples of *Directed Changes* are:

- (a) regulatory changes or changes in regulatory requirements,
  - (b) changes in legislation;
  - (c) changes in strategy;
  - (d) changes in key assumptions;
  - (e) significant, externally driven changes where the baseline needs to be realigned to reflect the actual conditions (e.g., pension increases or above contractually-agreed-to changes in raw materials or utilities costs, corporate direction);
  - (f) Change in scope
- 2.6.5 Not all change requests will result in a baseline revision. Change requests used to obtain and document approval to change a commitment, such as a project milestone, may not result in a revision to the schedule baseline. When a re-baseline is not warranted, the impacts of change requests will be documented and *variance* to baseline monitored.

## 3.0 DEFINITIONS AND ACRONYMS

### 3.1 Definitions

**Accrual** is the value of work completed and eligible for payment but not yet included on an invoice.

**Committed Costs** is value of work purchased, but not yet paid, against the budget allocation for that work.

**Directed Changes** are changes generally initiated by entities external to the project, such as project sponsors. Examples are scope change, regulatory change, change due to a change in program strategy, etc.

**Management Reserve** is added over and above *contingency* reserves used to account for "unknown-unknowns" in a project, including, but not limited to major estimating or scheduling errors and natural disasters. (See also N-MAN-00120-10001-RISK, Nuclear Projects Risk Management Process).

**Performance** is the comparative ratio between the planned rate of progress and the actual rate of progress.



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**Residual Risk** is the risk remaining after the mitigation actions in the risk response plan have been executed. The probability and impact of the risk may have been reduced but not completely eliminated, thus may still materialize. (See also N-MAN-00120-10001-RISK, Nuclear Projects Risk Management Process).

**Variance** is the nominal differential between planned and actual progress or forecasted cost.

**Work Breakdown Structure (WBS)** is a deliverable-based hierarchical breakdown of the entire project scope used to define and group a project's discrete work elements (or tasks) in a way that helps organize, define and control the total work scope of the project.

### 3.2 Abbreviations and Acronyms

**BCS** Business Case Summary  
**CPI** Cost Performance Index  
**EV** Earned Value  
**EVM** Earned Value Management  
**NR** Nuclear Refurbishment  
**P&M** Projects and Modifications  
**PV** Planned Value  
**PMP** Project Management Plan  
**SCR** Station Condition Record  
**SPI** Schedule Performance Index  
**WBS** Work Breakdown Structure

## 4.0 RECORDS AND REFERENCES

### 4.1 Records

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**PROJECT CONTROLS**

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (Asset Suite Type/Sub-Type)
Change Control Form	N-FORM-11252 (NR) or N-FORM-10607	N	<p>Index in SharePoint as Record.</p> <p>Property # - REF - Control Account No - XXXXXXXX</p> <p>Control Account No (#####XYZZ) is 10 digits and consists of the project number/project phase/control account ID/work package #.</p> <p>Project number and project phase must be populated. If control account ID and work package # are not used populate with 0s.</p> <p>Retention = 6 Years after project closed per the approval of Project Closure Report, FIN-FORM-PA-005. RRC: N02-0038</p> <p>Retention T20 (NR)</p>
Project Performance Reports	n/a	N	<p>Index in SharePoint as Record.</p> <p>Property # - REP - Control Account No - XXXXXXXX</p> <p>Control Account No per above.</p> <p>Retention = 6 Years after project closed per the approval of Project Closure Report, FIN-FORM-PA-005. RRC: N02-0038</p> <p>Retention T20 (NR)</p>

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### 4.2 References

- N-MAN-00120-10001-GRP, Nuclear Projects Gated Process
- N-MAN-00120-10001-RISK, Nuclear Projects Risk Management Process
- N-MAN-00120-10001-SCH, Nuclear Projects Scheduling Process
- N-MAN-00120-10001-SCH-07, Earned Value Management
- N-STD-AS-0028, Project Management Standard
- NK38-REP-09701-10127, Proposal for DN Refurbishment H&S Metrics

#### 4.2.1 Developmental References

- INPO 09-002, Excellence in Nuclear Project Management, June 2010.
- Project Management Body of Knowledge, 4th Edition (PMBOK Guide)
- N-STD-AS-0029, Contract Management Standard

### 5.0 REVISION SUMMARY

This is a new manual.

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## Appendix A: Forecasting Methods

The following methods can be used for project forecasting:

**Method 1:** The most accurate method is to consider all committed costs and obtain an estimate of the hours or cost of the remaining work, hence:

Estimate at Completion (EAC) = Actual costs + Estimate To Complete (ETC).

**Method 2:** This method assumes the rate of progress, efficiency or burn rate realized to date will continue.

$EAC = [Budget\ at\ Completion\ (BAC)] \div [Cost\ Performance\ Index\ (CPI)]$ .

This is useful for predicting what the total cost will be if the progress continues at the current rate. Knowing this will often trigger corrective actions to mitigate the impacts of any poor performing project activities. It is also an excellent gauge against Method 1.

Similarly, to forecast date of completion:

$EAC_t = BAC_t \div SPI$ .

For example planned duration of 10 weeks with an  $SPI=.90$  ,  $10wk \div 0.90 = 11.1$  weeks estimate to complete.

**Method 3:** Another forecasting method using EV metrics assumes that future performance is influenced by both current cost and schedule performance.

$EAC = AC + [BAC - EV] / (CPI \times SPI)$ , equal weighting.

$EAC = AC + [BAC - EV] / (0.8\ CPI + 0.2\ SPI)$ , non-equal weighted sample (80/20).

**Method 4:** Used for forecasting costs and work-hours by assuming that work from this point forward will progress at planned rates whether or not these rates have been realised to this point. Therefore,

$EAC = Actual\ Costs + Remaining\ budget$ .

This method is normally not very useful since it ignores the actual progress rate or efficiency to date.

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## Project Execution Plan - DNGS Integrated Implementation Plan Project

NK38-PEP-01060-10016-R0001

2016-02-17

Order Number: N/A

Other Reference Number: N/A

### Internal Use Only

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Revision Number	Date	Comments
R000	2016-02-17	Initial Issue.



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### 1.0 PROJECT DEFINITION

This Project Execution Plan (PEP) identifies the work required for the Darlington Station Integrated Implementation Plan (IIP). The need for this work is identified in the Darlington NGS Integrated Implementation Plan [R-1].

#### 1.1 Needs Statement (Background)

The justification for the continued operation of Darlington following Life Extension is documented in the Global Assessment Report [R-2] and Integrated Implementation Plan [R-1]. These two documents were prepared in accordance with the CNSC Regulatory Document RD-360, "Life Extension of Nuclear Power Plants" [R-3]. RD-360 requires the licensee to demonstrate that continued station operation poses no unreasonable risk to health, safety, security of the public or the environment, and will continue to conform to international obligations.

RD360 also provides the steps required when undertaking a project to extend the life of a nuclear power plant (NPP). As required by RD360, Section 7.1 - Project Execution Planning, this PEP document identifies what needs to be done to achieve the desired outcomes for the life extension project. Furthermore, per RD-360- Section 7.3, Project Monitoring, the licensee is expected to monitor the (Life Extension) project for progress, safety, and quality at all phases of execution. These requirements are reflected in OPG governance, N-PROC-LE-0005, Nuclear Refurbishment Integrated Safety Review – Darlington.

The IIP presents the scope and the schedule for implementation of corrective actions and safety improvement identified through the Integrated Safety Review (ISR) [R-4]. There are two main sources of scope: Component Condition Assessments (CCA) and Darlington Scope Requests (DSR). CCAs were performed on critical components, in accordance with N-PROC-MP-0060, Aging Management Process [R-5] to provide a snapshot of their condition. These assessments generated actions to repair / replace components and to monitor the condition of components going forward. DSRs are the scope items that are generated by Nuclear Refurbishment's scope management system, overseen by the Program Scope Review Board (PSRB). Life extension DSRs that can be executed outside of the Refurbishment outages have been assigned to Darlington Station, which are subsequently managed by this project.

There are total of 162 IIP items committed to CNSC. The scope of Darlington Station IIP Project covers the IIP scope that is not covered by the existing programs within Refurbishment. DNGS IIP Change Control and Closeout Process, Appendix A [R-6] identifies the list of station owned IIP items.

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### 1.2 Project Objectives (Critical Success Factors)

The Objective of the Darlington Nuclear Station Integrated Implementation Plan Project is to inspect, overhaul or replace the components as required in accordance with the Darlington NGS Integrated Implementation Plan [R-1] in order to support safe and reliable operation post-refurbishment.

Plant Aging Management department plans and oversees the execution of Station-Owned Integrated Implementation Plan (IIP) items. These IIP items are regulatory requirements, owned by Darlington SVP. DNGS Integrated Implementation Plan [R-1] provides a description of the IIP items and the regulatory commitment date.

The scope of this PEP only covers the IIP items that owned by Darlington SVP. Each of the IIP items will have to be completed on-time and within budget.

### 1.3 Project Scope

The scope of the station-owned IIP items can be found in Appendix A, as cross referenced from the two following documents:

- DNGS Integrated Implementation Plan [R-1]
- DNGS IIP Change Control and Closeout Process, Appendix A [R-6]

#### 1.3.1 Inspection / Assessment IIP items

The scope of the inspection / assessment IIP items is to:

- Perform inspection to the component condition and assess the inspection result.
- Determine the replacement strategy if required in order to support safe and reliable operation post-refurbishment.
  - Inspection results that are favorable will require no further action.
  - Inspection results revealing minor degradation will require either enhanced monitoring or will be addressed by normal station practices.
  - Inspection results revealing significant defects that will be corrected by replacement of the component. If the component replacement has been identified as one of the IIP items in the Darlington NGS Integrated Implementation Plan [R-1], the component replacement will be managed by this project. Otherwise, the component replacement will be addressed through normal station work management processes.

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Assessment of inspection result and the recommended path forward will be accepted by Darlington Performance Engineering, Component Engineering or Nuclear Safety Engineering as appropriate.

### 1.3.2 Replacement IIP items

Replacement of the component is either identified in the Darlington NGS Integrated Implementation Plan [R-1] or determined from the inspection IIP items. The component replacement will be executed through Item Equivalency Evaluations (IEE), Non-Identical Component Replacement (NICR) or Modification. If applicable, the scope will include the following:

- Execute modification following Engineering Change Control (ECC) process, N-PROC-MP-0090.
- Prepare Engineering Specifications for the procurement of the replacement component.
- Obtain necessary design, operations and / or regulatory approvals to execute the project.
- Identify training needs for the replacement component and identify impact on the training simulator.
- Complete a Human Factors (HF) evaluation and integrate recommendations into the replacement strategy in order to ensure the HF deficiencies are suitably addressed.
- Perform qualification and factory acceptance testing of the replacement component, as necessary.
- Procure the replacement component and provide spares if required.
- Develop plans and schedules, for the installation and commissioning of the replacement components.
- Identify changes to operating and maintenance procedures.

### 1.3.3 Code Gap IIP items

The code gap IIP items are activities to address the code gaps resulting from ISR and CNSC comments. The activity description and CNSC commitment date to address the code gap are provided in the Darlington NGS Integrated Implementation Plan [R-1].

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### 1.3.4 Contingency IIP items

Contingency IIP items will need to be executed if there are significant defects identified in the inspection IIP items. The contingency IIP items are the compensatory activities to address significant defects that will be corrected by replacement of the component. This is applicable to the component replacement that has been identified as one of the IIP items in the Darlington NGS Integrated Implementation Plan [R-1].

### 1.4 Priority/Timing

The CNSC commitment date for IIP items can be found in Darlington NGS Integrated Implementation Plan [R-1].

The project schedule of the station owned IIP items can be found in Appendix A.

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## 2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

### 2.1 Organization

The primary roles and associated organizational positions are as follows:

Table 2.1 - Organization	
Customer	D. Burger, Manager, Darlington Performance Engineering K. Leung, Manager, Darlington Component Engineering E. Sorin, Manager, Darlington Reactor Safety Engineering
Project Sponsor	J. Lehman, Director Station Engineering, Darlington
Design Approval	J. Wight, Senior Manager and Design Authority, Plant Design, Darlington
Installation Approval	S. Gregoris, Director Operations and Maintenance, Darlington
Regulatory Interface	D. Coleman, Manager, Reg. Affairs, Darlington
Project Owner	S. Shaikh, Manager, Darlington Plant Aging Management

The project's organization is shown in Figure 1.

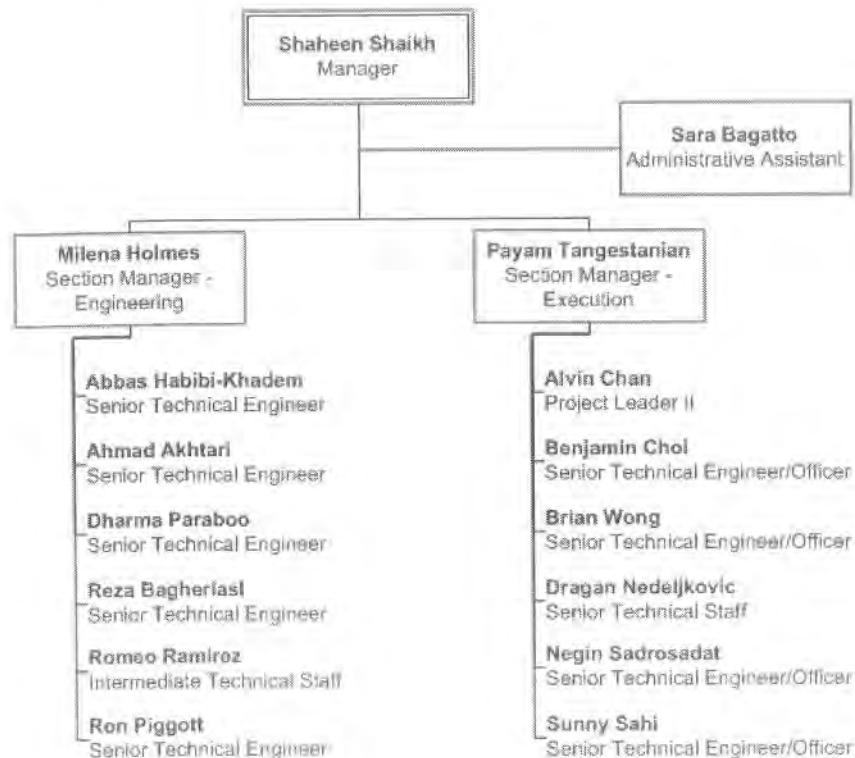


Figure 1 – Project Organization

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### Note:

Plant Aging Management Department will also oversee the planning and execution of IIP items that are managed by Projects and Modifications and Computers and Control Design (CCD) Department

## 2.2 Responsibilities

### 2.2.1 Project Responsibility Matrix – WBS (Provide Input/Prepare/Review/Approve)

The detailed task responsibilities are provided in the Table 2.2.2.

### 2.2.2 Description of Responsibilities

Plant Aging Management department has budget for 21 individuals in the department. Additional staffs will be obtained when required.

Table 2.2.2 – Project Management Responsibilities		
Role	Name	Responsibility
Project Owner	S. Shaikh	<ul style="list-style-type: none"> <li>Oversee progress of IIP items on behalf of DN SVP, to ensure completion of the IIP work.</li> <li>Approve the Project Execution Plan.</li> <li>Ensure sufficient Plant Aging Management resources are available to meet project commitments.</li> <li>Support Section Manager in resolution of issues requiring Stratum IV intervention and raise issues to the Project Sponsor when required.</li> <li>Approve assignment of OPG Plant Aging Management Department resources.</li> <li>Assess and approve contracts and fulfill Contract Owner role.</li> </ul>
Section Manager – Execution	P. Tangestanian	<ul style="list-style-type: none"> <li>Project oversight on behalf of Project Owner.</li> <li>Responsible for managing execution work and is the primary interface with the customer(s).</li> <li>Responsible for ensuring that the personnel involved in project activities have the required qualifications.</li> <li>Identify and obtain commitment of resources with required qualifications.</li> <li>Review and approve project scope, schedule, and deliverables.</li> <li>Ensure accurate project reporting is provided to Project Owner, Sponsor, Customer and other stakeholders.</li> <li>Project oversight for IIP items that are managed by Projects and Modifications and CCD.</li> </ul>
Section Manager – Engineering Services	M. Holmes	<ul style="list-style-type: none"> <li>Responsible for providing technical support for project.</li> <li>Responsible for ensuring that the personnel involved in project activities have the required qualifications.</li> <li>Identify and obtain commitment of resources with required qualifications.</li> </ul>



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**Table 2.2.2 – Project Management Responsibilities**

Role	Name	Responsibility
		<ul style="list-style-type: none"> <li>• Approve project technical product deliverables and ensure that deliverables meet project quality requirements.</li> <li>• Review and approve project scope, schedule, and deliverables.</li> <li>• Ensure accurate project reporting is provided to Project Owner, Sponsor, Customer and other stakeholders.</li> <li>• Project oversight for IIP items that are managed by Projects and Modifications and CCD.</li> </ul>
Project Leader	A. Chan	<ul style="list-style-type: none"> <li>• Develop and maintain Project Execution Plan.</li> <li>• Define project scope, schedule, and deliverables.</li> <li>• Ensure implementation of project in accordance with the approved plan.</li> <li>• Support Section Managers to ensure accurate project reporting is provided to Project Owner, Sponsor, Customer and other stakeholders.</li> <li>• Provide Cost and Schedule Monitoring.</li> <li>• Initiate PCRAFs and BCSs to obtain approvals for scope, cost and schedule changes.</li> <li>• Ensure project close-out activities are completed</li> <li>• Assist with technical issue resolution.</li> <li>• Support Project Owner by providing technical advice on the interface with Customers and Stakeholders.</li> </ul>
Mod Team Leader (MTL)	S. Sahi B. Choi N. Sadrosadat B. Wong	<ul style="list-style-type: none"> <li>• Define project scope, schedule, and deliverables.</li> <li>• Carry out ECC MTL Role responsibilities as per Modification Process.</li> <li>• Ensure coordination of work control, operations and maintenance groups for installation and commissioning activities.</li> <li>• Ensure coordination of stakeholders to assist with technical issue resolution.</li> <li>• Chair Project Status Meetings.</li> <li>• Work with Supply Chain to acquire external qualified resources.</li> <li>• Support Section Managers and Project Leader in monitoring and reporting on the progress of IIP items.</li> </ul>
Engineering	A. Akhtari R. Bagheriasl D. Paraboo R. Ramirez R. Piggott A. Haibibi-Khadem	<ul style="list-style-type: none"> <li>• Provide project technical product deliverables such as technical specification, work plan, inspection criteria and assessing inspection scope.</li> <li>• Resolve technical issues and ensure integration with stakeholders as necessary.</li> <li>• Support Section Manager Engineering Services</li> <li>• Work with MTLs to progress the IIP items and prepare project close out reports.</li> </ul>

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### 2.3 Design Authority

Design Authority for the changes to be implemented is the Senior Manager, Plant Design, Darlington.

### 2.4 Stakeholder Identification and Involvement

Table 2.4 highlights the more significant stakeholders and their requirements and responsibilities.

Table 2.4 - Stakeholder Requirements and Responsibilities		
Stakeholder	Stakeholder Requirements	Stakeholder Responsibilities
<b>Customer:</b> Manager, Performance Engineering, Darlington  Manager, Component Engineering, Darlington  Manager, Reactor Safety Engineering, Darlington	Identifies the problem to be solved, the requirements and priorities for solution.	<ul style="list-style-type: none"> <li>Prepares ECR for the change.</li> <li>Approves initial scope and any subsequent changes</li> <li>Approves outputs</li> </ul>
<b>Project Sponsor:</b> Director Station Engineering, Darlington	Ensures that the project is in line with the needs of the station.	<ul style="list-style-type: none"> <li>Approves Project Charter</li> <li>Accepts Project Execution Plan</li> </ul>
<b>Installation Approval:</b> Director Operations and Maintenance, Darlington	Ensures that Operations and Maintenance issues are properly addressed.	Ensures that required personnel are available to support the development, review and implementation of the applicable project elements, including the receipt of any operator and maintenance training.
<b>Design Authorization:</b> Senior Manager, Plant Design, Darlington	Ensures that the design has been properly implemented.	Ensures specified requirements are met. Has the Design Authority role.
<b>Regulatory Interface:</b> Director, Nuclear Regulatory Affairs	Ensures that the interface with the Regulator (CNSC) is managed.	Ensures required personnel are available to coordinate any submissions to the CNSC.



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Table 2.4 - Stakeholder Requirements and Responsibilities		
Stakeholder	Stakeholder Requirements	Stakeholder Responsibilities
<b>IIP Oversight:</b> Manager, Refurbishment Project Engineering, Quality Engineering	Ensure oversight is provided for Station IIP items	Ensure any IIP change requests are prepared and submitted to CNSC. Ensure IIP status update is provided to CNSC when required.

### 3.0 WORK SCOPE AND SCHEDULE

#### 3.1 Work Breakdown Structure, Complete With Account Codes

The project Work Breakdown Structure (WBS), complete with account codes is shown in Figure 2. Corresponding TEMPUS work events and external contracts will be established in accordance with this WBS.

The complete charge number associated with the WBS elements is described below:

XXXX-62030-YYY-XXXX-4301-80110-000-00000-09-3100-LOCAL

Where:

- **XXXX:** RC code
- **YYY:** Resource type and varies depending on what type of purchase resource (e.g., OPG staff, managed task, augmented staff, materials)
- **LOCAL:** Local number will be created for each of the IIP items that are funded under 16-80110.

**Note 1:** 16-80110 covers the project expense such as labour, material and purchased services expenses. The labour cost for Plant Aging Management department will be charged to 16-80079 (Aging Management Project). Tempus events will be provided to other organizations to cover the planning and execution or overtime expenses. Material will be purchased through material request associated with the work orders that will be charged to 16-80110.

**Note 2:** Separate project number will be created for replacement IIP / contingency IIP items that cost more than \$200 k per unit. Any projects that are managed by Projects and Modifications and CCD department will have a separate project number as well.

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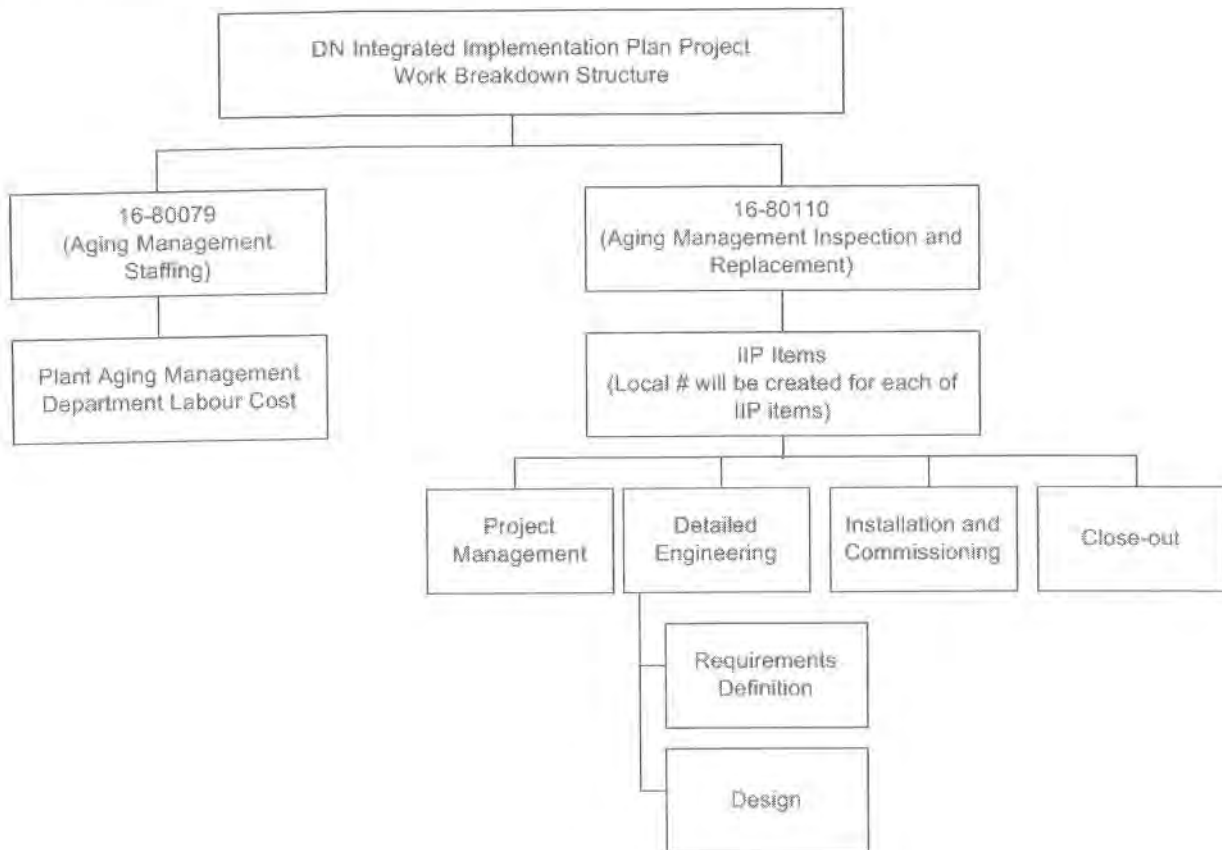


Figure 2 – DN Integrated Implementation Plan Project – Work Breakdown Structure

## 3.2 Description of WBS Scope

### 3.2.1 Project Management

This includes project management and oversight activities comprising work scope approval, project planning, scheduling, administration (e.g., close-out) and reporting activities, budgeting and estimates, staffing and work assignment, and communication external to the project.

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### 3.2.2 Requirements Definition

This includes defining the scope of work of the inspection / replacement activities, which is based on the Darlington NGS Integrated Implementation Plan [R-1], CCA and DSR. If a modification is required, the design requirement will be defined in Modification Design Requirement (MDR).

### 3.2.3 Design

This is only applicable to the replacement IIP items. This includes preparation of the design change papers such as drawings, technical specification, etc. Document Scoping Checklist will identify the affected documents associated with the modification.

### 3.2.4 Installation and Commissioning

If applicable, this includes preparation of the installation and commissioning strategy, preparation of the commissioning specification, preparation of work plans, modification of Operations documents, execution of the work plans, and preparation of the commissioning reports and Available for Service (AFS) activities.

### 3.2.5 Close-Out

This includes the commissioning reports that document the findings and recommended path forward of the associated inspection activities. Integrated Implementation Plan (IIP) Completion Declaration Form will be filled in order to close the IIP items as per N-INS-03680-10001, DNGS IIP Change Control and Closeout process.

For modification, this will also includes Design EC close-out activities (including all update and approvals to affected documents), Project EC and Master EC close-out activities, project financials finalized and closed, completion of any required self-assessments and completion and approval of project close out report.

## 3.3 Constructability, Operability, Maintainability

The process of inspection / replacement is consistent with normal maintenance activities. The activities will be completed by qualified technicians under existing maintenance procedures. Walkdown and informal Constructability, Operability, Maintainability and Safety (COMS) meeting are recommended to define the feasibility and issues of the inspection / replacement activities.

## 3.4 Approved Schedule

The project schedule is included in Appendix A.

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### 3.5 Interactions with Other Projects and/or Divisions

The interaction with other related projects, activities or organizations is described in Table 3.5.

Table 3.5 – Interactions with other Projects/Activities	
Project/Activity	Interactions
16-31432 - DN Containment Button-up Activity Monitors Replacement	Monthly meeting to review the level 1 plan report from Projects and Modifications. Review any major scope variance, risk of missing important milestone and any long term risk in meeting the CNSC commitment date, and opportunities to optimize execution timeframe and resources.
16-31532 - DN Powerhouse Water ACUs Replacement	
16-31544 - DN Radiation Detection Equipment Obsolescence	
16-31710 - DN Shutdown Cooling Heat Exchanger Replacement	
16-80036 - DN R22 Refrigerant ACU Replacement	
16-80037 - DN ECI Hydraulic Control Circuit Replacement	
16-80124 - DN Obsolete Programmable Logic Controller Replacement	
16-80151 – FHA and FSSA Project	
16-82887 - DN LISS Ball Position Detection System Replacement	Monthly meeting to review the level 1 plan report from Computers and Control Design. Review any major scope variance, risk of missing important milestone and any long term risk in meeting the CNSC commitment date, and opportunities to optimize execution timeframe and resources.
16-33977 - DN DCC Replacement / Refurbishment / Upgrades	
16-80078 - DN DCC/CP/SEM Aging Management	
16-82824 - DN Annunciation Modifications and Post-Accident Monitoring Configuration Management	Coordination with Performance Engineering / Component Engineering will be required to ensure they are informed of the scope of work, inspection results and recommended path forwards.
Performance Engineering / Component Engineering	
Work Control	
Regulatory Affairs	
Operations and Maintenance	
Refurbishment Project Engineering, Quality Engineering	Bi-weekly meeting to provide status update of Station IIP items. Review any major scope variance, risk of missing important milestone and any long term risk in meeting the CNSC commitment date, and opportunities to optimize execution timeframe and resources.

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### 4.0 PROJECT RESOURCES

#### 4.1 Project Resource Demand

Project resource demands have been established as part of setting up the Plant Aging Management department. The project resource is funded by 16-80079 (Aging Management Staffing Project).

All the staff from Plant Aging Management are essential to the success of the project. Staff from Planning and Execution Section will lead for the duration of the project. In addition, they will perform the MTL role in the ECC process. Plant Aging Management Engineering Section will provide resolution to technical issues.

Support from other station base resources such as Plant Design, Operations, Maintenance, Supply Chain, Reactor Safety, Performance Engineering and Component Engineering will be required to support this project.

- Plant Design will provide support during detailed design, installation and commissioning phase.
- Operations and Maintenance are responsible for supporting the installation and commissioning planning. Maintenance is also responsible performing the installation and commissioning if the Chestnut Park Accord (CPAA) has awarded the execution of IIP items to Power Workers Union (PWU).
- Supply Chain is responsible for procuring the required materials, securing the services of qualified external service providers and administering the associated contracts.
- Staff from the Darlington Reactor Safety department will provide support to the project during the design phase.
- Staff from Performance Engineering and Component Engineering will provide support and be integrated throughout the project in their areas of responsibility, as necessary.

In addition, external consulting services from service providers such as Kinetics Inc. will be established to help perform some of the inspection analysis in order to determine the degradation condition of the equipment.

In terms of the projects managed by Projects and Modifications and CCD department, the project resources have been established from their organization. The project resource is funded by the associated projects.

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### 4.2 Project Resource Availability

Project resources from Plant Aging Management are committed to the project. Management from other organizations has committed to provide support as needed to the project.

Purchase Order for external consultant service is currently in-progress.

### 4.3 Contracting/Procurement Strategies (If Applicable)

External contracting will follow the Purchased Services Agreement (PSA) for all contracted staff requirements, as necessary.

External consultant contract will follow the Purchased Services Agreement (PSA) for all contracted consultant requirements, as necessary.

## 5.0 PROJECT COSTS

### 5.1 Cost Breakdown Structure

The Cost Breakdown structure corresponds to the project WBS. Costs are collected from OPG's time management (TEMPUS), purchase management (Asset Suite) and financial management systems. The project cost is compiled and reviewed monthly. Forecast updates are provided when requested.

### 5.2 Project Estimates and Assumptions

The cost estimate for this project is \$98.2 million, which was based on the assessment from the CCA / DSR. It includes the IIP items that are managed by Project and Modifications and CCD department. However, cost estimate for DN Station IIP items were not adequately assessed in the CCA / DSR (SCR D-2015-26444). There is an action to provide a Class 5 cost estimate by the end of 2016 Q2.

The cost estimate for 16-80110 (DN Aging Management Scope Defining BCS) is \$7.91 million (without contingency), which was based on the assessment from the CCA / DSR. BCS will be revised when the Class 5 cost estimate is completed.

### 5.3 Project Cash Flows

The project cash flow for 16-80110 in 2015 to 2018 are \$682 k, \$2,555 k, \$2,893 k and \$1,780 k respectively (without contingency). The total budget is \$9,888 k including \$1,978 k contingency.



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### 5.4 Project Funding and Release

The approved BCS for 16-80110 is classified as OM&A Project. Partial Execution BCS was approved in 2015. The final execution BCS will be submitted once the cost estimate is completed.

## 6.0 PROJECT CONTROLS

The project will be planned, managed and controlled in accordance with the principles identified in N-PROG-AS-0007, Project Management. This includes the use of a standard set of project management mechanisms, including planning, monitoring and reporting tools. The project controls will be consistent with N-STD-AS-0028, Project Management Standard.

### 6.1 Safety Control

All work on the project will be conducted in accordance with all applicable legal, corporate, and OPG Nuclear safety programs.

### 6.2 Reactor Safety Control

Changes to physical plant and/or station work processes impacting reactor safety will be managed in accordance with established OPG procedures to ensure reactor safety. In the event that these normal processes define issues requiring a project specific reactor safety plan, such plan will be developed and incorporated into the PEP at that time.

### 6.3 Environment Control and Waste Management

Environmental Management, N-PROG-OP-0006 is used to identify considerations with respect to the environmental aspects of a project.

N-FORM-10422, Environmental Impact Worksheet and N-FORM-10114, Radioactive Waste notification will be completed during the design phase if required.

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## 7.0 PERFORMANCE MEASUREMENT AND EVALUATION

### 7.1 Project Management Measures (CPI, SPI, Etc.)

Standard project Cost Performance (CPI), Schedule Performance (SPI) and activity completion indices will be used to monitor this project. Cost, quality, safety and schedule performance will be measured against the project start and completion for each activity. This information will be reviewed on a monthly basis and can be provided when requested.

### 7.2 Effectiveness Measures

#### 7.2.1 During Implementation

During the implementation of the Preliminary and Detailed Engineering phases, project schedule included in Appendix A are monitoring to ensure the scope and CNSC commitment date for each IIP items defined in Darlington NGS Integrated Implementation Plan [R-1].

#### 7.2.2 Safety and Environmental Performance in the Context of Ontario Power Generation Being the Owner of This Project

All safety and environmental targets are zero (see Table 7.2.2). Any deviations will be handled in accordance with approved OPG-N procedures.

Table 7.2.2 - Project Safety and Environmental Performance	
Performance Indicator	Target
Fatalities	0
Permanent Disabilities	0
LTA's	0
MRPH's	0
Injuries to the public	0
Ministry of Labour Non-Compliance or Stop Work Orders	0
Contractor Safety Infractions vs. Requirements	0
S-99 Reportable Events	0
Reportable Spills	0

#### 7.2.3 Upon Completion

Upon project completion, the stakeholders should agree that the project objectives have been met, and that the needs statement requirements have been satisfied by the deliverables. The following measures should also be used to gauge the success of the project:

- Milestone dates committed to vs. met
- Actual cost vs. budgeted cost



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- Actual schedule vs. plan
- Completion of all Station IIP items are accepted by CNSC

### 7.3 Ongoing Performance Monitoring

Once the IIP item is completed, there will be no continuing work related directly to this project. Any additional component inspection / replacement will be handled in accordance with normal maintenance / modification procedures.

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### 8.0 RISK MANAGEMENT AND CONTINGENCY PLAN

The Risk Management and Contingency Plan (Table 8.0) is designed to identify and quantify specific risks to project activities and results. It also establishes mitigating strategies to ensure successful completion of the activities and results in accordance with established schedules. Note that to effectively manage these risks, the project requires support in the form of a strong commitment from senior management and involvement of the line organization.

**Table 8.0 - Risk Management and Contingency Plan**

Risk Class	Description of Risk	Risk Probability	Risk Impact	Risk Management Strategies (Avoidance/Mitigation/Correction)
Cost	Cost estimate accuracy from CCA / DSR	High	Cost and schedule	Perform a Class 5 estimate by 2016 Q2. In addition, a contingency of 20% will be included in the estimate.
Scope	Additional scope identified / transferred from Refurbishment Department	Medium	Cost and schedule	The current project scope is defined in the Darlington NGS Integrated Implementation Plan. DN Senior Management approval is required for additional scope transferred from Refurbishment department.
Schedule	Execution is delayed due to station conditions not allowing work to proceed on schedule	Medium	Schedule	Advance planning and alignment with station resources and work management milestones. Plan with schedule margin to ensure no impact to the CNSC commitment date. Communicate the importance of IIP scope to other organizations.
Resources	Resource constraint of skilled / qualified in-house staff to provide support	Medium	Schedule	Management from other organizations has committed to provide support as needed to the project.  The needs and plan for the skills required will be identified early on. An allowance for the higher cost of contractors has been factored in. Contingency for overtime is available, if necessary.  Prioritize work to ensure critical work is done within the available envelope.
Quality	Unavailability of station SME support / input / verification	Medium	Quality / Performance	Monitor and coordinate activities with management support (if required). Regular performance monitoring of the team members. External consultant will be obtained if required.
Technical	Component inspection does not identify the degraded condition of the component	Low	Quality / Performance	The inspection scope and procedure will be reviewed with Performance Engineering / Component Engineering.
Regulatory	Delay in execution of IIP items impact to the DN license submission and the CNSC condition for completion of DNRU2	Medium	Quality / Performance	Any risk of meeting the CNSC commitment date or required deliverables will be communicated to CNSC in advance. Provide regular project status update to Regulatory Affairs.

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**Table 8.0 - Risk Management and Contingency Plan**

Risk Class	Description of Risk	Risk Probability	Risk Impact	Risk Management Strategies (Avoidance/Mitigation/Correction)
Environmental	None			
Health and Safety	Normal health and safety concerns	Very Low	Schedule	All work on the project will be conducted in accordance with all legal, OPG corporate, OPG Nuclear and site safety programs.
Investment	Inadequate determination and management of IIP items results in not meeting the equipment reliability requirement and potential FLR impacts.	Very Low	Cost and schedule	The scope of IIP items were based on CCA / DSR. Systematic approach has been used to identify the life extension actions for critical components in order to finalize the IIP scope.  The remaining Non-IIP items will be managed through regular maintenance / modification procedure.
Other	None			

### 8.1 Description of Risk

See the *Description of Risk* column in Table 8.0.

### 8.2 Risk Probability

See the *Risk Probability* column in Table 8.0

### 8.3 Risk Impact

See the *Risk Impact* column in Table 8.0.

### 8.4 Risk Management Strategies (Avoidance/Mitigation/Correction)

See the *Risk Management Strategies (Avoidance/Mitigation/Correction)* column in Table 8.0.

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### 9.0 PROJECT COMMUNICATION PLAN

The following communications plan is designed to communicate to the project participants and the stakeholders key information as it is produced in this project, as well as the results of important meetings, which could have an impact on the project work.

#### 9.1 Reports (Including Status Reports at All Levels)

The following reporting will be used:

- Weekly update will be provided to DN Director of Station Engineering. Highlight of one or few items will be shared with CNE and CNO as part of overall engineering program progress reporting.
- Quad charts updated monthly and presented to DN Senior Management team monthly.
- Quarterly progress updates presented at the Darlington Senior Work Management meeting and Engineering Alignment meeting
- Progress updates presented to Nuclear Executive Committee meeting, PAC meeting, DN Journey of Excellence meeting, etc as required.
- Bi-weekly project progress update will be provided to DN Refurbishment.
- IIP project update presentation will be prepared and issued to the Plant Aging Management intranet website once a quarter.

#### 9.2 Documentation/Filing

Documentation is prepared, verified, approved and issued in accordance with standard OPGN Procedures. Adverse conditions and actions are handled via the corrective action program and the action tracking process, as appropriate.

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### 9.3 Meetings

Weekly project status update meetings will be scheduled to review each of the IIP items that are managed by Plant Aging Management. In addition, team meetings with different working groups will be held regularly as required. Actions assigned at these meetings will incur regular follow-up until actions are closed out.

Monthly meeting to review the Level 1 plan report from Projects and Modifications and CCD Department. Review any major scope variance, risk of missing important milestone and any long term risk in meeting the CNSC commitment date, and opportunities to optimize execution timeframe and resources.

### 10.0 PROJECT CLOSURE

The project will be declared complete with all the DN Station IIP items declared complete and Integrated Implementation Plan (IIP) Completion Declaration Form have been filled in order to close the IIP items as per N-INS-03680-10001, DNGS IIP Change Control and Closeout Process. This is also including the completion of the close-out activities for the replacement IIP items that follow the ECC process.

### 11.0 REFERENCES

- [R-1] OPG Report, NK38-REP-03680-10185 R001, "Darlington NGS – Integrated Implementation Plan (IIP)".
- [R-2] OPG Report, NK38-PEP-03680-10186, "Darlington NGS – Global Assessment Report".
- [R-3] CNSC Regulatory Document, RD-360, "Life Extension of Nuclear Power Plants", February 2008.
- [R-4] OPG Report, NK38-REP-03680-10104 R001, "Darlington NGS Integrated Safety Review (ISR) – Final ISR Report".
- [R-5] OPG Procedure, N-PROC-MP-0060, "Aging Management Process".
- [R-6] OPG Report, N-INS-03680-10001, "DNGS IIP Change Control and Closeout Process".

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### Appendix A: DN Station Integration Implementation Plan Schedule



#	JIP Title	SYSTEM	JIP #	DSR #	# of WO	Resp.	Legend	Note	2015				2016				2017				2018				2019				2020				2021																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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1A	DN HVAC System for MCR & SCA: Sample Inspection to Quantify Degradations & Determine Scope (CCA 1842)	HVAC	CC 023	TS0190-3 TS190-14	29	Sunny	IPG I/P	Each Inspection WO can only take 4 hours max. If inspection fails, ERT fire watch has to be in placed to meet the code requirement				Planning			Execution U3 (3 WOs)	Execution U4 (4 WOs)	Execution U5 (5 WOs)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														





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# Nuclear Program

## TITLE

### PROJECT MANAGEMENT

## AUTHORIZATION

DOCUMENT OWNER:	Dietmar Reiner SVP Nuclear Projects
APPROVAL FOR ISSUE:	Robin Manley Director, Nuclear Regulatory Affairs and Stakeholder Relations
AUTHORIZATION AUTHORITY:	Glenn Jager Chief Nuclear Officer, OPG

## DOCUMENT RELATIONSHIP

Applicability:	All of Nuclear
Receives Authority from:	N-CHAR-AS-0002, Nuclear Management System

Document is Related to Pressure Boundary ☐ Document Requires CNSC Notification ☐

## PURPOSE AND SCOPE

This Program describes the organizational responsibilities, interfaces and key program elements for managing and executing projects in Ontario Power Generation – Nuclear (OPG-N). Projects are widely used to implement solutions to improve, repair or correct issues that arise in the course of conducting OPG-N business. Program activities are performed in accordance with governing documents that prescribe controls and responsibilities to ensure activities are carried out in a safe and effective manner by qualified personnel. Key activities of this Program include, Project Management, Contract Management, Field Engineering, Project Oversight and Management of Supplemental Workers.

This program is applicable to all OPG-N organizations that manage and/or execute projects and the

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### PROJECT MANAGEMENT

program draws its authority from N-CHAR-AS-0002, Nuclear Management System, which supports the requirements described in Canadian Standards Association (CSA) N286-05, Management system requirements for nuclear power plants and CSA N286-12, Management system requirements for nuclear facilities.

### DATES (YYYY-MM-DD)

PDF Creation Date:	2015-11-27
Compliance Date:	Immediate Except for CSA N286-12 Bases which will come into effect January 1, 2016 when Darlington's new Licence takes effect.

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### 1.0 DIRECTION

All organizations executing projects within OPG-N shall follow the principles and requirements set out in this program for the planning, organizing, executing, and controlling of resources to ensure the safe and effective execution and completion of projects. Safety and quality shall be the overriding priority and shall not be compromised for cost or schedule.

It is recognized that projects will differ in complexity, resource requirements, duration and cost and therefore in order to accommodate these variances a *risk based graded approach* shall be used to determine requirements for planning and control of the project work effort. This risk based graded approach will maximize project control effectiveness and assist in identification and mitigation of project risk. The specifics of the risk based graded approach used for the project should be documented.

#### 1.1 Organization

Detailed information regarding the organizational roles and responsibilities for the Project Management Program are provided in section 2.0 of this document.

Roles and responsibilities for the Nuclear Projects organization as well as organizations supporting and interfacing with the Nuclear Projects organization are described in N-STD-AS-0020, Nuclear Organization.

#### 1.2 Managed System

N-PROG-AS-0007, Project Management (this document) incorporates, directly or by reference, the controls necessary to meet the requirements of CSA N286-05, Management system requirements for nuclear power plants and CSA N286-12, Management system requirements for nuclear facilities, for all program activities. The program describes the processes and controls for Project Management, Contract Management, Field Engineering, Project Oversight and Management of Supplemental Workers that are not explicitly addressed in other programs under N-CHAR-AS-0002 Nuclear Management System. Appendix A shows the implementing governance and the interfacing programs that together establish the managed system for the Project Management program.

Executing organizations may use guides, manuals, instructions, or other directions, to implement the principles of this program and the associated standards.

The authority and responsibility for developing, implementing and maintaining this Program has been delegated to the Project Director, Contract Management and Project Controls Office in Projects and Modifications department. All other management personnel designated in the Program have the authority and responsibility to participate and support the implementation of Program requirements in their area of activity.

##### 1.2.1 Key Principles

Projects executed in OPG-N shall be guided by the following set of key principles:

- (a) Projects are defined, planned, managed, and controlled. [B3]

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- (b) Business drivers for projects are clear and in support of corporate business goals. **[B3]**
- (c) Each project has a clear need or opportunity statement. **[B3]**
- (d) A graded, risk-based approach is used for Project Management processes and controls. **[B1],[B3]**
- (e) Project risks are identified and managed. **[B3]**
- (f) Each project has a Sponsor or receiving organization and an executing organization where the project objectives, roles, responsibilities, and accountabilities are well communicated. **[B3],[B4]**
- (g) Each project has a clear set of stakeholders identified who are consulted for project input. **[B4]**
- (h) Staff are competent at the work they do and clearly understand the expectations. **[B5],[B6]**
- (i) Projects are planned, approved, and executed using a phased approach. **[B3]**
- (j) Projects have a defined scope and corresponding cost estimate, schedule, and resource requirements. **[B3],[B4]**
- (k) Operating experience and lessons learned are captured, shared, and integrated as part of a continuous improvement process. **[B2],[B7]**
- (l) Information required for successful project execution shall be managed and communicated in a timely manner. **[B8]**
- (m) Contracts and contractors are managed. **[B11]**
- (n) Graded and effective oversight is applied to projects. **[B1],[B2]**
- (o) Project performance is monitored in order to direct corrective actions as needed. **[B3][B8]**
- (p) Projects follow an appropriate quality program. **[B3][B4]**
- (q) Project changes are managed and controlled. **[B9]**
- (r) Project Records are maintained. **[B10]**

### 1.3 Implementing and Interfacing Documents

The implementing and interfacing documents that establish the project management governance framework are described below and shown in Appendix A, Nuclear Projects Governing Document Hierarchy.

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### 1.4 Project Management

A project is defined as a temporary and unique endeavor undertaken outside the routine base activities of the normal work program. A project is initiated to address an identified business gap, need, or opportunity. Portfolio or Program Management (as used in this document and its associated standards) is the management of a set of projects coordinated to achieve strategic level objectives and benefits which would otherwise not be realised if the projects were managed individually.

Project Management is the application of a methodical approach for guiding a project from start to finish to ensure project objectives including safety, quality, schedule, budget, and intended benefits are realized.

N-STD-AS-0028, Project Management Standard provides the principles and requirements for managing and executing all projects undertaken by OPG-N. This standard identifies the critical project management attributes and methodology required to manage projects throughout the project life cycle.

### 1.5 Contract Management

Contract management is the process that enables parties to a contract to meet their obligations in order to deliver the objectives required from the contract. It involves active monitoring, managing issues proactively as they arise, and anticipating future issues throughout the contract life cycle. Contract management incorporates oversight of Supplier personnel to ensure they meet all safety, quality, cost, schedule, and performance requirements. Contract management also involves building a good working relationship between OPG and the Supplier.

N-STD-AS-0029, Contract Management Standard provides the principles and requirements for managing contracts, contractors and suppliers for projects initiated and/or executed by OPG-N.

### 1.6 Project Oversight

Project Oversight is the assessment necessary to ensure project objectives are achieved. It is distinct from the in-line and normal quality assurance and control processes. Oversight is based on a proactive and graded, risk based approach. The means by which the different executing organizations implement project oversight will vary based on business requirements. Project Oversight is applicable but not limited to the areas of Safety, Quality, Cost and schedule performance, Solution effectiveness, Value for money, Regulatory and environmental compliance, Human performance, Project planning, Engineering, Procurement, sub-suppliers and sub-contractors and Installation and construction activities.

N-STD-AS-0030 Project Oversight Standard, provides the principles and requirements for project oversight and surveillance for projects initiated and/or executed by OPG-N

### 1.7 Field Engineering (for Project Execution)

Field engineering activities including technical support, quality planning, quality control, and field oversight are necessary to ensure project execution activities meet the specified safety,

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quality, and documentation requirements for all execution activities that are undertaken under the OPG-Nuclear Management System

N-STD-AS-0031, Field Engineering Standard provides direction for persons performing field engineering activities in compliance with the nuclear management system and Canadian Standards Association CSA N286-05, Management system requirements for nuclear power plants and CSA N286-12, Management System Requirements for Nuclear Facilities

## 1.8 Management of Supplemental Personnel

Supplemental personnel are vital to the success of Nuclear Projects and OPG-N. They fill an important gap created by insufficient resources or skills of OPG-N employees. Operating Experience (OPEX) shows that building strong relationships with these workers, treating them with the same respect as OPG employees, and integrating them fully into their project teams are vital to good performance, regardless of the processes in use. "Supplemental Workers" refers to persons who conduct work or provide services on or off site who are not full-time OPG-N personnel but who follow the same high standards and processes as regular OPG-N personnel as defined in N-CHAR-AS-0002, Nuclear Management System. Supplemental workers include any of the following:

- contractors and vendors who perform work on site
- contractors and vendors who perform off-site work, such as engineering modifications, component fabrication, equipment refurbishment, and equipment testing
- personnel from another location within OPG or from an industry alliance who perform work on site, such as shared resources during outages
- personnel from within OPG who may only work part time at the station, such as switchyard personnel, inspection services, diving and other water services, environmental services, and roving valve teams
- personnel from another location who perform work off site, such as corporate engineering support

N-STD-AS-0032, Oversight of Supplemental Personnel provides the oversight principles and requirements to be applied to work packages initiated and/or executed within OPG by supplemental personnel.

## 1.9 Performance Indicators and Review

Program shall be reviewed and reported in accordance with N-PROC-RA-0023, Fleetview Program Health and Performance Reporting.

## 2.0 ROLES AND ACCOUNTABILITIES

### 2.1 Senior Vice President, Nuclear Projects

Establishes and Authorizes N-PROG-AS-0007, Project Management.

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Ensures that the Program is maintained and delivered in accordance with program requirements and N-CHAR-AS-0002, Nuclear Management System, and in accordance with applicable regulations, codes and standards, and to accepted professional standards.

### 2.2 Vice Presidents, Nuclear Projects

Support the SVP Nuclear Projects in integrating programs to manage execution of work in their respective Business unit in accordance with the approved Project Management Program and Standards.

Develop Business Unit policies and processes and establishes performance standards for activities and functions.

Provide direction and oversight of the quality program and governance in accordance with this program for their respective Business unit.

### 2.3 Project Director, Contract Management and Project Controls Office, P&M,

Assumes Program Owner roles and accountabilities in accordance with section 1.2 above as delegated by SVP Nuclear Projects and as described in N-PROG-AS-0001, Managed Systems.

Act as the Single Point of Contact for all Governance issues for the Nuclear Projects business unit.

Develops and maintains the Project Management Program including policies, programs, standards, and other required processes in support of the Nuclear Projects business unit and in accordance with N-CHAR-AS-0002, Nuclear Management System and to meet OPG policies and requirements and Canadian Standards Association CSA N286-05, Management system requirements for nuclear power plants and CSA N286-12 Management system requirements for nuclear facilities.

As delegated Program Authority, rules on decisions regarding all other program changes which may be in dispute and directs the change(s) to be implemented and complied with by all parties working with or using this program

Ensures that Project Management Program is periodically monitored and assessed.

Ensures consistent performance standards are established and reported.

### 2.4 Directors and Managers in Nuclear Projects

Ensure requirements established in the Project Management program are incorporated into all phases of nuclear projects work and any supporting processes are developed and fully supported and aligned with the program.

Ensures nuclear projects activities meet standard and procedural requirements.

Ensures competent resources are available to support the program work activities.

See also standard accountabilities for Manager.

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## 3.0 DEFINITIONS AND ACRONYMS

### 3.1 Definitions

#### ***Graded Approach<sup>1</sup>:***

A flexible selection process that allows the project manager to choose a more or less rigorous application of project control elements. This flexibility permits customizing project control needs to the specific project and focuses the team efforts

#### Clarification Notes:

1. it must be remembered that the Graded Approach Process cannot be used to “grade to zero” (i.e., eliminate requirements).
2. Even in the least stringent application of the Graded Approach Process, compliance with applicable portions of stated requirements is mandatory.
3. The graded approach that is used must be documented in the project records and should be communicated to the project team and all stakeholders

#### ***Risk Based Graded Approach:***

Accounts for identified risk elements and their likelihood of occurrence while using a graded approach. The approach can be simple identification of risk consideration or formally documented in the format of A “Graded Approach Worksheet” which identifies and documents values for predetermined risk elements with their likelihood of occurrence which is then used to determine a total risk score to assess the graded approach to use.

### 3.2 Abbreviations and Acronyms

None

## 4.0 BASES AND REFERENCES

### 4.1 Bases

The bases below pertain to various clauses in CSA N286-05 and CSA N286-12

- |       |  |
|-------|--|
| [B-1] | CSA N286-05, Clause 0.3, Operational safety focus, paragraph 2 describes graded approach<br>CSA N286-12, Clause 4.1.3, Graded approach |
| [B-2] | CSA N286-05, Clause 4, Management assessment of effectiveness<br>CSA N286-12, Clause 4.13, Continual Improvement                       |

---

<sup>1</sup> The definition here for “Graded Approach” and “Risk Based Graded Approach” is for use with this document and its associated standards. It is not to be interpreted to be the same as stated in CSA N286-12 clause 4.1.3



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- [B-3] CSA N286-05, Clause 5.1, The business is defined, planned and controlled.  
CSA N286-12, Clause 4.3, Business planning.
- [B-4] CSA N286-05, Clause 5.2, The organization is defined and understood  
CSA N286-12, Clause 4.4, Organization
- [B-5] CSA N286-05, Clause 5.3, Personnel are competent at the work they do  
CSA N286-12, Clause 4.5.2, Human resources (sections (a), (b), (c), (d))
- [B-6] CSA N286-05, Clause 5.4, Personnel know what is expected of them  
CSA N286-12, Clause 4.5.2, Human resources (sections (e), (f))
- [B-7] CSA N286-05, Clause 5.6, Information is sought, shared and used  
CSA N286-12, Clause 4.12, Use of Experience
- [B-8] CSA N286-05, Clause 5.7, Information is provided in time to the people who  
need it  
CSA N286-12, Clause 4.7.2, Information
- [B-9] CSA N286-05, Clause 5.12, Changes are controlled  
CSA N286-12, Clause 4.10, Change
- [B-10] CSA N286-05, Clause 5.13, Records are maintained  
CSA N286-12, Clause 4.7.4, Records
- [B-11] CSA N286-05, Clause 6.4, Purchasing and material management  
CSA N286-12, Clause 7.6, Supply Chain

## 4.2 References

### 4.2.1 Performance References

- N-PROC-RA-0023, Fleetview Program Health and Performance Reporting
- N-PROC-RA-0097, Self-Assessment and Benchmarking
- N-PROG-AS-0001, Managed Systems
- N-PROG-AS-0005, Business Planning
- N-PROG-MA-0026, Equipment Reliability
- N-PROG-MP-0001, Engineering Change Control
- N-PROG-MP-0007, Conduct of Engineering
- N-PROG-OP-0006, Environmental Management
- N-PROG-RA-0002, Conduct of Regulatory Affairs
- N-PROG-RA-0003, Corrective Action

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N-PROG-RA-0016, Risk and Reliability Program

N-PROG-TR-0005, Training

N-STD-AS-0028, Project Management Standard

N-STD-AS-0029, Contract Management Standard

N-STD-AS-0030, Project Oversight Standard

N-STD-AS-0031, Field Engineering Standard

N-STD-AS-0032, Oversight of Supplemental Personnel

OPG-PROC-0056, Post Implementation Review

OPG-PROC-0058, Procurement Activities

OPG-PROG-0006, Investment Management

OPG-PROG-0009, Items and Services Management

OPG-PROG-0010, Health and Safety Management System Program

### 4.2.2 Developmental References

A Guide to the Project Management Body of Knowledge (PMBOK Guide) 5th Edition, PMI

Excellence in Nuclear Project Management, INPO 09-002

N-CHAR-AS-0002, Nuclear Management System

N-STD-AS-0020, Nuclear Organization

OPG-STD-0017, Organizational Authority Register

OPG-STD-0030, Classification, Protection and Release of Information

OPG-STD-0076, Developing and Documenting Business Cases

## 5.0 REVISION SUMMARY

This is an **intent** revision.

- Due to extent of changes, no revision bars are shown
- Rewritten to ensure compliance with:
  - N286-12, "Management system requirements for nuclear facilities"

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- OPG-STD-0001, Requirements for Administrative Governance Documents
  - Align with Business Transformation and OPG-POL-0033 – OPG Business Model
  - Address deficiencies identified in Nuclear Oversight Audit Report OPGN NO-2015-022
  - Address change in reporting relationship for Nuclear Projects from CEO to CNO
- The following DCRs have been incorporated:
  - DCR#0000118328
  - DCR#0000118944
  - DCR#0000119990
  - DCR#0000127054
  - DCR#0000131423

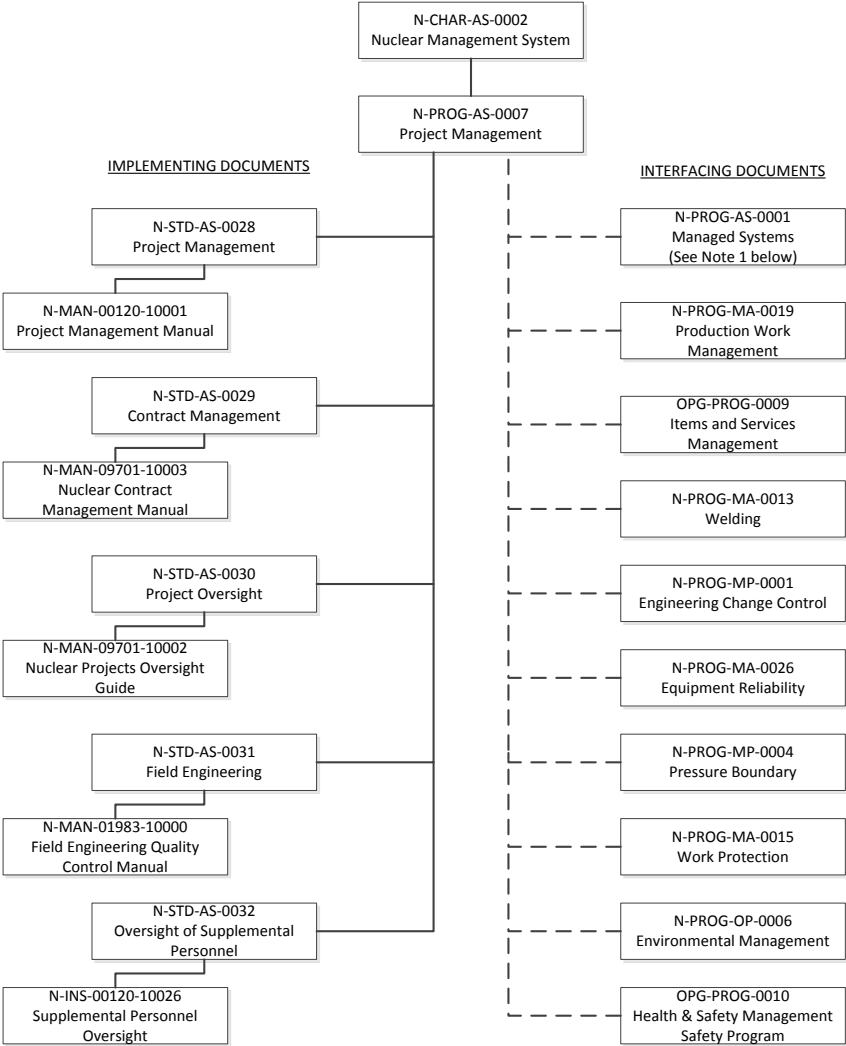
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Appendix A  
 Implementing and Interfacing Documents

The implementing and interfacing documents that establish the project management governance framework are shown below:



**Note 1:**  
 N-PROG-AS-0001 has been written to specifically address all of the generic requirements of CSA N286-05, Management system requirements for nuclear power plants and CSA N286-12, Management system requirements for nuclear facilities. As such it includes all of the following programs:

N-PROG-AS-0005	Business Planning
N-STD-AS-0020,	Nuclear Management system Organization
OPG-PROG-0001	Information management
N-PROG-AS-0002	Human Performance
N-PROG-TR-0005	Training
N-PROC-AS-0068	Organizational Change Control
N-STD-AS-0024	Change Management
N-PROG-MP-0006	Software
N-PROG-RA-0010	Independent Assessment
N-PROG-RA-0003	Corrective Action



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# Nuclear Standard

<b>TITLE</b>
<b>PROJECT MANAGEMENT STANDARD</b>

<b>AUTHORIZATION</b>
<p>SINGLE POINT OF CONTACT: Dave Stiers Director, Management System Oversight</p> <p>DOCUMENT OWNER: Gary Rose VP, Planning and Project Controls</p>

DOCUMENT RELATIONSHIP	
Applicability:	All of Nuclear
Receives Authority from:	N-PROG-AS-0007, Project Management Program

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<b>PURPOSE</b>
This standard provides the criteria, expected behaviours and output requirements for the successful and timely execution of all projects in Ontario Power Generation – Nuclear (OPG-N). It describes the Project Management attributes and methodology required to manage projects throughout the project life cycle.

<b>DATES (YYYY-MM-DD)</b>	
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<b>EXCEPTIONS</b>
None

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### 1.0 DIRECTION

This standard provides the criteria, expected behaviours and output requirements for the successful and timely execution of all projects in Ontario Power Generation – Nuclear (OPG-N). It describes the Project Management attributes and methodology required to manage projects throughout the project life cycle.

The requirements for effective management of a project are dependent on the level of risk inherent to the project. Projects are managed using a graded, risk based approach.

Portfolio or Program Management is the management of a set of projects coordinated to achieve strategic level objectives and benefits. Projects executed as part of a Portfolio or Program should implement additional levels of integration and oversight within the context of this standard.

Projects are initiated, funded, and executed by many different groups and organizations within OPG-N

All staff within OPG-N that work on projects will apply the criteria, methodology and good practices described in this standard for all project management activities.

Detailed process instructions, guides, work aids and good practices for all key elements of project management in OPG-N are stored in the controlled documents module of Asset Suite and can also be accessed via N-MAN-00120-10001 which is available on the OPG intranet through “PowerSearch” or as an E-Manual under the Nuclear Projects webpage.

### 1.1 Project Management

Project Management is the discipline of planning, organizing, securing, and managing resources to bring about the successful completion of specific project goals and objectives. It is the application of a methodical and iterative approach for guiding a project from start to finish. It incorporates tools and processes to plan, execute, monitor, control and close-out project activities to ensure all project requirements are met.

Managing a project typically includes:

- (a) Identifying and documenting project requirements and deliverables to satisfy the project needs and objectives including key constraints, risks and assumptions.
- (b) Providing graded, risk based oversight of the project team, supporting departments, contractors, and suppliers.
- (c) Addressing the various needs, concerns, and expectations of stakeholders.
- (d) Developing project plans, estimates and schedules.

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- (e) Developing funding and contracting strategies.
- (f) Monitoring, reporting, communicating, and controlling project performance.
- (g) Documenting and managing project risks, identifying mitigating actions to eliminate or reduce the risk and implementing corrective measures.
- (h) Planning, managing and directing the project execution.
- (i) Managing and controlling project changes and priorities.
- (j) Incorporating operating experience and lessons learned.
- (k) Balancing competing project constraints including the following:
  - Scope
  - Schedule
  - Cost/Budget
  - Resources
  - Risks
  - Value for money.

1.1.1 The Project Manager has the overall accountability for the project and project management and shall use a graded, risk based approach when selecting the type and detail for Project Management processes and tools. The required level of Project Management and controls are a function of the project risk, complexity, duration, expected cost and project phase.

1.1.2 All work performed during a project shall:

- (a) Maintain safety and quality as the overriding priority.
- (b) Be executed by staff who are competent for the type of work.
- (c) Be executed in phases. Progression from one phase to the next is approved at a *Decision Gate* where project progress and performance is reviewed by management and validated to ensure project requirements and objectives are being satisfied.
- (d) Use as required the guides, instructions, forms and good practices for the specific project management area that are provided in the project management manual N-MAN-00120-10001 and further described in the project management e-manual available on the Project Management Intranet web page.

## 1.2 Project Phases and Decision Gates

Consistent with industry best practices, project development, execution and close-out is broken into Project Phases separated by *Decision Gates*. The gated concept provides points in the development and execution of the project for management decision to stop, rework or



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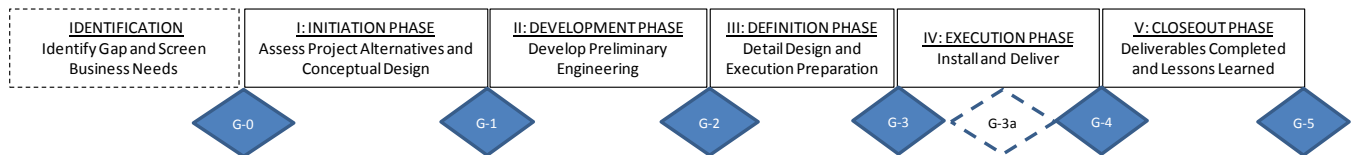
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proceed. It controls progression approvals and shall be used to manage the project through the project life cycle. This process requires that projects meet a consistent expectation of quality and performance. At each *Decision Gate*, the current phase deliverables and project performance are reviewed together with the plan and deliverables for the next phase(s).

1.2.1 The project life cycle typically consists of the following five phases:

- Identification phase
- Initiation phase
- Development Phase
- Definition phase
- Execution phase
- Close Out phase.

Figure 1, Project Phases and Associated Decision Gates, illustrates the typical project phase and *decision gate* relationship.



**Figure 1: Project Phases and Associated Decision Gates**

**Note:** There may be additional *Decision Gates* (e.g. G3a) within a project phase depending on project risk, funding release and execution strategy, and organization's process. *Decision Gates* may be revisited when priorities or strategies change. In specific instances some projects will not be required to go through certain Gates. These projects will document why certain Gates are not applicable to their project.

A project proposal begins at *Decision Gate 0*. During the period prior to Gate 0, a business gap, need or opportunity has been identified by the initiating organization. The Gate 0 decision is primarily focused on confirming strategic alignment and intended benefits with the initiating organization and OPG-N business objectives.

## 1.3 Identification Phase

The Identification of the Business Proposal finishes at Gate 0 and includes actions to assess the business need or gap. The purpose of Gate 0 is to approve progression to the Initiation Phase.

1.3.1 The Identification Phase deliverables typically include:

- (a) Project Alternatives

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- (b) Project Charter or equivalent created.

### 1.4 Initiation Phase

The project Initiation Phase begins after Gate 0 and ends at Gate 1. The objective of the Initiation Phase is to evaluate viable alternatives and develop the scope and conceptual design of the preferred alternative. The Gate 1 supporting documents are prepared to summarize the alternatives analysis and rationale for recommending the preferred alternative so that an informed decision to continue or cancel the project can be made.

#### 1.4.1 The Initiation Phase deliverables typically include:

- (a) Alternative options evaluated and a preferred alternative recommended.
- (b) Initial scope description and conceptual design report
- (c) Development Phase Business Case Summary
- (d) Initial total project cost estimate and schedule for the preferred alternative.
- (e) Work for the next phase(s) defined and planned, complete with a detailed estimate and schedule.
- (f) Project charter update and supporting documents.
- (g) Applicable Gate 1 *Approval Package* to support the development of the project.

### 1.5 Development Phase

The Development Phase starts at Gate 1 and ends at Gate 2. The objective of the Development Phase is to develop the preferred alternative to a point where there is confidence that all major elements of the scope are accounted for. At the conclusion of this phase, Gate 2 decision approves progression to define the project.

#### 1.5.1 Development Phase deliverables typically include:

- (a) Refined total project cost estimate and schedule
- (b) Preliminary engineering complete
- (c) Project Management Plan
- (d) Identification of engineered equipment and services
- (e) Initial project contracting strategy

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- (f) Definition Phase Business Case Summary
- (g) Applicable Gate 2 *Approval Package* to support the definition of the project

### 1.6 Definition Phase

The Definition Phase starts at Gate 2 and ends at Gate 3. The objective of the Definition Phase is to demonstrate readiness for execution. The definition phase includes the procurement of engineered equipment, completion of detailed engineering, preparations for construction/field work, and, detailed scoping of work. During this phase inputs to the performance baseline are refined, engineering, designs are completed, and execution contracts are assembled.

#### 1.6.1 Definition Phase deliverables typically include:

- (a) Final scope description and requirements.
- (b) Detail engineering complete.
- (c) Risk Assessment and mitigating plans
- (d) Regulatory Approvals identified and received or pending.
- (e) Control cost estimate and integrated resource loaded schedule.
- (f) Execution Phase Business Case Summary.
- (g) Applicable Gate *Approval Package* with updated project plans to support the next phase(s) including Gate 3 approval to begin the Execution Phase.

### 1.7 Execution Phase

The project Execution Phase includes the main construction/installation and commissioning work. It may also include completion of procurement.

#### 1.7.1 Execution Phase deliverables typically include:

- (a) Pre-installation and commissioning readiness.
- (b) Quality Plan.
- (c) Safety Plan.
- (d) Regular reporting on project safety, quality, schedule and budget.

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- (e) Installation and Commissioning Work Plans (if applicable).
- (f) Installation and Commissioning Execution Packages.
- (g) Installation/construction, inspection/testing and commissioning complete.
- (h) Project Close Out phase planned.
- (i) Operations and Maintenance documentation updated.
- (j) Next *Approval Package* with updated plans and schedule, if applicable, for a multi-unit/phase project.
- (k) Available for Service (AFS) or Operations Acceptance approved (Gate 4).
- (l) Gate 4 approval to begin Close Out Phase.

#### 1.8 Close Out Phase

The Close Out Phase is the last phase in the project life cycle and includes the final actions to complete all activities and formally finish and close out the project. This phase should be completed as quickly as possible after final AFS in order to minimize project costs.

##### 1.8.1 Close Out Phase deliverables typically include:

- (a) Completion of any outstanding actions/deficiencies from final AFS and Gate 4.
- (b) Project financials finalized and closed.
- (c) Remaining project materials dispositioned as spares, surplus or obsolete.
- (d) New and affected drawings updated, approved and issued.
- (e) Records and documents filed.
- (f) Information Managed Systems updated.
- (g) Lessons Learned captured and documented.
- (h) Regulatory actions dispositioned and/or completed as needed.
- (i) Action tracking assignments completed and closed.
- (j) Completion and approval of project close out report (Gate 5).

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### 1.9 Key Project Management Elements

Each executing organization shall have graded, risk based processes to incorporate the key Project Management elements.

The key Project Management elements include the following items:

- Safety
- Scoping
- Estimating
- Resource planning
- Risk management
- Scheduling
- Cost management
- Procurement and contract management
- Communication
- Quality management
- Project oversight
- Project controls.

The ability to influence the outcome and success of a project is greatest at the front end of the project lifecycle. The key Project Management elements shall be applied in a manner that minimizes the likelihood of encountering issues during the execution of the work. As the project progresses and matures, the planning products should be further developed and refined to reflect the latest project information.

The products of the key Project Management elements are summarized in a Project Management Plan. Any other elements unique to a particular project should also be specified in the plan.

#### 1.9.1 Safety

Safety, including nuclear safety, radiological safety, environmental safety and conventional safety, is an overarching element in project management. Safety impacts people, quality, costs and schedule.

Each project shall consider safety in the planning, managing, controlling and execution of project deliverables.

#### 1.9.2 Scoping

Project scoping involves defining the project objectives and deliverables based on business requirements, assumptions, constraints and value for money.

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- (a) Each project shall have a well defined project scope in order to produce an accurate estimate and schedule.
- (b) The inputs to determining the project scope should include but are not limited to:
  - Project Charter or equivalent
  - Project stakeholders
  - Station/System Health Reports
  - Station Engineering (system engineer)
  - Design Basis and Design Requirements
  - Facilitated workshops and Value Engineering
  - Regulatory requirements
  - Field Walk Downs
  - Lessons Learned (internal and external)
  - OPEX and SCRs
  - Governance
  - Challenge and COMS meetings
  - Risk mitigating plans.
- (c) There shall be a process and plan to deal with scope changes. Project scope changes shall be managed and strictly controlled, with the impacts thoroughly understood, as they have the potential to affect the project risks, cost, schedule and stakeholders. Project scope changes require approval from the project sponsor or the applicable authorization authority appropriate for the project. If changes are significant the project may need to be re-evaluated.

### 1.9.3 Estimating

Estimating is the process of quantifying the funding and resources required to complete the relevant project activities to achieve project objectives. An accurate cost estimate leads to a more precise project schedule and budget which forms the basis for project decisions, value and performance. Each project shall have a cost estimate and:

- (a) Each project should create a cost estimate which includes the documentation of assumptions, constraints, class of the estimate along with the cost range, deliverables, and other relevant information that the estimate is based on.
- (b) Estimating should be repeated for each project phase and should become more refined and accurate as the project scope and details mature.
- (c) Estimating should be performed to determine the cost of changes including the addition of project scope.
- (d) The estimate for the next immediate project phase should be of sufficient detail and accuracy to ensure thorough resource planning and cost control.

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### 1.9.4 Resource Planning

Resource planning includes identifying the quantity and type of resources required for the successful completion of project deliverables.

- (a) The Project Manager shall ensure that qualified personnel, equipment and material are available at each stage of the project, in order to meet the oversight, schedule, quality and technical requirements.
- (b) Resource planning shall be graded and risk based and should be used as an input to develop the contracting and procurement strategies, and project schedule.

### 1.9.5 Risk Management

Risk Management is the process used to identify, manage and control project risks throughout the project lifecycle.

- (a) The Project Manager shall ensure that project risk management is executed thoroughly to decrease the likelihood of unexpected issues occurring and adversely impacting the project and stakeholders.
- (b) Risk Management includes:
  - Identification and analysis of project risks
  - Mitigation and/or avoidance of risks through preventive action planning and execution
  - Determining the budget and schedule contingency required for residual risks
  - Developing risk contingency plans to deal with residual risks that may materialize
  - Monitoring and controlling risks throughout the project lifecycle.

### 1.9.6 Cost Management

Cost management includes the processes related to assessing and managing the actual cost of deliverables against the budget baseline. The budget or cost baseline is based on the resource loaded project schedule. Cost management includes:

- (a) Establishment of the budget or cost baseline.
- (b) Monitoring the status and trend of cost performance.
- (c) Implementing corrective actions as required.
- (d) Managing the use of contingency funding required to manage project risks.
- (e) Forecasting future budget requirements.
- (f) Managing required budget changes.

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### 1.9.7 Scheduling

The project schedule outlines the deliverables and activities, their interrelationship and execution sequence. It is the main planning and monitoring tool used to communicate the execution of project deliverables.

Scheduling includes:

- (a) Identification of key activities including their start and finish date, duration and resources.
- (b) Activities that are deliverable based and communicate what needs to be done.
- (c) The sequence and logical interrelationship of activities and milestones.
- (d) Identification and optimization of the critical path.
- (e) Regular monitoring and updating to track performance and initiate corrective action for schedule threats.
- (f) Look ahead planning and strategizing to identify and manage priorities, opportunities, and threats.
- (g) The inclusion and management of float in the schedule.

### 1.9.8 Procurement and Contract Management

Projects shall manage contracts and suppliers in accordance with N-STD-AS-0029, Contract Management Standard.

### 1.9.9 Communication

The project manager shall ensure that proper and effective communication practices are used throughout the project life cycle. This is to ensure that all project team members, stakeholders, contractors and suppliers understand the deliverables and are working with the required and most recent information.

The communication requirements include:

- (a) Maintaining alignment between team members and stakeholders.
- (b) Timely distribution and control of information, documentation and changes.
- (c) Communicating targets and expectations.
- (d) Regular project team planning and progress meetings.
- (e) Informing stakeholders of project progress, risks and changes.



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- (f) Expediting support and issue resolution.
- (g) Reporting on project performance.

#### 1.9.10 Quality Management

Quality management processes are required to control human performance, engineering, work planning, materials, and field work, in order to meet the requirements of the project.

- (a) Each project shall define what quality program is to be used in the project's quality plan.
- (b) The quality plan includes the methods that will be used to measure the project actual performance against the defined quality requirements.
- (c) The project quality plan should demonstrate the following elements where applicable:
  - (1) Quality planning to determine the type and frequency of internal and external quality standards and monitoring required for project success.
  - (2) Quality Assurance to plan a systematic pattern of means and actions designed to provide confidence that items or services will meet specified requirements and perform satisfactorily in service. These include quality systems, instruction, training, qualification and checklists.
  - (3) Quality Control processes to ensure that specified requirements are met through monitoring, inspections, testing, examinations or verifications. This includes the documentation of non-conformances and corrective actions.

Refer to N-STD-AS-0031, Field Engineering Standard, for projects using OPG-N's quality program.

#### 1.9.11 Project Oversight

Projects using a contractor's or vendor's quality management system shall implement oversight in accordance with N-STD-AS-0030, Project Oversight Standard.

#### 1.9.12 Management of Supplemental Personnel

Supplemental personnel are vital to the success of Nuclear Projects and OPG-N. They fill an important gap created by insufficient resources or skills of OPG-N employees.

N-STD-AS-0032, Oversight of Supplemental Personnel provides the oversight principles and requirements to be applied to work packages initiated and/or executed within OPG by supplemental personnel.

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### 1.9.13 Project Controls

- (a) Projects shall have control processes established to support key project management elements including but not limited to:
  - (1) Planning support.
  - (2) Monitoring of key project performance indicators (i.e. metrics).
  - (3) Schedule and cost variance and indicator analysis.
  - (4) Forecasting of project costs and schedule.
  - (5) Risk management.
  - (6) Project reporting to communicate project health and facilitating oversight.
  - (7) Contingency development and control.
  - (8) Safety and quality monitoring and reporting.
  - (9) Change management.
  - (10) Document control and records management.
- (b) Project performance shall be measured, on a regular basis, in comparison to the baseline deliverables and milestones approved in the applicable project gate *Approval Package*.
- (c) The monitoring and reporting of key performance indicators shall allow for the detection of at risk deliverables and support the direction of any corrective actions needed to recover performance. Analysis and corrective action shall support consideration of both project performance and business planning.
- (d) Changes to scope, cost, and schedule shall be managed and controlled through the applicable executing organization process.

## 2.0 ROLES AND ACCOUNTABILITIES

### Project Manager

The project manager is accountable for the following for all assigned projects:

- Initiating, planning, executing, controlling, and closing project management processes
- Setting and managing the project team priorities and ensuring that the assigned projects are supported and executed per the approved Business Case Summaries and Project Management Plans.
- Ensuring that all project activities are carried out safely, integrated into site work planning, and executed in accordance with the standards and processes established under the Nuclear Projects program in the areas of scope management, schedule management, cost management, quality management, resource management,

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communications management, risk management, procedures/contract management, and project oversight

- the establishment of project reporting metrics and effective processes to reliably collect information ensuring that project reports are produced in a timely and accurate manner to support project management requirements and project information is communicated to all stakeholders

## 3.0 DEFINITIONS AND ACRONYMS

### 3.1 Definitions

**Approval Package** is a general term for a prescribed assembly of documentation prepared by the Project Manager and submitted for approval at a *Decision Gate*. The *Approval Package* forms the basis for authorizing authority consideration and subsequent approval for the project to proceed to the next phase. The content, structure, and rigor of the *Approval Package* will vary at each *Decision Gate* depending on a number of factors including organizational process, scope and complexity of the project and project stage.

**Decision Gate** is a management hold and review point in the Project Life Cycle where project attributes such as readiness, quality, value, risks and funding requests may be reviewed prior to approval of project advancement to the next phase or stage.

**Engineered Equipment** is equipment requiring application-specific technical specifications to meet the performance requirements for the project.

### 3.2 Abbreviations and Acronyms

<b>AFS</b>	Available For Service
<b>COMS</b>	Construction Operations Maintenance Safety stakeholder review process
<b>OPEX</b>	Operating Experience
<b>OPG</b>	Ontario Power Generation
<b>OPG-N</b>	Ontario Power Generation - Nuclear
<b>SCR</b>	Station Condition Record

## 4.0 BASES, RECORDS AND REFERENCES

### 4.1 Bases

None

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### 4.2 Records

- 4.2.1 Any controlled documents which may be produced as a result of this document should be managed in accordance with OPG-PROC-0178, Controlled Document Management.
- 4.2.2 Any records which may be produced as a result of this document should be managed in accordance with OPG-PROC-0019 Records and Document Management, and N-MAN-00120-10001-RDM Nuclear Projects Records and Document Management.

### 4.3 References

#### 4.3.1 Performance References

N-STD-AS-0029, Contract Management Standard  
N-STD-AS-0030, Project Oversight Standard  
N-STD-AS-0031, Field Engineering Standard  
N-STD-AS-0032, Oversight of Supplemental Personnel  
N-GUID-00120-10011, Collaborative Front End Planning Process  
N-MAN-00120-10001, Project Management Manual

#### 4.3.2 Developmental References

A Guide to the Project Management Body of Knowledge (PMBOK Guide) 5<sup>th</sup> Edition  
Association for Advancement of Cost Engineering (AACE)  
INPO 09-002, Excellence in Nuclear Project Management  
N-PROC-MP-0083, Constructability, Operability, Maintainability, and Safety  
N-PROC-MP-0090, Modification Process  
OPG-PROC-0056, Post Implementation Review  
OPG-PROC-AS-0006, Records and Document Control  
N-PROC-AS-0007, Project Management

## 5.0 REVISION SUMMARY

### This is non-intent revision.

- Sec 1.2.1 added bullet for Development Phase.
- Revised Figure 1 to show Development Phase in the project phases and decision gates
- Sec 1.3 and Sec 1.3.1 revised to align with identification phase activities and deliverables
- Sec 1.4 and Sec 1.4.1 revised to align with initiation phase activities and deliverables
- Sec 1.5 and Sec 1.5.1 added for development phase activities and deliverables
- Sec 1.6 and Sec 1.6.1 revised to align with definition phase activities and deliverables
- Minor revisions to section 1.7 execution



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# Nuclear Standard

<b>TITLE</b>
<b>PROJECT OVERSIGHT STANDARD</b>

<b>AUTHORIZATION</b>
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DOCUMENT RELATIONSHIP	
Applicability:	All of Nuclear
Receives Authority from:	N-PROG-AS-0007, Project Management Program

Document is Related to Pressure Boundary <input type="checkbox"/>	Document Requires CNSC Notification <input type="checkbox"/>
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<b>PURPOSE</b>
This standard provides the criteria and behavioral requirements for Project Oversight and the key elements for oversight of projects executed in Ontario Power Generation – Nuclear (OPG-N). Project oversight is an important aspect of project management which is used to ensure project deliverables and objectives are achieved.

<b>DATES (YYYY-MM-DD)</b>	
PDF Creation Date:	2016-04-26
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**EXCEPTIONS**

None

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### 1.0 DIRECTION

This standard provides the Project Oversight principles and requirements to be applied to projects initiated and/or executed within OPG-N. Oversight is the independent assessment necessary to ensure OPG and project objectives are achieved. It is distinct from the in-line and normal quality assurance and control process. Oversight is applicable but not limited to:

- Safety
- Quality
- Cost and schedule performance
- Solution effectiveness
- Value for money
- Regulatory and environmental compliance
- Human performance
- Project planning
- Engineering
- Procurement, suppliers and contractors
- Installation and construction activities

Oversight is based on a proactive and graded, risk based approach. The means by which the different executing organizations implement this standard may vary based on business requirements and taking into consideration the risk profile and complexity considerations of the particular project being undertaken.

#### 1.1 Key Oversight Elements

- (a) Oversight shall be performed throughout the project lifecycle.
- (b) The extent and frequency of oversight shall be applied strategically using a graded approach based on project complexity, risks, and performance. The level of oversight shall be modified to reflect the current project performance and changes in the risk profile. Examples where increased levels of oversight may be required include:
  - Project areas that include new processes or technology
  - Activities of high consequence to safety, quality, cost or schedule
  - Critical evolutions or changes

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- Where suppliers are new or have performed less than expected on current and previous projects
  - Fabrication by sub-contractors
  - Where nuclear safety or operation may be impacted
  - Project areas with evidence of negative trends, e.g. cost, schedule, safety or quality performance.
- (c) Oversight shall be applied proactively in a manner that allows for early detection of potential issues and effective implementation of corrective actions. Methods of proactive oversight may include:
- Communicating and establishing expectations and targets
  - Conducting regular status meetings
  - Look ahead planning and strategizing
  - Conducting challenge and preparedness meetings
  - Performing direct observation, surveillance and assessments
  - Using trend analysis and performance metrics
  - Tracking and resolving issue
  - Prompt escalation of issues
- (d) Oversight shall be applied in a manner that respects contract terms and conditions. It does not direct the work of suppliers who are performing under their own approved management system. Oversight results shall be communicated to stakeholders through the pre-approved designated authority for the oversight.
- (e) Oversight shall be applied to the portfolio or program of projects as well as to individual projects. The portfolio or program oversight shall be conducted in a manner that ensures:
- communication, coordination and integration between projects in order to establish and understand the interrelationships
  - overall portfolio safety, quality, cost and schedule performance
  - a higher degree of oversight for large projects and programs that include multiple projects.
- (f) The oversight strategy, roles and responsibilities shall be documented in a project oversight plan. The oversight plan shall be reviewed and updated when required to meet the project objectives in alignment with project and supplier performance.



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- (g) The Project Manager should develop the oversight plan with stakeholder input and shall:
  - (1) Direct and execute the overall project oversight.
  - (2) Obtain the necessary resources to execute the oversight.
- (h) Oversight results that include corrective actions shall be documented and communicated to the appropriate project stakeholders.
- (i) Lessons learned are used for continuous improvement.

### 1.2 Project Oversight Process

Detailed process instructions, guides, work aids and good practices for all key elements of project oversight in OPG-N are provided in various documents which have been independently developed and implemented.

The following instructions have been -written to assist Project Managers and contract owners implement the requirements of N-STD-AS-0030 Project Oversight Standard (governance), N-STD-AS-0032 Oversight of Supplemental Personnel (governance), and the guidelines presented within the following documents:

N-MAN-09701-10002, Nuclear Refurbishment Project Oversight.

N-INS-09701-10007, Project Oversight Planning and Implementation

N-INS-00120-10026, Supplemental Personnel oversight

N-GUID-01920-10000, Guideline for Engineering Oversight

N-GUID-09701-10022, Supply Chain Oversight

N-GUID-09701-10120, Guideline for Construction Oversight

[N-GUID-00120-10008, Contractor Management Process](#)

N-INS-09701-10007, Project Oversight Planning and Implementation is primarily intended to assist with the development of the Project Oversight Plan (POP) particularly for obtaining consistency on format and content. This is essential when recognizing that there are various groups executing projects across OPG Nuclear. It is imperative that consistency in format and minimum content is required specifically because of, the variation in project cost, complexity, duration and risk, and user groups such as Inspection and Maintenance Services (IMS), Station Engineering and Project & Modifications(P&M).

[N-GUID-00120-10008, Contractor Management Process, identifies the minimum process requirements for monitoring a contractor during the field execution of contracted work at Ontario Power Generation Nuclear \(OPGN\).](#)

In addition, oversight departments charged with ensuring that adequate oversight is being applied on projects require consistency and some minimum standard for POP's in order to

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measure application of governance and foster continuous improvement through the analysis of oversight results.

The Oversight process documents are available on the OPG intranet through "PowerSearch" or as an E-Manual under the Nuclear Projects webpage.

## 2.0 ROLES AND ACCOUNTABILITIES

### Vice President - Nuclear Projects Oversight

The Vice-President - Nuclear Projects Oversight, acts as the Program Owner for oversight and sets direction, monitors compliance, and assesses effectiveness in accordance with N-STD-AS-0030 Project Oversight Standard,. This is also described in the Nuclear Refurbishment Project Oversight Guide, N-MAN-09701-10002. Nuclear Projects Oversight supports the project teams in the development of their Project Oversight Plans (POPs) and the associated tools, including training, as required.

### Project Manager

The Project Manager is accountable for the following:

- Ensure adequate oversight is planned and implemented for the project.
- Develop and implement the Project Oversight Plan (POP)
- Engage and utilize the support of the functional groups in the development and implementation of the POP.
- Determine and resource the project oversight team (functional & support group representation) and how they will function.
- Document the expectations around communicating (internal and with vendor) and on the importance of sharing critical oversight results in an expeditious manner.
- Communicate expectations around oversight effort (full time, part time, twice a week, etc).
- Hold recurring meetings with the project team to review oversight results and revise the POP as required.

### Functional Support Organization Managers:

The functional organizations, in accordance with approved RACI (Responsibility, Accountability, Consultation, Information) documentation, are accountable to identify the oversight to consider for inclusion in the POP. They are also accountable to provide additional and or specialized resources to execute the plan when requested by the Project Manager.

## 3.0 DEFINITIONS AND ACRONYMS

### 3.1 Definitions

None

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### 3.2 Abbreviations and Acronyms

None

### 4.0 BASES, RECORDS AND REFERENCES

#### 4.1 Bases

None

#### 4.2 Records

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4.2.2 Any records which may be produced as a result of this document should be managed in accordance with OPG-PROC-0019 Records and Document Management, and N-MAN-00120-10001-RDM Nuclear Projects Records and Document Management.

#### 4.3 References

##### 4.3.1 Performance References

[N-GUID-00120-10008, Contractor Management Process](#)

-N-GUID-01920-10000, Guideline for Engineering Oversight

N-GUID-09701-10022, Supply Chain Oversight

N-GUID-09701-10120, Guideline for Construction Oversight

N-INS-09701-10007, Project Oversight Planning and Implementation

N-INS-00120-10026, Supplemental Personnel oversight

N-MAN-09701-10002, Nuclear Refurbishment Project Oversight

##### 4.3.2 Developmental References

N-PROG-AS-0007, Project Management

N-STD-AS-0028, Project Management Standard

N-STD-AS-0029, Contract Management Standard

N-STD-AS-0031, Field Engineering Standard

N-STD-AS-0032 Oversight of Supplemental Personnel

### 5.0 REVISION SUMMARY

[For Revision R001A](#)

[This is a non-intent revision.](#)

- [Cover Page updated to show revisions to SPOC and Document Owner based on updated Governing document ownership list](#)
- [Section 1.2 updated to include N-GUID-00120-10008, Contractor Management Process](#)

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- Section 4.3.1 updated to add N-GUID-00120-10008, Contractor Management Process to performance references

For R001: This is a **non-intent** revision.

- Document Authority updated
- Purpose statement updated
- Sec 1.0 Direction: The last sentence added to the last paragraph.
- Sec. 1.2 Project Oversight Process: entire section updated
- The following DCRs have been incorporated:

DCR# 0000116240

DCR# 0000120901

DCR# 0000122318

DCR# 0000123330

DCR# 0000124055

DCR# 0000127902

CHANGE



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## **PURCHASED SERVICES AGREEMENT OPERATING INSTRUCTION**

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**PURCHASED SERVICES AGREEMENT OPERATING INSTRUCTION**

**Revision Summary**

Revision Number	Date	Comments
R001	2014-06-03	Added Management Working Committee to Sections 1.4.2, 1.4.3, 1.5.1, 1.6.5, 1.6.6, & 1.6.7. Added reference to CPAA in Section 1.5.1. Added Management Nuclear SPOC to Section 1.6.4 & 1.6.5. Added bullet re work less than 250 hours annually to Section 1.9.1. Added local dispute resolution to Section 1.9.8, 1.10.1 (b)

## Instruction

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### 1.0 DIRECTION

This instruction provides a joint approach to making good business decisions regarding the use of Purchased Services.

It reinforces the principles and processes for deciding how work gets done, but is not intended to hinder getting work done.

In order to complete discussions and any necessary dispute resolution process prior to work commencing, it is essential that initiators start the Purchased Services Agreement (PSA) process immediately upon recognizing an external contract may be required.

If differences arise between this instruction and the OPGN PWU/Management PSA Operational Plan, May 2004, the Operational Plan shall prevail.

### 1.1 Background

Article 12, item 12.4.1, Purchased Services Agreement, of the PWU Collective Agreement (CA) requires Management and the PWU to maintain a working Operating Plan

### 1.2 Philosophy

1.2.1 It is OPGN's intent to use regular staff to perform most work of a continuing nature.

1.2.2 OPGN shall strive to provide regular staff with continuous employment.

1.2.3 All parties agree that a consistent, managed, and joint approach to assignment of work within the Company is necessary to provide security for employees, a more effective, productive organization, and an excellent product for the customer.

### 1.3 Principles

With respect to work performed by PWU members, OPGN shall be guided by the following principles. OPGN shall:

- Conduct all work as effectively as possible.
- Measure effectiveness of all work by its impact on staff, business, and ultimate impact on customers.
- Perform most work of a continuing nature with Company employees.
- Determine when work is to be done by a non-PWU member through a joint decision making process, with both parties assuming joint responsibility for these decisions.
- Ensure that the impact of such decisions on continuous employment is minimized.



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- If possible, use a team and consensus approach when making decisions and resolving any issues that arise internally.
- Consult and make timely decisions consistent with the need to get work done.
- Develop, implement, and continue a joint process of communications and education.
- Strive for consistency through use of these principles versus policy and procedure.

**1.4 Decision Makers**

1.4.1 It is recommended that Decision-Makers for PSA discussions should be as follows:

- PWU PSA Single Point of Contact (SPOC) as designated by PWU executive.
- Management PSA SPOC as designated by Management.

1.4.2 The Management Working Committee shall make decisions regarding the following:

- A Work Package controlled by a Site, Head Office department or division, and affecting **only** that particular Site
- A Work Package controlled by a Work Unit affecting another Work Unit in Ontario Power Generation Nuclear (OPGN).

1.4.3 The local Site SPOC shall present the Management Working Committee's decision to the PWU site SPOC.

1.4.4 Persons identified as SPOCs shall be given appropriate decision-making authority by OPGN and the PWU executive, as applicable, and shall be responsible for following the decision-making process.

1.4.5 It is recognized that a given decision may require involvement of more than these two individuals.

**1.5 Work Jurisdiction Issues**

1.5.1 Prior to entering into PSA discussions, work assignments shall be made following the Chestnut Park Accord (CPAA) process.

**Note:** All CPAA requests shall follow the Management Working Committee review process.

1.5.2 Jurisdictional disputes between the PWU, Society, Building Trade Unions, or non-represented employees are **not** fit matter for PSA discussions, and shall **not** be dealt with under provisions of Article 12.

1.5.3 A PSA is required for any work assigned to the PWU for which OPGN is contemplating utilizing non-PWU represented personnel or non-OPGN personnel to perform the work in question.

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**1.6 Decision Making Process**

- 1.6.1 Management and the PWU shall notify each party, in writing, which PSA contacts have appropriate decision making and signing authority.
- 1.6.2 N-FORM-11245, Purchased Service Agreement Request, shall be used to initiate the PSA process.
- 1.6.3 Responsibility for initiating the PSA process for a particular Work Package shall rest with Initiator/Project Manager for the controlling Work Unit, or the unit accountable for completing work.
- 1.6.4 The initiator shall route completed PSA request forms to the Management Nuclear SPOC.
- 1.6.5 The Management Nuclear SPOC shall perform the following:
- (a) Present the PSA request to the Working Committee, which shall review the details and assign a threshold classification.
  - (b) Following Working Committee review, forward the document to the Site SPOC for presentation to the PWU.
- Note:** A site specific number is assigned to the document prior to presentation to the PWU.
- 1.6.6 In determining information requirements, the Working Committee should take into consideration the effort required to collect this information, relative to the size of the job and CA requirements.
- 1.6.7 Based on resource requirements identified in a PSA request, the Working Committee shall assess availability of qualified internal resources, taking into consideration station or site work program priorities. Availability of internal resources shall include those:
- Within the work unit
  - In other units within the location
  - Other sources identified by the parties.
- 1.6.8 In order to optimize the review process, a joint review of the Work Program should be undertaken early in the year and at appropriate levels, using the budget and/or business plan as an information source. This would allow Purchased Services joint decisions to be made in a timely manner.
- Note:** It is expected that most decisions would be made at that time, including contracts of a recurring nature.
- 1.6.9 For work not known or defined at the budget stage but identified later in the year, the PSA process shall be initiated as early as possible.

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**1.7 Joint Decisions**

- 1.7.1 If Site Decision-Makers reach a consensus decision regarding preferred alternative(s), the decision is documented on the PSA form and work proceeds accordingly.
- 1.7.2 Site Decision-Makers shall communicate their decisions to the Management SPOC.
- 1.7.3 If parties are unable to reach a consensus decision, the issue shall be referred to the dispute resolution process after the local resolution process has been exhausted.

**1.8 Establishment of Threshold**

- 1.8.1 Establishment of Threshold is designed to remove from the process, on a case by case basis, certain issues relating to Purchased Services. The Threshold shall operate in such a way as to allow flexibility in local decision making. Any decisions regarding what is below Threshold shall be non-precedent setting.
- 1.8.2 If there is a dispute with the PWU on whether the threshold permits a proposed Purchased Service, and there is no consensus, and, if it is reasonable in the circumstances, parties shall strive to resolve this dispute before the Purchased Service occurs.
- 1.8.3 Failure to obtain a resolution in advance shall not preclude work from being performed, nor shall it preclude the matter from being resolved under Article 12.2.7, Dispute Resolution Process.

**1.9 Below Threshold Discussions**

- 1.9.1 Below Thresholds include the following:
- Subject matter lacking in substance.
  - Consequences which are relatively insignificant.
  - Where the nature or consequences of the work which represents a Purchased Service is remote from work currently performed by the PWU on a continual basis. For purposes of clarity, this does not mean geographically remote.
  - Emergencies.
  - Any work performed under a manufacturer's warranty, except where the manufacturer authorizes the company to do the work.
  - Work being done for OPG by Hydro One, AMEC, NSS, Kinetricks, and NHSS at the point each company is spun off from OPG and the work of the same nature done by these companies in the future, so long as the union continues to represent the employees of these companies.
  - Where a distinct work program or work package at a worksite identified in the PSA request(s) is 250 hours or less annually.

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- 1.9.2 If Management requires a contractor or Purchased Service to perform certain work, and if that work falls under one or more of these thresholds, then the Working Committee will assign a below threshold classification to the PSA request and notify the Site SPOC.
- 1.9.3 The Site SPOC shall notify the appropriate PWU SPOC of the proposed Purchased Service, and provide them with specific information with regard to Purchased Service.
- 1.9.4 After receiving information, the PWU has three working days to request further discussion in an effort to come to an agreement that the work is in fact below threshold.
- 1.9.5 If the PWU does not request further discussion within three days then Purchased Service shall be deemed to be below threshold.
- 1.9.6 If discussions are requested, the Site SPOC shall arrange a meeting within three working days of a request for discussion.  
**Note:** Failure of Site SPOC to provide the required information, as set out in notice form shall indicate work is automatically deemed to be above threshold.
- 1.9.7 Discussions should focus on whether or not the work in question falls under one or more thresholds, and therefore does not require a signed PSA to proceed.
- 1.9.8 If no agreement on threshold can be reached, Management shall proceed to contract the work. After all Local Dispute Resolution options have been exhausted, the PWU has the right to grieve. All parties shall strive to reach an agreement prior to letting the contract.
- 1.9.9 In case of emergency, decisions to use Purchased Services shall be subject to the same information requirements, review, and dispute resolution as non-emergency cases, but management may contract the work immediately.
- 1.9.10 The arbitrator has indicated Management is required to present a written business case to the PWU. This does not have to be an in-depth business case for below threshold matters, but the arbitrator would like to ensure that contracting out makes business sense and that any cost estimates or comparisons are accurate.
- 1.9.11 Grievances shall be referred to the arbitrator, (in accordance with Article 12 of the OPGN/PWU collective agreement), who shall act with full remedial powers. The PWU usually drives this grievance process.
- 1.9.12 As stated above, discussions shall take place within three working days of the PWU request.
- 1.9.13 When the work has been completed, and if requested, the PWU shall be provided with details of the final contract cost. Refer to Appendix A, Process for Below Threshold Flowchart.

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**Note:** For above threshold Purchased Services, refer to Appendix B, Above Threshold Process.

### 1.10 Below Threshold Dispute/Grievances

1.10.1 Processing threshold grievances shall be used by both parties, in accordance with Article 12 of the OPGN/PWU CA. The process is as follows:

- (c) The required joint discussions shall take place to decide whether the work in question falls under one or more threshold.
- (d) If no agreement can be reached, Management may proceed to contract the work, and the PWU has the right to grieve. Or, both parties may agree to refer the matter for Local Dispute Resolution. If unsuccessful the matter may be referred to arbitration.

**Note:** Damages are more likely if work is contracted before the dispute is resolved.

- (e) Threshold grievances shall be prepared by the PWU PSA SPOC, as designated by the PWU individual responsible for PSAs, and presented to the Site Management PSA SPOC.
- (f) Within 48 hours, Management shall respond to the grievance, in writing, stating its position.
- (g) Both parties shall endeavour to complete a Record of Discussion form, or an agreed upon Statement of Facts sheet.

**Note:** Arbitrator (in accordance with Article 12 of the OPGN/PWU CA) has already ruled that a response such as “no violation of CA” shall not be sufficient.

- (h) The PWU office shall assign a grievance number.
- (i) The Site Management PSA SPOC shall forward copies of the completed grievance forms and associated Fact Sheets or Record of Discussion forms to the PWU office and Corporate Labour Relations.
- (j) Grievances shall be referred to arbitration and scheduled through joint agreement between Corporate Labour Relations and the PWU.
- (k) If required, local discussions shall take place with a view to resolving a threshold grievance up to the arbitration date.

### 1.11 Above Threshold Purchased Service Agreement discussions.

1.11.1 Above threshold Purchased Services will not commence until they have been agreed to by the PWU. Failure to have joint agreement means that Purchased Services shall not proceed until the Joint Resolution Committee (JRC) resolves the dispute.

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(Reference: OPGN PWU/Management PSA Operational Plan, Section 7.0).

**1.12 Evaluating Alternatives**

**1.12.1 Parties shall consider such alternatives as:**

- Doing work internally.
- Doing part of the work internally and part externally.
- Doing work externally and agree to acquire capability to do work internally in future.
- Doing work externally.

**1.12.2 When evaluating alternatives, parties shall consider the impact on the customer, employees, and business, using the following criteria:**

- Reliability of service to customer
- Customer responsiveness
- Community impact
- Company relations' impact
- Job continuity
- Ability to perform work
- Amount of overtime required for work
- Availability of resources
- Cost
- Timeliness
- Quality
- Need for control over results
- Safety
- Impact on environment.

**1.12.3 In order to evaluate a proposed Purchased Service against above criteria, both parties require sufficient information to have a meaningful discussion. Such items as scope of work, budget, and resource requirements, including skills, equipment requirements, facilities, supervision, and overtime are all areas that may be discussed.**

**1.12.4 It is important that Management 'package' work appropriately. Management should be prepared to share this information with the PWU.**

**1.12.5 Prior to a meeting of the JRC, Management shall provide the following:**

- Copies of tender or request for proposal documents, if any.
- An accurate description of the work which is subject of the proposed PSA.
- Accurate details on bids, price, and scope of the work, as set forth in the bid.
- A full cost-benefit analysis, including incremental costs, but excluding overhead costs that may be incurred.

**1.12.6 If Management wishes to proceed with a PSA and cannot get local agreement, they shall complete the required information listed above and send to the PWU. This**

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information is designed to be used as Management's business case for above threshold PSA's.

- 1.12.7 Parties shall endeavour to complete discussions within 10 days of the PWU receiving the business case, and if no agreement can be reached the matter shall be forwarded to internal local dispute mechanism.

**1.13 Purchased Services Agreement Joint Resolution Committee**

- 1.13.1 If parties cannot come to a local decision on a Purchased Service, Management shall have the right to refer the matter to the JRC.
- 1.13.2 In accordance with Article 12 of the OPGN/PWU CA, the JRC consists of one Management representative, one PWU representative, and the Arbitrator, who shall act as chairperson, plus additional resources, if required.
- 1.13.3 The JRC shall resolve disagreements on proposed above threshold Purchased Services on a consensus basis and in an expeditious manner, within 30 days of notice to PWU.
- 1.13.4 The Chairperson shall:
- (a) In the event that the parties are unable to resolve the issue by consensus decision, render a decision.
  - (b) Issue such orders as appropriate to give full effect to such decisions, and address any consequences the decisions may have in the workplace.
- 1.13.5 If formal bids have been received for a proposed PSA, management shall provide the PWU and, if necessary, members of the JRC, with details of the price and scope of the work bid.

**1.14 Contracts of a Recurring Nature**

- 1.14.1 There are Work Packages that are carried out on a regular basis for which PSA decisions for each contract would not be practical. For most of these contract types, an annual review is sufficient, unless documented reasons for the initial decision to contract changes significantly.
- 1.14.2 Parties should strive to identify these types of contracts so that they can be dealt with efficiently.

**1.15 Contracts Not Subject to In-Depth Review**

Normally, types of contracts not subject to in-depth reviews shall be those identified as below threshold.

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**1.16 Time Frame for Decision Making**

- 1.16.1 The fundamental principle of the PSA review process is that it shall not hinder getting work done. Enough time shall be left between the proposed start of job and the target date for the PSA process to take place.
- 1.16.2 Unless extenuating circumstances dictate otherwise, the Initiator of the PSA process for a particular Work Package shall establish a target date for reaching a PSA decision, taking into account such factors as work schedule, size of job, potential impact on staff, and number of affected Work Units.
- 1.16.3 When a target date has been agreed to, Decision-Makers shall make every effort to meet that target date. If no agreement is reached by the target date, the issue shall be automatically scheduled for dispute resolution, even if discussions continue locally.

**1.17 Joint Training of Decision Makers**

- 1.17.1 All PSA Decision-Makers shall receive joint training on the PSA process, and the PSA operating procedure, including the Teplitsky video created for this purpose.
- 1.17.2 Signatories of this document shall ensure development and delivery of joint training for Decision Makers.

**2.0 DEFINITIONS AND ACRONYMS**

**2.1 Definitions**

None

**2.2 Abbreviations and Acronyms**

<b>CA</b>	Collective Agreement
<b>CPAA</b>	Chestnut Park Accord Addendum
<b>JRC</b>	Joint Resolution Committee
<b>OPGN</b>	Ontario Power Generation Nuclear
<b>PSA</b>	Purchased Services Agreement
<b>PWU</b>	Power Workers Union
<b>SPOC</b>	Single Point of Contact

**3.0 RECORDS AND REFERENCES**

**3.1 Records**

- 3.1.1 The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.



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### **PURCHASED SERVICES AGREEMENT OPERATING INSTRUCTION**

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (PassPORT Type/Sub-Type)
Purchased Service Agreement (PSA) Request	N-FORM-11245	N	Retained by department

## 3.2 References

### 3.2.1 Performance References

N-FORM-11245, Purchased Service Agreement Request

### 3.2.2 Developmental References

Collective Agreement between OPG and PWU

OPGN PWU/Management PSA Operational Plan, May 4, 2004

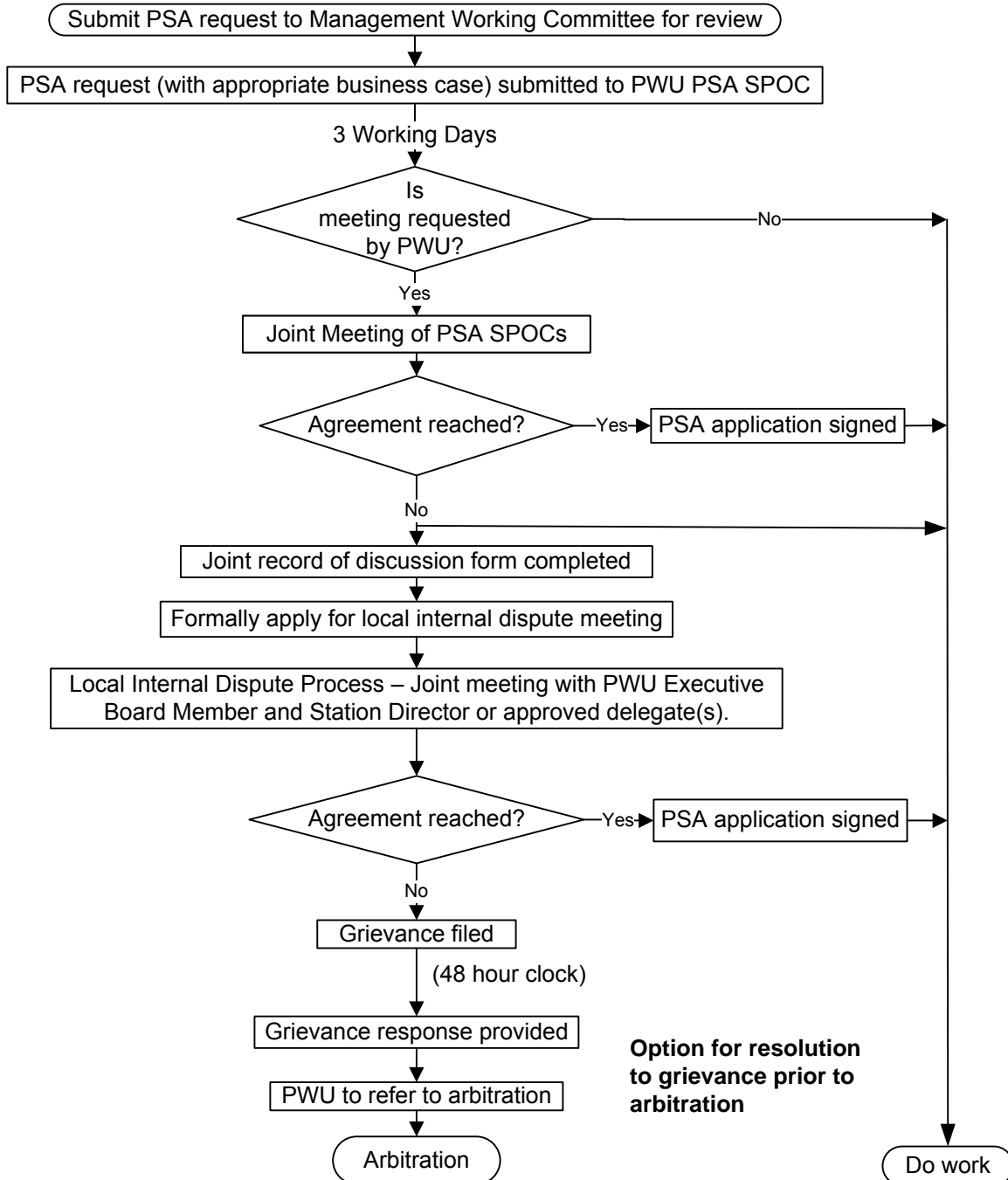
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## PURCHASED SERVICES AGREEMENT OPERATING INSTRUCTION

### Appendix A: PSA – Below Threshold Process



**Notes:** - Timelines adjustment subject to change with joint agreement.  
- Both parties may bring resources as required for discussions.

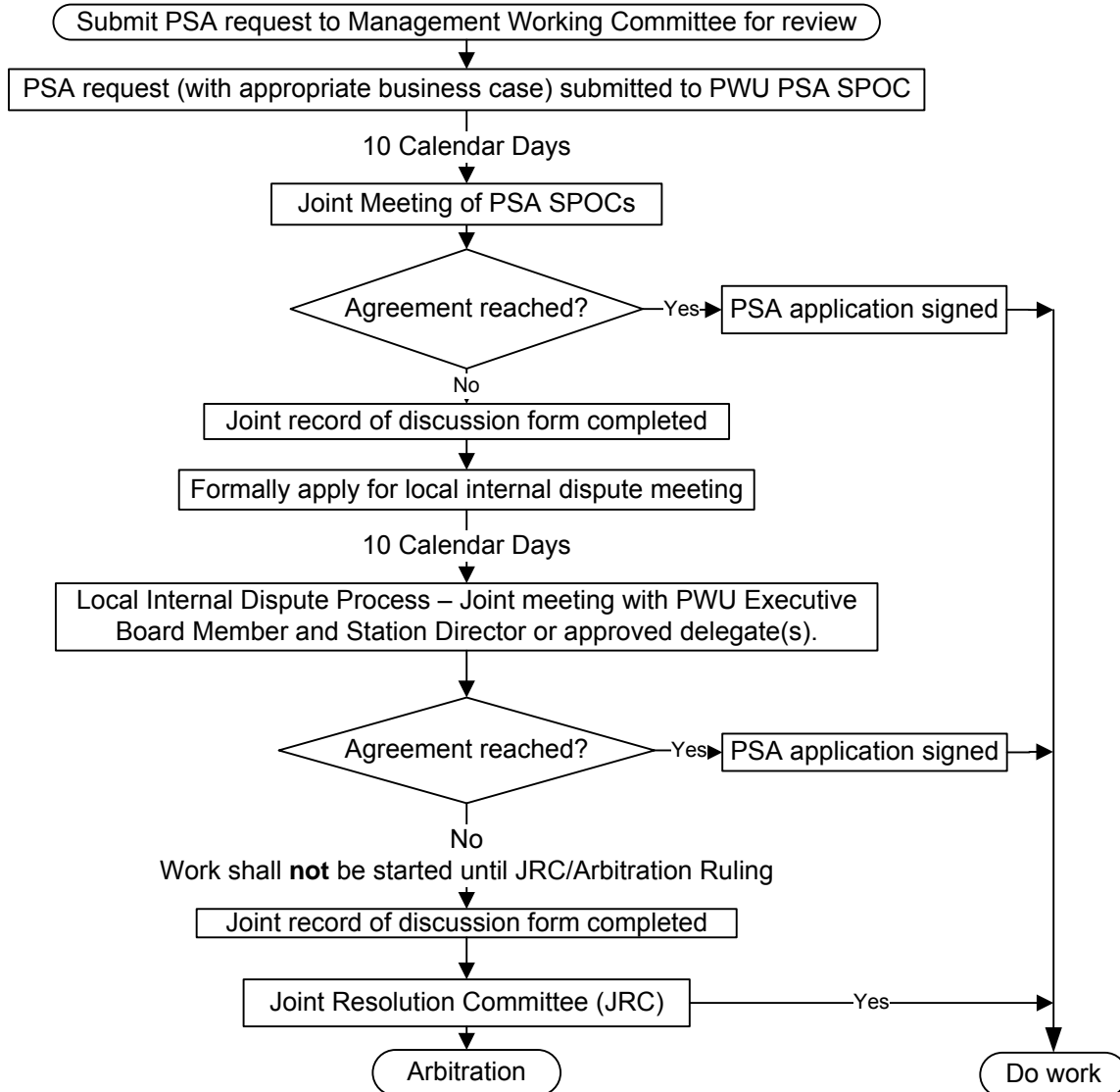
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## PURCHASED SERVICES AGREEMENT OPERATING INSTRUCTION

### Appendix B: PSA – Above Threshold Process



- Notes:**
- Arbitration should occur within 30 days (calendar) of application to PWU.
  - Timelines adjustment subject to change with joint agreement.
  - Both parties may bring resources as required for discussions.



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# Ontario Power Generation Standard

<b>TITLE</b>
<b>REQUIREMENTS FOR ADMINISTRATIVE GOVERNANCE DOCUMENTS</b>

<b>AUTHORIZATION</b>
<p>SINGLE POINT OF CONTACT: Richard Collyer Section Head, Governance and Services</p> <p>DOCUMENT OWNER: Shelley Tucker Senior Manager Information Management Program Authority</p>

DOCUMENT RELATIONSHIP	
Applicability:	OPG Wide
Receives Authority from:	OPG-PROG-0001, Information Management

Document is Related to Pressure Boundary <input checked="" type="checkbox"/>	Document Requires CNSC Notification <input type="checkbox"/>
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<b>PURPOSE AND SCOPE</b>
<p>This standard provides the following:</p> <ul style="list-style-type: none"> <li>• Description of OPG's Framework for Governing Documents (The Framework).</li> <li>• Criteria for selecting the correct document type for a particular use.</li> <li>• Standard format for Governance documents.</li> </ul>

<b>DATES (YYYY-MM-DD)</b>	
PDF Creation Date:	2016-06-29
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### REQUIREMENTS FOR ADMINISTRATIVE GOVERNANCE DOCUMENTS

#### EXCEPTIONS

Emergency Preparedness and Response Plans (EPRP) should use OPG-TMP-0001, OPG Governance Document, but may follow other requirements in accordance with N-STD-AS-0014, Requirements for Technical Procedures.

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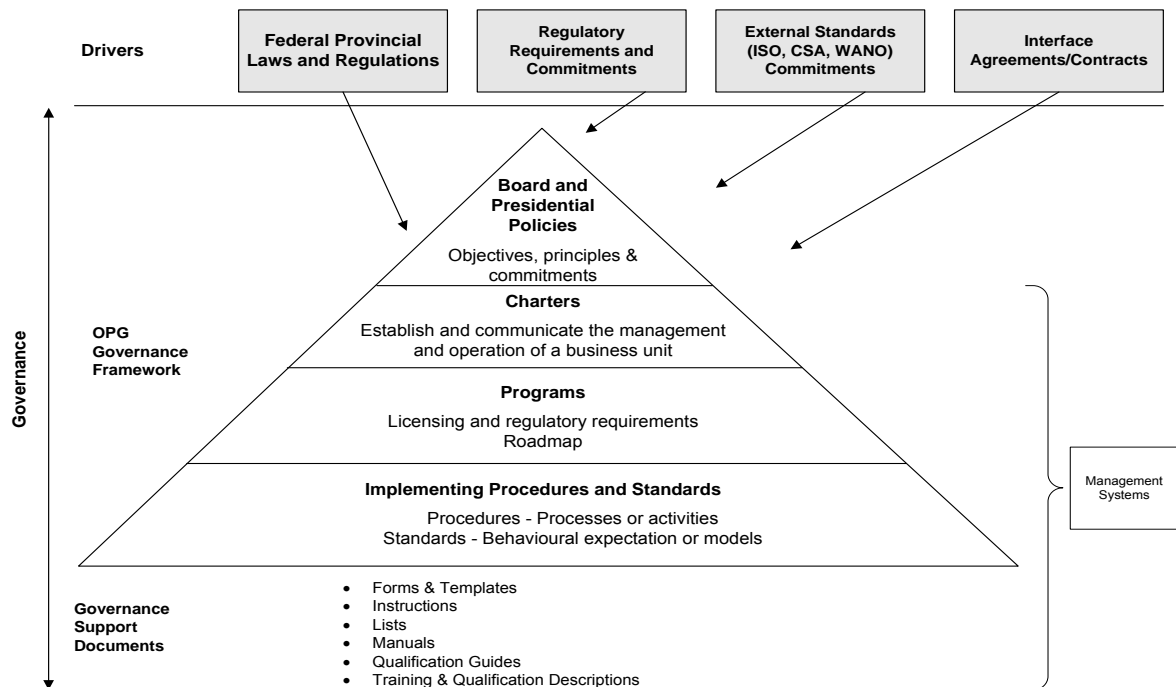
## 1.0 REQUIREMENTS

OPG's Integrated Framework describes how the company's governance and management systems interact to guide the operation of OPG.

Administrative Governance documents are documents that support and satisfy:

- Best business practices
- OPG's mission statement
- Code of Ethics
- Legal, regulatory, licensing, and quality assurance (QA) obligations and commitments
- Hierarchical authority; and
- Administrative levels associated with safe and ethical conduct of a successful business.

Figure 1, Ontario Power Generation Governance Framework Relationships, demonstrates the relationship amongst OPG's drivers, The Framework, and Governance support documents required to provide OPG with a compliant, consistent, and cost-effective control of its business.



**Figure 1: Ontario Power Generation Governance Framework Relationships**

Where appropriate, each Line of Business (LOB) should define governance that meets the minimum requirements of their business and obligations.



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### REQUIREMENTS FOR ADMINISTRATIVE GOVERNANCE DOCUMENTS

In general, Governing documents:

- Stipulate philosophy, mandatory rules, regulations, and management controls.
- Contain only objectives, requirements, or processes required to comply with legal, regulatory, and licensing requirements.
- Contain commitments to external standards.
- Are appropriate where there is risk of unacceptable economic impact.
- Are appropriate if endangerment of personnel, public, environment, or damage to plant equipment is possible.
- Shall consider the impact on people with disabilities. Refer to OPG-STD-0074, Accessibility for Ontarians with Disabilities Act Integrated Accessibility and Customer Service Standard.

#### 1.1 Ontario Power Generation Governance Framework

The Framework is a webpage showing Governance documents in a hierarchical manner alongside all other Governance documents in the same LOB or business program area.

#### 1.2 Lean Principles

Proposed Governance changes driven by new requirements need to be rigorously reviewed against the source of the requirement, with an evaluation of the change to improve performance, increase efficiency, and lower costs. The bias should be against creating new Governance.

The following principles apply:

- (a) **Mandated** – There is a legal, regulatory, or high-level Corporate goal requiring the Governance which, if not documented, would represent an unacceptable risk to the company.
- (b) **Unique** – The Governance addresses a unique purpose. No other Governance exists that covers the proposed process or program.
- (c) **Material** – There is substantial benefit and value added by implementing the Governance, considering the cost of implementing and maintaining the processes associated with the document.

#### 1.3 Usage

##### 1.3.1 Classification

- (a) Usage Classification designates the applicable requirements for Governance use during an activity. It denotes the frequency or degree of reference by the user versus the dependence on the user's memory and recall.

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(b) Any document that contains Nuclear bases shall comply with N-STD-AS-0002, Procedure Use and Adherence.

(c) Levels of use from higher to lower are Continuous, Reference, and Information.

**Note:** Typically, administrative Governance documents are Information. For documents in a legacy format, if no usage classification has been designated, assume usage classification to be Information.

#### 1.3.2 Shall, Should, and May

Evaluate use of the following verbs to indicate an obligation to carry out an action. Use of the words **shall**, **should**, and **may**, shall be interpreted as follows:

- (a) Actions or steps associated with the word **shall** are mandatory and strict compliance is required with the step as written. Deviations are permitted only by formal prior Governance revision and authorization. Actions or steps associated with the word **shall** are used in Governance to denote activities where failure to execute would result in a violation of a code, standard, licence or legal requirement or where, in the Program Owner's judgment, similar significant negative consequences would result.
- (b) Actions or steps associated with the word **should** are recommended or preferred management expectations or actions. The Band G Manager directing the task has approval to authorize occasional and rare deviations from the directions contained in the Governance. However, such deviations shall:
  - (1) Not violate the intent of the Governance.
  - (2) Not become a common or usual pattern of behaviour.
- (c) Actions or steps associated with the word **may** provide the end user with the option, on his/her own authority, to differ from the directions contained in the associated step(s). This provides the end user with flexibility, while intelligently meeting the purpose and intent of the step.

#### 1.4 Document Types

Governing documents consist of the following types:

- Policy
- Charter
- Program
- Procedure
- Standard.

Governance support documents may include the following types:

- Form
- Instruction
- List
- Manual

## Ontario Power Generation Standard

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### REQUIREMENTS FOR ADMINISTRATIVE GOVERNANCE DOCUMENTS

- Qualification Guide
- Template
- Training and Qualification Description.

OPG-GUID-08130-0001, Writing Guide for Administrative Governance Documents, provides recommendations for creating or revising Governance documents.

#### 1.4.1 Policies

Highest level of governing documents, used by the President or Board of Directors, to define high-level objectives, principles, or commitments for the conduct of OPG's business. Policies define the powers, rights, and privileges which may be exercised by OPG and its officers.

#### 1.4.2 Charters

Establish and communicate the management and operation of a business unit. In Nuclear, the Charter and its associated Programs and lower-level governance form the Nuclear Management System. In non-Nuclear, Charters may be used to implement OPG-POL-0033, OPG Business Model.

#### 1.4.3 Programs

- Intermediate-level Governing documents that take authority from a Policy or Charter.
- Articulate how business objectives, requirements (licensing, legal, regulatory, QA), and commitments are fulfilled.
- Program activities are implemented by Procedures, Standards, and Governance support documents.

#### 1.4.4 Procedures and Standards

- Lower-level Governing documents that take authority from a Program or Policy.
- Peer-level documents and do **not** take authority from each other.
- May exist at either an OPG or LOB level for a given process or implementation requirement, but **not** both.
- A Standard should **not** define technical, design, or training requirements. These are defined in design basis documents or training documents.

#### 1.4.5 Governance Support Documents

- Provide detailed instructions, criteria, or requirements for tasks or activities **mandated** by a Governance document.
- Satisfy an internal commitment.
- Typically take authority from a Procedure or Standard.

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#### 1.5 Revision Types and Criteria

##### 1.5.1 New

Creation of a new document.

##### 1.5.2 Intent Revision

Non-urgent change to a Governance document that modifies, deletes, or adds actions, roles, purpose, or conditions.

##### 1.5.3 Minor Revision

- (a) An urgent intent change required in less than 5 business days when adherence with existing process is not possible.
- (b) May be used to initiate a pilot process.
- (c) Shall not be processed on documents listed in N-LIST-00531-10002, OPG Documents Referenced in Licence Conditions Handbook, without prior approval from Manager, Nuclear Regulatory Affairs.
- (d) Should not be used for forms or templates due to the requirement to show tracked changes.

##### 1.5.4 Non-Intent Revision

A change to a Governance document that does **not** modify, delete, or add actions, roles, purpose, or conditions, e.g., typographical errors, obvious incorrect sequence of steps, added or removed statements for clarification, compliance date changes, renumbering with no other intent changes.

#### 1.6 Document Section Requirements

- (a) All sections of OPG-TMP-0001 are **mandatory**, however if there are no requirements for a section, state "None".
- (b) Requirements outlined in this section are for Programs, Procedures, Standards, and Governance support documents. If writing a Charter or Policy document, consult Senior Manager, Information Management Program Authority.

##### 1.6.1 Authorization

This section appears on the cover sheet. Refer to Governance Ownership list on the Governance website for correct position holders.

##### 1.6.2 Document Relationship

This section appears on the cover sheet.

- (a) Identify document applicability (e.g., OPG Wide, All of Nuclear, Supply Chain).

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- (b) Identify document number and title from which the document receives direct authority. The “parent” document is required to direct use of “child” document and to build the framework structure.

#### 1.6.3 Document is Related to Pressure Boundary Checkbox

This section appears on the cover sheet.

Pressure Boundary related governing documents are those that support the implementation of the Pressure Boundary QA program as documented in N-MAN-01913.11-10000, Pressure Boundary Program Manual. Refer to N-LIST-01913.11-10001, Nuclear Pressure Boundary Governing Documents. If a document is included in this list, select the “Document is Related to Pressure Boundary” checkbox.

#### 1.6.4 Document Requires CNSC Notification Checkbox

This section appears on the cover sheet.

Documents listed in N-LIST-00531-10002 require Canadian Nuclear Safety Commission (CNSC) written notification or acceptance. If a document requires CNSC notification, select the “Document Requires CNSC Notification” checkbox.

#### 1.6.5 Purpose or Purpose and Scope

This section appears on the cover sheet of the Governance document and requires text input.

- (a) Provide a clear and brief description of the fundamental intent or focus of the document.
- (b) Limit rationale, background, or process details.
- (c) Include any external requirement references (associated Program document bases) that the document supports.

#### 1.6.6 Dates

This section appears on the cover sheet.

- (a) The PDF Creation Date updates automatically to always show as “today’s” date. When the final PDF is prepared for approval, the PDF will show the date the PDF was created.
- (b) Compliance date should match compliance indicated on OPG-FORM-0001, Governance Management Record, Section C and should be assigned as follows:
- Immediate

**Note:** Compliance date for forms is always “Immediate”.

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- Immediate (See Exceptions)

If “Immediate (See Exceptions)”, the exceptions should clearly indicate exceptions to immediate compliance (e.g., Compliance with Section X is not required until YYYY-MM-DD. Compliance at Darlington is not required until YYYY-MM-DD).

- Future Date (See Exceptions)

If “Future Date (See Exceptions)” is used, the exceptions box should state “Previous revision (R0XX) should be used until the Compliance date of YYYY-MM-DD”.

#### 1.6.7 Exceptions

This section appears on the cover sheet.

- (a) If there are no exceptions, state “None”.
- (b) Identify exceptions or specific circumstances in which the document or parts of it do not apply.
- (c) If there are specific functional areas, processes, or organizational units that would normally fall under the scope of the document, but are purposely excluded, identify and provide the rationale for such exceptions.
- (d) If there are specific circumstances, periods of time, or conditions under which all or parts of the document do not apply, give specifics.

#### 1.6.8 Relevance to Nuclear Safety Policy

This section is optional and if selected, appears on the cover sheet and requires a simple statement.

Include N-POL-0001, Nuclear Safety Policy, requirements to which the relevant Governance is most closely aligned.

#### 1.6.9 Table of Contents

- (a) If a document is greater than 12 pages or contains appendices, a Table of Contents (TOC) is required.
- (b) If included in a document, TOC should appear on its own page. Font size may be reduced to conserve space.
- (c) TOC should be refreshed after all revisions are made to the document.

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#### 1.6.10 Direction or Process or Requirements

This section is the most important section of a Governance document and is **mandatory**. Content requirements vary according to the specific Governance type. Consult the requirements listed below for the most common Governance document types.

##### 1.6.10.1 Programs

Programs are “roadmap” documents that convey how implementing and support documents are integrated to form a managed system that meets specific program requirements.

- (a) Section 1.0 should be titled either Direction or Requirements.
- (b) Define compliance to external requirements. These are licensing, legal, regulatory, and QA requirements and principles. These requirements are called ‘Bases’ and should be noted and listed as follows:
  - (1) If entire Program implements a basis requirement, identify basis requirement in Purpose or Purpose and Scope Section of document.
  - (2) In the Program document text, identify each basis requirement as shown in example below.
 

**Example:** Any work activity that affects reactor regulation or fuel cooling shall be governed by an approved procedure. **[B-1]**
  - (3) If multiple bases apply to a statement, enclose each basis number in separate brackets.
 

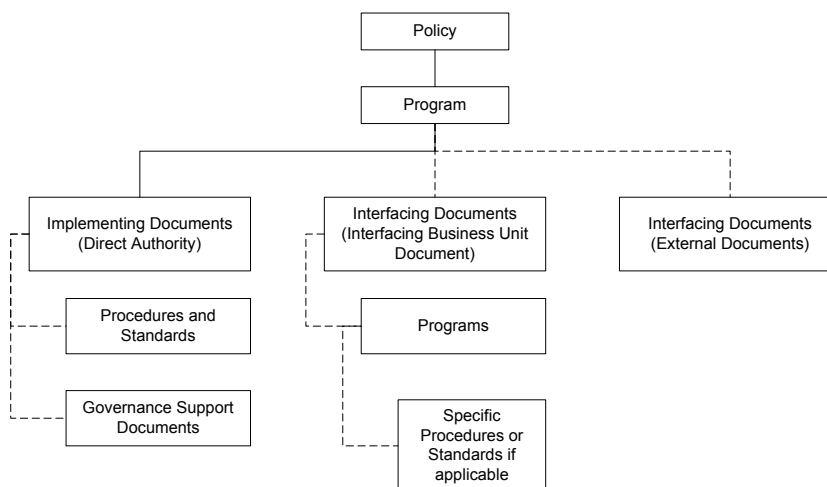
**Example:** Any work activity that affects reactor regulation or fuel cooling shall be governed by an approved procedure. **[B-1] [B-2] [B-3]**
  - (4) List bases documents in Section 4.1, Bases, of the document.
- (c) Include a figure illustrating the entire program scope to at least the level of Procedure and Standard, including implementing and interfacing documents. Refer to Figure 2, Program Model, as an example.
  - (1) Implementing documents should include documentation that provides implementing details for requirements, activities, and processes described by the Program.
  - (2) Interfacing documents should include documentation that interfaces or interacts with the Program to fulfill requirements or commitments.
  - (3) If the figure is large, it may be included as an appendix.

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**Figure 2: Program Model**

- (d) Specify the performance indicators or monitoring activities that are necessary to ensure overall Program requirements are met.

#### 1.6.10.2 Procedures and Standards

Title Section 1.0 as either Direction or Process (Procedure) or Direction or Requirements (Standard), and include a **brief** overview of the process or requirement to serve as an introduction.

- (a) A Procedure establishes:

- **Who** has to do it.
- **What** has to be done.
- **When** it is required.
- **Where** it is required.
- **How** it is done.

**Note:** If the level of detail on the “how” is complex, consider the creation of an Instruction (Governance support document) to further detail the activities or tasks required by staff.

- (b) A Standard:

- (1) Defines behavioural expectations or criteria requirements used to control business activities.
- (2) Prescribes specific criteria common to a class of outputs.



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#### 1.6.11 Roles and Accountabilities

- (a) Identify and provide a high-level summary of accountabilities for Manager level (Band G) or higher position holders or roles concerning the accomplishment of activities related to the implementation of the document.
- (b) If accountability is shared by multiple positions, use whatever term is encompassing (e.g., Line Management).
- (c) Use positions outside the functional area covered by the document only as necessary to define boundary accountabilities.
- (d) If required, include definition or description of a role as an introduction to this section.
- (e) Do **not**:
  - (1) Duplicate actions, activities, or tasks already covered by Section 1.0 of the document.
  - (2) Use personal names.

**Note:** Governance support documents should not specify accountabilities or responsibilities.

#### 1.6.12 Definitions

- (a) If there are no definitions, state "None".
- (b) Define only those terms that are unfamiliar to the user. If a term is understandable within the context of the statement in which it appears, do not define it.
- (c) Do **not** define:
  - (1) Generic terms if the dictionary definition conveys the meaning of a term.
  - (2) Terms commonly used within the applicable business area.
  - (3) Criteria, process steps, or activities already in the body of the document. Examples may be included.

#### 1.6.13 Abbreviations and Acronyms

Some abbreviations and acronyms are more widely known than the spelled out versions. Use of abbreviations and acronyms should be for the benefit of the reader, however there should not be so many acronyms that the document becomes unreadable.

- (a) If there are no Abbreviations and Acronyms, state "None".
- (b) If there are abbreviations and acronyms, list in the Abbreviations and Acronyms section at a minimum.
- (c) Do not add commonly known terms to the abbreviations and acronyms list, e.g., OPG.

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#### 1.6.14 Bases, Records, and References

##### 1.6.14.1 Bases

- (a) For program documents, this subsection is **mandatory**.
- (b) For procedures and standards, if no bases, state “None”.
- (c) Bases are a listing of licensing, regulatory, and legal requirements and external commitments such as International Organization for Standardization (ISO), World Association of Nuclear Operators (WANO), Canadian Standards Association (CSA), etc. Could also be industry guidelines and standards of excellence (e.g., INPO or WANO) and requirements of codes and standards.
- (d) Many records must be retained by the Corporation in order to satisfy the requirements of federal and provincial statutes and regulations. The following are a few examples of statutes and regulations that require records to be kept:
  - Nuclear Safety and Control Act
  - Ontario Business Corporations Act
  - Ontario Corporations Act
  - Federal Income Tax Act
  - Limitations Act and Canada and Ontario Evidence Acts
  - Ontario Power Generation Administrative Requirements.
- (e) For each basis requirement, identify specific clauses or sections of the basis requirement so that it is clear which is being addressed by the Program document.

**Note:** Basis coverage may be detailed in an associated document.

##### 1.6.14.2 Records

- (a) If no records are produced, sentence and table may be removed and state “None.”
- (b) Complete the Records Table provided as part of the template. State what outputs in the form of records are generated from the process and how, where, and for how long they are retained. Refer to Figure 3, Records Table, for required information.

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Record Created	Associated Form or Template Number	QA Record? Y/N	Filing Information/Retention (AIMS Type/Sub-Type)
<i>Name of Record Being Created</i>	<i>Form or Template used to record the record</i>	<i>QA Record? In accordance with OPG-PROC-0179</i>	<i>WHERE INDEXED/FILED? e.g., Indexed in AIMS. HOW IDENTIFIED? Document Number e.g., Facility- Doc Type/Sub Type – SCI – 7 or 5 digit Sequence No. RETENTION? Records Retention Code (RRC) in accordance with the Corporate Records Retention Schedule (CRRS), (this may be blank if in progress, or for stand-alone records, provide a recommended retention period). E.g., ADM-0012</i>

Figure 3: Records Table

- (c) Refer to OPG-PROC-0019, Records and Document Management, and, for Nuclear, OPG-PROC-0179, Nuclear Quality Assurance Records, for further information and guidance.
- (d) For Forms:
  - (1) Ensure the Records File Information in the header has only 3 generic statements and remove any other wording.
  - (2) Provide direction as to where or what to do with the Forms once completed.
  - (3) The SCI/GSI/USI line is only required if the Form has a unique SCI/GSI/USI, if it doesn't, this line is not required.

**Note:** If a record is mentioned in a governance document, but receives authority from another, it should be listed in the records table but the filing directions should reference the applicable document.

### 1.6.14.3 References

Ensure documents listed as performance or developmental references are available (e.g., issued in an Approved Information Management System [AIMS]).

#### (a) Performance References

List documents a user needs to obtain for use in conjunction with the document. This includes any forms or templates that a user may need.

- (1) Identify each reference by document number and title. Do not include revision number, unless a specific revision or version was used.
- (2) Industry guidelines and standards of excellence (e.g., INPO or WANO) and requirements of codes and standards are considered to be performance references. If only a specific portion of the performance reference is implemented or applies, document that portion specifically.

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(3) If there are no performance references, state “None”.

(b) Developmental References

List documents that were used in the preparation of the document that may provide the user with additional information.

(1) Identify each reference used to develop the content of a Governance document by both its document number and title (if known). If a specific revision or version was used, identify it.

(2) If there are no developmental references, state “None”.

#### 1.6.15 Revision Summary

(a) Remove all previous revision summaries as only the current summary is required.

(b) Indicate revision type (i.e., intent, non-intent, minor revision, or new document).

(c) State if revision bars are not used.

(1) Use the revision bar tool in the body of the document to designate document alterations, **except** as noted below:

- Shifted document text
- Editorial corrections
- Page header information
- TOC
- Forms
- Major rewrites
- Rev 000 documents
- Authorization box on cover sheet
- Revision Summary.

(2) Show revision bars in right margin.

(d) Indicate any superseding or obsoleting action(s), including minor revisions.

(e) Provide a clear and simple summary of changes, including a gap analysis between the current revision and the previous one.

#### 1.6.16 Appendices

(a) Use appendices for information such as tables, illustrations, or narrative text that is difficult to integrate into the body of the document.

(b) Samples of forms and templates should normally be included in appendices. If included, each form should be a completed sample and watermarked as “Sample”.

(c) Ensure each appendix is referred to in the document or by another appendix.

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- (d) Appendices should be designated by letters and placed in alphabetical order. Arrange the appendices in the order they are referred to within the document.

## 1.7 Document Control

### 1.7.1 Document Numbering Scheme

The minimum set of information required should be consistently applied and recorded in the "Document Number" box (header of template), as follows:

**Note:** Legacy document numbering schemes may remain in place.

- (a) Sponsoring Business Unit identifier or Facility (i.e., FIN [Finance], N [Nuclear], PC [People & Culture], etc.)

**Note:** If Governance compliance is expected across all LOBs, choose OPG.

**Note:** Centre-led organizations that own Program documents tied to generating business management systems may use the generating facility identifier, e.g., N.

- (b) Document type.
- (c) Governance Support documents include a System/Subject Classification Index (SCI) number.
- (d) Unique numeric number assigned sequentially for each document type.
- (e) In Nuclear:
- (1) Include a third-level, two-letter code, e.g., AS, MA, TR. These are used for Charters, Programs, Procedures, and Standards as described below:

AS	Provide Administrative Assistance
HR	Manage Human Resources
LE	Life Extension
MA	Maintain Plant
MM	Procure and Control Material
MP	Modify Plant (Engineering)
OP	Operate Plant
RA	Comply with Nuclear Regulatory and Industry Requirements
SS	Safe Storage
TR	Training
WM	Waste Management

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**Note:** Refer to N-CORR-00583-{332055}, OHN Work Breakdown Structure (NEI Code) Dictionary, for further information regarding the Administrative Code chart.

- (2) Any requests for a new third-level code should be approved by Senior Manager, Information Management Program Authority.

**Note:** Applicability within the sponsoring business unit is identified on the cover sheet under Document Relationships (e.g., a procedure applicable only to Supply Chain would be numbered BAS-PROC-XXXX, applicability would be Supply Chain).

#### 1.7.2 Watermarks

- (a) Draft watermark should be applied to Governance documents that are not yet approved for use.
- (b) Minor revisions shall be issued with a “**CHANGE**” watermark.

#### 1.8 Writing Practices and Format

OPG-GUID-08130-0001 may be used when preparing Governance documents.

### 2.0 ROLES AND ACCOUNTABILITIES

#### 2.1 Senior Manager, Information Management Program Authority

- 2.1.1 Ensures The Framework is maintained.
- 2.1.2 Monitors review cycles and reports/communicates on overdue and coming due documents.

### 3.0 DEFINITIONS AND ACRONYMS

#### 3.1 Definitions

None

#### 3.2 Abbreviations and Acronyms

<b>AIMS</b>	Approved Information Management System
<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>CRRS</b>	Corporate Records Retention Schedule
<b>CSA</b>	Canadian Standards Association
<b>EPRP</b>	Emergency Preparedness and Response Plans
<b>INPO</b>	Institute of Nuclear Power Operations
<b>ISO</b>	International Organization for Standardization
<b>LOB</b>	Line of Business
<b>OPEX</b>	Operating Experience

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<b>QA</b>	Quality Assurance
<b>RRC</b>	Records Retention Code
<b>SCI</b>	System (or Subject) Classification Index
<b>TOC</b>	Table of Contents
<b>WANO</b>	World Association of Nuclear Operators

#### 4.0 BASES, RECORDS AND REFERENCES

##### 4.1 Bases

None

##### 4.2 Records

None

##### 4.3 References

##### 4.3.1 Performance References

N-LIST-00531-10002, OPG Documents Referenced in Licence Conditions Handbook

N-LIST-01913.11-10001, Nuclear Pressure Boundary Governing Documents

N-MAN-01913.11-10000, Pressure Boundary Program Manual

N-POL-0001, Nuclear Safety Policy

N-STD-AS-0002, Procedure Use and Adherence

N-STD-AS-0014, Requirements for Technical Procedures

OPG-GUID-08130-0001, Writing Guide for Administrative Governance Documents

OPG-PROC-0019, Records and Document Management

OPG-PROC-0179, Nuclear Quality Assurance Records

OPG-PROG-0001, Information Management

OPG-STD-0074, Accessibility for Ontarians with Disabilities Act Integrated Accessibility and Customer Service Standard

OPG-TMP-0001, OPG Governance Document

##### 4.3.2 Developmental References

PPA AP-907-005, Procedure Writers' Manual produced by the Procedure Professionals Association

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N-CHAR-AS-0002, Nuclear Management System

N-CORR-00583-{332055}, OHN Work Breakdown Structure (NEI Code) Dictionary

N-POL-0001, Nuclear Safety Policy

N-PROC-AS-0078, Nuclear Performance Monitoring and Reporting

N-PROG-AS-0001, Managed Systems

OPG-PROG-0001, Information Management

N-PROG-OP-0001, Nuclear Operations

N-TMP-10017, Approved Roles

OPG-GUID-08140-0001, Using a Template - Tips and Tricks

OPG-POL-0033, OPG Business Model

OPG-PROC-0001, Process Administrative Governance Documents

OPG-PROC-0178, Controlled Document Management

OPG-STD-0030, Protecting OPG's Information and Intellectual Property

## 5.0 REVISION SUMMARY

This is an **intent** revision.

- Minor changes throughout for clarification.
- Changed Director, Nuclear Regulatory Affairs and Stakeholder Relations, to Manager, Nuclear Regulatory Affairs throughout.
- Removed references to specific Lines of Businesses throughout.
- Replaced N-PROC-AS-0003 with OPG-PROC-0178 throughout (DCR 133045).
- Replaced N-PROC-AS-0042 with OPG-PROC-0179 throughout (DCR 133041).
- Replaced N-PROG-AS-0006 with OPG-PROG-0001 throughout (DCR 132951).
- Section 1.6.14.3: Removed requirement for reference lists to appear in alpha numeric order (DCR 135272).



Plan

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**RETUBE & FEEDER REPLACEMENT (RFR) PROJECT MANAGEMENT PLAN**


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## Retube & Feeder Replacement (RFR) Project Management Plan

**NK38-PLAN-09701-10074-R004<sup>3</sup> MP**  
2016-10-13

Order Number: N/A  
Other Reference Number:


**Internal Use Only**

Prepared by:  <sup>for Michael</sup>  
Michael Hersch  
Tooling Project Manager - RFR Project

Date: October 13, 2016

Reviewed by:   
Marc Paiment  
Project Manager - RFR Project

Date: October 13, 2016

Approved by:   
Ken Brown  
Project Director - RFR Project

Date: 13 Oct, 2016

Plan

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**RETUBE & FEEDER REPLACEMENT (RFR) PROJECT MANAGEMENT PLAN**

## Revision Summary

Revision Number	Date	Comments
R000	2012-02-03	Initial Issue
R001	2012-06-20	Revised to include updated project gate progression strategy, RFR EPC Agreement Information, RFR Contract Oversight, and alignment with RFR Contractor management plans.
R002	2013-02-04	Revised and detailed all plans and created separate detailed plans referenced herein for Project Controls, Engineering, Contract, and Oversight.
R003	2016-10-13	<p>Comprehensive update to reflect scope, organization, and management plans as of Gate 3A: Unit 2 Execution Estimate was approved in august 2016. This includes Execution phase plans and processes. Minor clarifications, formatting and grammatical corrections throughout the document.</p> <p>Section 1.0 changed from Introduction to Executive Summary with overview of current project status. Duplicate listings of PMBOK sections with reference to chapters removed – the table of contents identifies where in this PMP information is located. Significant updates to rest of Section 1.</p> <p>Section 2 Streamlined, duplicate lists removed.</p> <p>Section 7, 8, 9, 10, 11 Project Controls Plan contents incorporated into this PMP. PCP contents updated to reflect current processes.</p> <p>Section 13 Roles and Responsibilities table updated for execution phase.</p> <p>Section 15 Risk management significantly revised to reflect significant alignment of RFR process with NR Risk management governance as well as “JV risk management plans for execution phase.</p> <p>Appendices updated to include PCP contents (PCP to be superseded to this document after issue)</p>

Plan

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## 1.0 EXECUTIVE SUMMARY

Darlington Nuclear Generating Station (DNFS) requires a major refurbishment to extend the service life of all four units. The Nuclear Refurbishment (NR) Program has completed its Definition Phase, with the Execution Phase started in early Q1 2016 after the OPG Board of Directors approved the Release Quality Estimate in November 2015. Unit 2 Execution Estimate has been approved as of August 2016.

The major component of the refurbishment program is the Retube and Feeder Replacement (RFR) project. This document is the Project Management Plan of the RFR project and is intended to:

- Define the scope of the project.
- Explain how RFR project activities are carried out.
- Explain RFR interfaces with Nuclear Refurbishment program as a whole.
- Provide the current execution baseline and define how the project will be carried out to completion.

This PMP takes its authority from the DNFS NR Project Charter [R-30] and the Project Management Program of OPG Nuclear [R-11]. This PMP will be kept current to ensure it accurately reflects the approved execution baseline and the processes for managing it.

### Current Project Status

The following are key issues that are being planned and executed at this time:

- Overall Execution Planning
  - Clarifying project management execution organization, including roles and responsibilities.
  - Identification and evaluation of opportunities to further reduce project schedule, cost and risks.
  - Finalize overall Series Readiness Requirements.
- Engineering, Operations & Maintenance
  - Completion of detailed engineering, issue of final Comprehensive Work Packages, Work Plans, ITPs and more detailed planning through NR optimized OPG work management processes.
  - Execution of Mobilization Plan work on mockups at DEC and WTS at vendor site is in progress. CWP contingency operations are being executed and CWPs marked up as applicable.



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- Execution of Process Qualification work is in progress on mockups at DEC for compliance with Technical Specifications incremental requirements.
- Development of future units MEC packages is in progress.
- Infrastructure
  - Planning for Logistics (onsite and offsite). Moving equipment between warehouses, clean room, contaminated facilities etc.
  - Finalize plans for inter-station transfer vehicle/movements/MODs.
  - Planning for training at the DEC mockups.
  - Finalize RWN waste streams and containers for storage of waste.[R-1]
- Tooling
  - All baseline tooling milestones have been completed as of this time.
  - progressing additional tooling milestones per project change directives.
  - Oversight of materials management plans [R-57], series readiness activities and repair/replace/troubleshooting work orders created through the JV's Tool Management Organization (TMO). [R-67]
  - Oversight of JV populating tooling, components/assemblies, and work orders in EPICOR material tracking and work management software application.
  - Detailed planning for commissioning of the Waste Tooling System.
  - Finalize process for Tooling Change Control.
  - DA signatures of RFS packages.
  - Oversight of ESCROW repository for Tooling Intellectual Property.
  - Interface with RTS project for pressure test of PHT system.
- Procurement
  - Oversight of procurement of Goods and OSM for unit 2 with associated Contract Milestones, OSM for future units in progress.
  - Oversight of JV recovery plans for critical at risk components (Feeder I690 material and lower feeder production).
- Project Integration
  - Ongoing integration efforts through NR stakeholders including O&M, schedule and work management.
  - Alignment between RFR schedule and other Refurbishment project schedules.

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- Construction and Field Work
  - Oversight and support of Prerequisite construction activities including Retube Control Centre construction and TPDS installation
  - Ongoing field walkdowns.
  - RWPB construction.
  - Transition of organization location to RPO and RFRISA.
  - Ongoing review and incorporation of lessons learned from current and previous construction projects (especially inside the DNGS protected area).

### 1.1 Revision Control

This document is reviewed and revised on periodic basis to update the changes and existing practices. The revision status is documented in the revision summary of this document.

### 1.2 RFR Project Scope

All Nuclear Refurbishment scope is allocated to project bundles via the Darlington Scope Request (DSR) Database [Appendix A]. The RFR DSRs describe the scope in general terms and the RFR project Scope of Work (SOW) [R-21] more precisely elaborates the work in functional terms. The RFR SOW is the key reference in the Contract established with The Joint Venture (JV) of SNC-Lavalin Nuclear Inc. and Aecon Construction Group Inc. The JV is also referred to in this document as the "EPC Vendor" or the "RFR Contractor". Scope is then managed using change control, in the NR program and in the Contract. A more detailed account of scope management is provided in Section 6.0.

In general, the RFR scope consist of all work required to complete the repair and replacement of feeders and fuel channels. In addition, some construction scope from other project bundles will be executed by the RFR Contractor where there is a substantial risk of interference between the scopes of work due to either system or geographic interferences. In order to keep the RFR team focused on its core scope, all reasonable efforts will be made to have any potential new scope completed by other workgroups.

Any changes to scope of RFR project are managed in accordance to the Change Control process described in Nuclear Refurbishment (NR) Program Change Management [R-71] . Any additional scope to the RFR contractor is managed through Project Change Directives (PCD) and Contract Amendments.

The RFR project scope is defined by breaking down its constituent activities by focus area:

- **Mock-ups:** Includes development of full scale Mock-Ups of the reactor at the Darlington Energy Complex (DEC), including vault internal structures, fuel

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channels, feeders, feeder cabinet, Fuelling Machine bridge, vault cranes and channel array. These mock-ups were utilized to perform Tool testing and commissioning, as well as integration activities during the Mobilization Plan activities and will be used extensively for trades training to minimize the performance ramp up when transitioning to the station environment.

- **Station Modifications:** Includes the engineering, procurement and construction of all temporary and permanent modifications to support the field execution of the RFR work scope. This will also include development of any required tooling, procedures, documentation, licenses, permits and approvals from regulatory bodies, Inspection & Test Plans, Job Safety Analysis, Comprehensive Work Packages and Work Plans.
- **Containment Isolation:** Includes the engineering, procurement and construction of all temporary and permanent modifications to separate the refurbishment unit reactor vault from station containment, including the test equipment to be installed and operated to demonstrate that the new temporary containment boundary meets all requirements for the station containment. Shielding will be installed as required to allow RFR work to continue when a fuelling machine with irradiated fuel onboard transitions beneath the refurbishment unit. This will also include development of any required tooling, procedures, documentation, licenses, permits and approvals from regulatory bodies, Inspection & Test Plans, Job Safety Analysis, and Comprehensive Work Packages.
- **Tooling:** Includes development of all removal, inspection, installation and common tooling, development of the associated procedures for their use, procurement of materials and goods, as well as qualification, testing and commissioning of the equipment.
- **Procurement:** Includes planning for, acquisition and storage of materials to support the RFR work scope. An overview of the major components required for acquisition is provided in the following sub-section.
- **Balance of Reactor Vault:** RFR will take on certain scope that could result in significant integration concerns in the vault so that RFR can have full control of the vault during Execution Phase. To date, the following items have been accepted into RFR for field execution:
  - Replacement of vault Air Cooling Units (ACUs). Engineering and Procurement remains with the Fuel Handling Project bundle.
  - Replacement of the Fuelling Machine (FM) bridge ballscrews. Engineering and Procurement remains with the Fuel Handling Project bundle.
  - FM bridge part replacement during bridge re-assembly. Engineering and Procurement remains with the Fuel Handling Project bundle.

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- Vacuum dry of PHT and moderator auxiliaries. Engineering, Procurement and Construction for the auxiliaries to agreed boundary point accepted from the Shutdown and Layup Project bundle.
- Annulus Spacer Retrieval Tool (ASRT) - during the end fitting removal series, this new set of tooling will retrieve 24 intact spacers for material surveillance and fitness for service assessment; the spacers are removed from four axial locations in each of six selected channels and transferred into a set of flasks for transport to an offsite testing facility. Engineering, Procurement and Construction (field execution) performed by RFR Vendor.
- Feeder and fuel Channel Baseline Inspections: to perform both the feeder and fuel channel inspections prior to installation activities. This strategy would eliminate the need for an initial in-service inspection outage.
- Flow element inspections: RFR to segregate 4 feeder flow elements in RFR waste containers to allow MCED to retrieve at Western Nuclear Waste Division to redirect to a 3rd party facility for destructive examination via COG.
- **Execution Phase Plan:** Includes the estimate development from Class 5 to Class 2 and a final version, Class 2 Estimate, Level 5 Schedule and RMO.
- **Waste Process:** Includes construction of the Retube Waste Processing Building (RWPB), processing of all wastes generated by the RFR project (primarily the reactor component waste streams such as fuel channel components), their segregation by type (non-radioactive, Intermediate and Low-Level Waste; incinerable, compactable, or processible), volume reduction, procurement of storage containers, and packaging in a form suitable for transfer to OPG's nuclear waste management division. This also includes all modifications and procedures to support the in-station transfer of waste flasks from the refurbishment unit to the RWPB.
- **Project Infrastructure:** OSM and Tooling Warehouse in DEC, OSM & Goods & Tooling storage (not in DEC), DEC Clean Room, Tooling Laydown areas in DEC, Tooling Laydown areas in DNGS, Tooling Contaminated Equipment Maintenance.
- **Integration, Logistics, and Optimization:** Integration of the work streams, planning the logistics of people and material movements through the infrastructure and transitions from series to series during the retube and waste processing and handling, and optimization of all of the work required for retube. Also managing the logistics for the entire Execution Phase, e.g. OSM, on-boarding, etc.

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- **Training:** For Execution Phase, train the trainers, running scenario by scenario, practicing and simulating the integration, logistics, troubleshooting, and optimization of the procedures, with the goal of reaching productivity rates in each series as quickly as possible and being predictable against the estimate series to series.
- **Execution – Unit 2:** Performing pre-requisites, on-boarding staff and organization, training series-by-series, commencing each series in unit, managing day-to-day schedule, achieving productivity rates, time reporting, quality record-keeping, RWPB waste factory operation, Warehousing and material delivery operations, tooling maintenance operation, transitions execution, flask transfer operations, managing the Execution Phase Milestone Schedule and reviewing the evidence required to pay the fixed fee payments and progress payments as the Execution Phase progresses.
- **Planning – Units 1, 3 and 4:** Planning for follow-on Units 1, 3, and 4 may require updates to modifications, tooling, mock-ups, procedures, logistics, etc. This planning will need to occur leading up to and during each Unit refurbishment window in parallel with current unit field execution.

### 1.3 RFR Project Phases

The RFR Project is divided into two phases: Definition and Execution phase based on the Contractual terms [R-28].

**Definition Phase:** Definition Phase referred to the period between Contract award (March 2012) until completion of Definition scope as defined by Contract Milestone “Definition Phase Complete”. The milestone date for Definition complete was 30 June 2016, however a negotiated settlement was agreed between OPG and the Joint Venture (JV) that extended dates for select deliverables.

Completion of some scope packages added via PCD was contractually exempt from the Definition phase milestone. Examples include the completion of Retube Waste Processing Building (June 2017) and various Tooling PCDs (June 2017).

The Definition Phase covers the development of the common work packages such as the Tooling and Mockups to be utilized for all Units, Mods Engineering for unit 2, Procurement of Reactor components and Goods for Unit 2 and all the planning activities for the work to be carried out in the Execution Phase.

**Execution Phase:** Execution Phase began with the signing of the Execution Phase Contract Amendment in January 2016, will carry the RFR project through mobilization, pre-requisite work, Mobilization Plan testing, training and on-boarding prior to first unit breaker in October 2016 to Commissioning, close out, de-mobilization of last unit (Unit 4) in 2026.

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The Execution Phase covers the actual carrying out of the work on a Unit by Unit basis, Commissioning work required to return the Units to service, the closeout activities related to individual unit and overall project/Contracts closeout.

#### 1.4 RFR Project Execution on Multiple Units

Subsequent to the demonstration of acceptable project performance on the first refurbished DNGS Unit and approval by OPG and its stakeholders, the remaining Units will continue to be refurbished. The planning assumption at this time is that the unit sequence is Unit 2→3→1→4, with unit 1 starting after removals on unit 3, and Unit 4 starting after unit 3 is restarted (resulting in approximately 3 years of overlap of units in refurbishment). This overlap sequence will allow the removal team to complete removals on Unit 3, integrate lessons learned from this second unit then proceed into training and preparation for removals on the third unit, then onto the fourth. Similarly, the installation team will gain efficiencies through the overlapped units. This will significantly increase the logistics efforts in the station and at the DEC mock-up where simultaneous demands for space and transition areas will need to be tightly choreographed.

#### 1.5 NR Program Gated Process for RFR Project Progression

Funding of the Nuclear Refurbishment project bundles is done via several progression gates, with each gate requiring an elaboration of project plans including the scope, schedule, cost, and risks. This elaboration can also be called “rolling-wave planning”. In this manner, the risk of less accurate long-term planning is minimized via multiple gated reviews based on the maturity of the project and integration within OPG and with our Contractor Partners. The Gated process is described in “Nuclear Projects– Gated Process” [R-70]

The gated approach for the RFR Project defines the work to be completed in each project phase and the applicable gates. Multiple sub gate releases were planned to allow more accurate forecasting as the Definition Phase work progressed as depicted in Table 1 below.

Table 1: NR Program Gated Process for RFR Project Progression			
Gate	Date	Progression Period	Scope for Funding request
Gate 1	Feb 2012	Mar 2012- Aug 2012	Project Initiation,
Gate 1 Refresh	Aug 2012	Sep 2012- Feb 2013	Progression to Feb 2013
Gate 2A	Mar 2013	Mar 2013-May 2014	Progression to the end of Mock Up scope
Gate 2B	June 2014	June 2014-June 2016	Progression to the end of Definition Phase scope
Gate 2C	April 2015	Apr 2015- Dec 2015	Retube Waste Processing Building(Incremental scope ) -Engineering, Pre construction, Estimate
Gate 3	Dec 2015	Dec 2015-June 2017	Retube Waste Processing Building- Construction Scope, Building Readiness

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Gate 3	Jan 2016	Jan 2016- Oct 2016	Definition Phase (incremental scope), Execution Phase prior to breaker open October 2016
Gate 3A	Sep 2016	Oct 2016- Oct 2019	Unit 2 Execution, Unit 3,1, 4 Engineering and Procurement

Subsequent gate progressions will be followed in accordance to the NR program guidelines.

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## 2.0 PROJECT GOVERNANCE, STRUCTURE AND PLANNING

A Nuclear Project's Management Model has been created for Nuclear Projects to provide the Standards which the Projects must comply with and incorporate into their plans. Refer to Darlington Refurbishment Program Framework. The Darlington Refurbishment Program Framework may be referenced in the RFR project plans so as not to duplicate detail in the RFR PMP and its supporting sub-tier plans.

### 2.1 Darlington Retube and Feeder Replacement Management Planning

This RFR PMP follows the guidelines of the Darlington Refurbishment project management Program [R-11] and Project Management Standard [R-12]. This RFR Project Management Plan adopted the best practices and aligns with the Project Management Body of Knowledge (PMBOK), shown in Figure 2 below.

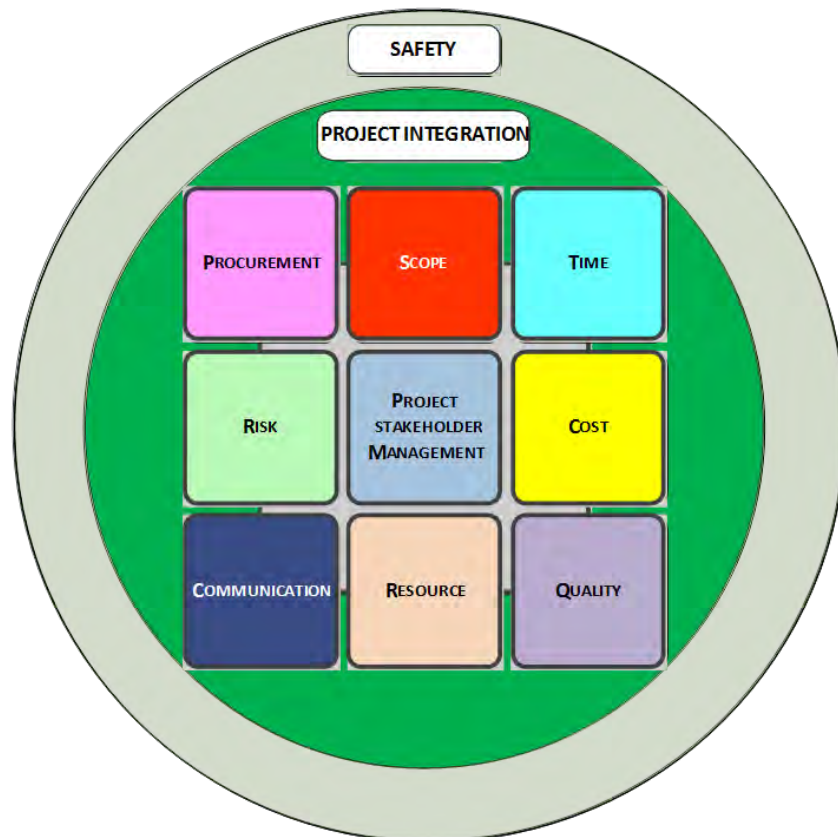


Figure 1: Darlington RFR Project Management Visual Representation



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Integration of OPG Governance, RFR Project Plans, and RFR EPC Contractor plans with all of OPG's Contractors is a key element for the successful execution of the RFR Project; the remainder of this PMP explains the plans of how this can be accomplished. It then becomes every team member's responsibility to follow the plans.

## 2.2 EPC Contractor Project Management Plans

A crucial input to the management and execution of the RFR Project is the integration of the EPC Contractor's plans [Section 20.0]. The EPC Contractor performs Project Management in accordance to the JV's governance per the Contract [R-28]. JV will create their own plans in accordance with the RFR Contract [R-28] and COIR [R-26],

For example, integration of the JV schedule, cost, risks and infrastructure must be aligned with OPG plans and the overall refurbishment program. Certain key JV plans in individual project management knowledge areas (cost, scope, time etc.) are noted in subsequent sections of this PMP, where the integration of these documents within OPG's project governance framework is also discussed.

## 3.0 PROJECT STAKEHOLDER AND INTERFACE MANAGEMENT

This section describes the:

- Identification of the project stakeholders
- Stakeholder matrix listing their involvement on the project
- Stakeholder matrix listing their expectations of the project

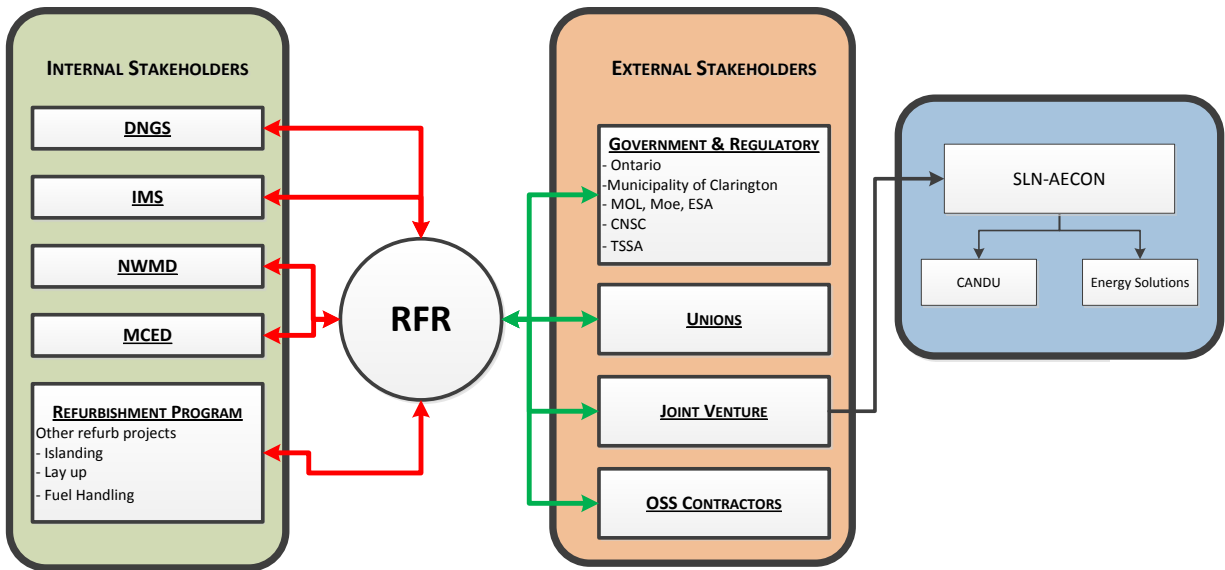
The major interfaces of stakeholder management are identified and presented in this section at a high-level, supplemented by a breakdown of key stakeholders by each discipline (Tooling, Engineering etc.) within RFR and a description of the specific areas of common interest at this time. A current understanding of future stakeholders or future needs of current stakeholders is presented and is subjected to update as the project progresses.

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**Note:**  
Official Communication governed by protocols in Program

**Figure 2: High-Level Stakeholder Relationships**

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### 3.1 Stakeholder organizations of the RFR project

The following table lists the stakeholder organizations that RFR project interfaces with and the accountability matrix

Stakeholder	Requirements or Expectations	Influence	Timing of Influence	Classification (Responsible, Accountable, Consult, Inform)
DNGS	Return to service of all units per Refurbishment Program Charter	RFR's key client; Owner of Plant SSCs	Project lifecycle	Consult
Refurbishment Program	Return to service of all units per Refurbishment Program Charter	Oversight to RFR	Project lifecycle	Accountable
QA	Adherence to standards and processes	Oversight to RFR	Project lifecycle	Consult
HSSE (Refurbishment)	Adherence to standards and processes	Oversight to RFR	Execution	Consult
Licensing	Adherence to regulatory standards and processes including Licence Condition Handbook	Oversight to RFR	Project lifecycle	Consult
Design Authority	RFR deliverables satisfy design requirements and have no adverse impact on plant SSCs	Oversight to RFR	Project lifecycle	Accountable
O&M (Refurbishment)	Interface in defining specific shutdown, pre-commissioning and startup requirements on RFR, as well as transfer of accountability of work planning and scheduling, and integration with station plan	Oversight to RFR	Project lifecycle	Consult
Balance of Plant	Interface in areas of common interest/scope such as Negative Pressure Containment (contingency items related to equipment readiness), structures (inspect RB and contingency RB structure repair), STOP, Airlock Door Seal Replacement, ESC inspection and contingency repairs), Emergency Heat Sink (EHS), PHT inspections and contingency work, Vault Vapour Recovery work	Responsible for Balance of Plant Work	Project lifecycle	Consult
Steam Generator	Interface in areas of common interest/scope such as Primary Side Systems Layup, Division of Work	Responsible for Steam Generator Work	Project lifecycle	Consult

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Islanding	Interface in areas of common interest/scope such as Bulkhead and Containment Isolations	Responsible for Islanding Work	Project lifecycle	Consult
Fuel Handling	Interface in areas of common interest/scope such as removal of irradiated fuel (including development of defueling tools and strategy)	Responsible for Fuel Removal Work	Project lifecycle	Consult
NWMD	Definition of waste generated (quantity and type) and select waste container design support	User of RFR products (waste) and waste container design support	Project lifecycle	Consult
IMS	Interface in areas of common scope such as ASRT tooling.	Responsible for transfer to transport flask.	Execution	Consult
MCED	Protecting assets (reactor and supporting SSCs)	Oversight to RFR	Execution	Consult
Joint Venture	Executing work as per RFR EPC agreement	Key Vendor	Project lifecycle	Responsible
OSS	Executing work as per OSS agreement	SME support and support on technical assessments	Execution	Responsible
Government of Ontario	Complete work on time, budget, within scope and with no safety incidents	Makes Go, no-go decision	Execution	Accountable
CNSC	Compliance with applicable regulations	Can stop work due to non-compliance	Project lifecycle	Accountable
Ministry of Environment	Compliance with applicable regulations	Can stop work due to non-compliance	Project lifecycle	Accountable
Ministry of Labour	Compliance with applicable regulations	Can stop work due to non-compliance	Project lifecycle	Accountable
Unions	Compliance with applicable collective agreements	Can stop work due to safety issues per OHSA.	Project lifecycle	Consult
TSSA	Compliance with applicable regulations	Can stop work due to non-compliance	Project lifecycle	Accountable
Electrical Safety Authority	Compliance with applicable regulations	Can stop work due to non-compliance	Project lifecycle	Accountable

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### 3.2 Communication

Section 14.0 describes the Communication Management Plan for effectively engaging stakeholders in project decisions and execution.

The JV has issued a Communication Plan for the RFR Project [R-42] [R-48].

## 4.0 SAFETY AND ENVIRONMENT

Safety is the core value of OPG [R-1][R-2] the NR Program and the RFR Project. Safety focus areas include (but are not limited to) nuclear safety, the conventional safety, radiological safety and protection of the environment.

Nuclear Refurbishment Health and Safety Program Management Plan [R-90] must be followed for the entire refurbishment project and is the highest level Safety document for the project. The RFR JV Site Specific Safety Plans [R-61][R-62], contain the unique requirements for management of H&S risks associated with the specific project activities in the mockup and in the field. The JV has also issued a Fire Safety Plan [R-63] for the RFR Project.

OPG has issued safety expectations for work in the Darlington Energy Complex warehouse and mockup area [R-27].

The RFR JV has issued an Environmental Management Plan [R-64] in alignment with the Darlington Refurbishment Environmental Program Management Plan [R-89] ,

The JV has issued an ALARA Plan [R-65] to document how they will manage the work and workforce to maintain radiological dose update as low as reasonably achievable..

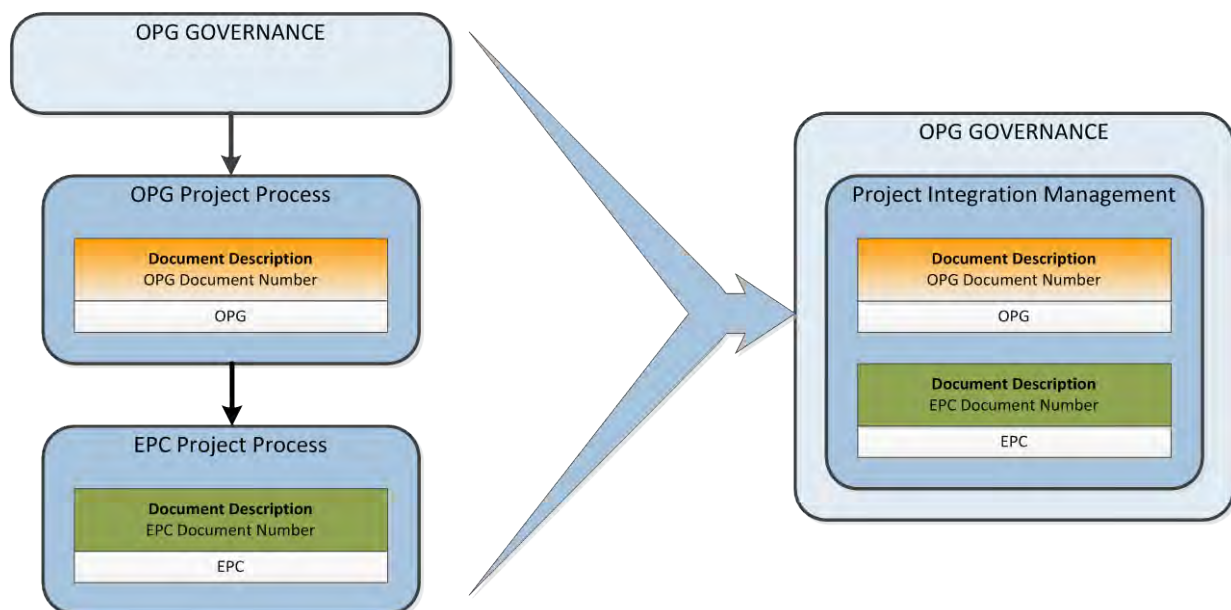
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## 5.0 PROJECT INTEGRATION MANAGEMENT

This PMP focuses on the integration of OPG and EPC Contractor planning and execution.

For each area of the project, a review of the relevant OPG, Darlington Refurbishment, RFR Project and EPC (Joint Venture) Project Governance was conducted. Figure 3 schematically shows the hierarchy and implementation of this governance for the RFR Project.



**Figure 3: RFR Project Document Set**

The figure on the left indicates a hierarchical view of governance, while the figure on the right shows the VenDiagram version. In each view, OPG governance is used to derive RFR project processes and integrate the EPC Contractor processes.

For example, the OPG program document on Project Management [R-11] is used to derive this project management plan. This is the highest level plan on the RFR project, and points, in turn, to the JV's internal Project Management Plan [R-47].

The RFR OSS Project Execution Plan [R-7] describes the general support and oversight of the managed task work to be undertaken by OSS staff, on behalf of OPG, in the areas of Tooling, Engineering, Owner Specified Material, and Infrastructure. This document was prepared for definition phase, and a review will be taken to determine if it should be updated given the retention of OSS services into the execution phase (to ensure seamless transition out of OSS Contract into a largely OPG staffed organization).

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## 5.1 Project Management Toolset

The project management toolset used by the RFR Project team is as follows:

Focus Area	Tool
Actions	Actions module in RMO Tool Project Lead's action registers – Sharepoint JV actions – AIR database JV actions – ACER database
Assumptions	Key RFR Project Assumptions – RMO tool, Non-key RFR Project Assumptions – PMP, Sharepoint, Contractor's Submittals
Issues	Issues module in RMO tool
Schedule	Primavera P6
Cost – Cost Management including Budget and Change Management, Earned Value Management, Forecasting	Ecosys
Cost – Contract Budgets, Actuals and Forecast transactions	ONCORE and Ecosys
Cost – Invoices, Salary Information	Invoices through OnCore and Asset Suite 7. Salary is also in ONCORE with restricted access
Risk	Risk module in RMO tool and JV Stature ( Risk Register)
Documentation – Working Files	Sharepoint
Documentation – Submittals from Contractors (excluding Invoices and Salaries)	VenDM, Sharepoint
Safety	SCR/CAR/NCAR, Oversight Findings in RMO Tool, Construction Oversight Binder Contractor Submittals
Quality	SCR/CAR/NCAR, Oversight Findings module in RMO Tool, Contractor Submittals, Design Reviews and Comment and Disposition Forms, ITPs, Reports
Oversight	SCR/CAR/NCAR, Daily Log in SharePoint, Oversight Findings in RMO tool, Contractor Submittals
Interface Management	Meetings and Minutes, Contractor documentation Integrated OPG Refurbishment schedule
Contract Documentation, Changes, Amendments, Claims	VenDM, Contractor's Submittals



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### 5.2 Project Oversight

The RFR Project Team will be performing oversight of vendors in compliance with Project Oversight Standard [R-14]. As described in the standard, oversight is the independent assessment necessary to ensure project objectives are achieved based on a proactive and graded, risk based approach, distinct from the in-line and normal quality assurance and control process.

The individual sub bundle leads will review the RFR RMO on at least a monthly basis to identify potential strategic oversight activities that would proactively detect potential problems with sufficient time to take mitigating actions to mitigate the impacts. It is expected that the RFR project will complete on average approximately 5-10 strategic oversight activities per month. The oversight activities will be planned in the RMO oversight tab with suitably SMART criteria and cross references to risks and actions as appropriate. The observations will be recorded in the Oversight Findings tabs of the RMO tool with reference to the source oversight activity. Observations and findings from routine and in-progress oversight activities will be recorded in the Daily Log tab of the RMO tool. In addition, RFR personnel can also email [RMORFR@opg.com](mailto:RMORFR@opg.com) to provide their updates to the RFR SPOC for review. This does not relieve them from their responsibility of entering the content into RMO.

The Nuclear Refurbishment Management System Oversight (MSO) group, over the course of the project, will also review the project work execution across all the project bundles and as required, implement the Corrective Action Program and co-ordinate Program Assurance activities (see also Darlington Program Management Systems And Performance Improvement Program Management Plan [R-92]).

### 5.3 Engineering Management

The Darlington Refurbishment Engineering Program Management Plan [R-91] defines the engineering and design roles and responsibilities for the refurbishment program. All Engineering Change Control (ECC) deliverables will be accepted or authorized in accordance with established Governance, usually through the Engineering Design Authority.

The Engineering Interface Requirements Guide [R-31], provides further direction and expectations for Refurbishment Engineering interfaces with OPG Project Managers and Contractor Agencies during the definition and execution of EPC contracts in support of the Program.

The RFR project has developed three documents to reflect the implementation of this governance: The Retube and Feeder Replacement (RFR) Design Plan [R-4], the RFR COIR [R-26] and the Retube Feeder Replacement (RFR) Engineering Plan [R-25]. (under revision at time of PMP revision 4 issue).

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The RFR Design Plan explains that although RFR is defined as a Repair and Replacement project, the ECC process will be used maintain configuration management. The Design Plan identifies the critical tasks for preliminary engineering, detailed design, installation and commissioning. An explanation of how the project adheres to OPG procedures, guidance and instructions is provided, which is to be used in conjunction with the RFR COIR [R-26]. As well, deviations, due to the timing of the Program development and the establishment of the EPC contract agreement are identified and the rationale for acceptability provided. Roles and responsibilities for the project team and relevant stakeholders are identified. Further, specific engineering related tasks to be performed by OPG are described in this plan.

The RFR Engineering Plan describes the principles, approach and responsibilities of OPG to oversee the engineering work that is performed by the RFR Contractors.

### 5.4 Construction Management

An RFR project-specific Construction Management Plan (in draft at time of PMP revision 4 issue), provides RFR Project-specific details regarding construction oversight activities that complement the Darlington Refurbishment Program Construction Plans, Guides, and Checklists which are contained in the following documents:

- Darlington Refurbishment Construction Program Management Plan [R-93]
- Guideline for Construction Oversight [R-32]

An RFR project-specific Retube Waste Processing Building (RWPB) Construction Management Oversight Plan [R-29] provide similar details for the RWPB Owner Only construction project.

The RFR Project will generally adhere to the Plans listed above with one noted exception that the Oversight Findings and routine/in-process observations will be documented in the appropriate tab of the RMO tool and not N-FORM-09701-00001, Oversight Report as specified in N-GUID-09701-10120. Further details of the RFR Construction Management and Oversight approach will be documented in the RFR Construction Management Plan [R-40].

### 5.5 Integrated Change Management

Change management refers to reviewing all change requests, approving changes and managing changes to the deliverables, documents and the baseline scope, costs, and schedule. Change Control is implemented to maintain the integrity of the project baseline including control of scope, cost, and schedule.

RFR project document management will be governed by the Refurbishment Program Planning and Controls Program Management Plan [R-88] and the Darlington Refurbishment Requirements for Process Support Controlled Documents [R-37].

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RFR project documents are tracked and stored in VenDM and the RFR Sharepoint site. Important project emails are retained by cc'ing to a project RFR email. There is one email for each project bundle.

The Project management toolset that is being employed is defined in section 5.1.

### 5.6 Incorporating OPEX and Lessons Learned

Nuclear Refurbishment Processing Operating Experience and Lesson Learned [R-77] describes the processes that enable the Nuclear Refurbishment (NR) Program to meet the requirements of OPG Nuclear Operating Experience [R-33] and also to ensure that relevant project OPEX associated with NR is documented, reviewed and archived to be used to improve project planning. Each RFR subbundle team will review available OPEX or Lessons Learned and ensure it is incorporated into the OPG and vendor plans for conducting and delivering the project work packages, e.g. Tooling, RWPB, Mockups, Estimate, etc. Engineering OPEX will be recorded in OPEX Reports prepared for design packages, others will be recorded in the NR OPEX library.

To facilitate search for OPEX, a webpage has been established within the Nuclear Refurbishment intranet Team Site (**OPG Web > Nuclear > Projects > Darlington Refurbishment > Project Management** ). From this page, numerous sources of OPEX can be accessed including COB, WANO and INPO.

In addition to event based OPEX, documents such as INPO 09-007 Principles for Excellence in Nuclear Project Construction [R-34] shall be utilized as they have distilled numerous lessons learned from past projects down to principles and attributes of a healthy construction environment and organization that will produce results that demonstrate a commitment to quality and safety throughout the work.

The JV have issued an OPEX Management Plan [R-50] and a Lessons Learned and Continual Improvement Work Instruction [R-49] to ensure that lessons learned are incorporated into current and future unit execution.

### 5.7 Contractor Submittals Processing, Roles and Accountabilities

Submittals are defined in the EPC Agreement [R-28] Exhibits. Processing, roles, and accountabilities for project documentation will be managed according to the requirements of the RFR Contract and Refurbishment Program Planning and Controls Program Management Plan [R-88].

### 5.8 Requests for Information (RFI) Processing

The RFR EPC Agreement specifically states that the RFR Contractor is accountable for obtaining whatever information is required to complete The Work, and that any information provided by OPG is for information purposes only. As such, formal RFIs are not to be submitted by the Contractor. Having said this, the OPG team will work collaboratively with the Contractor to support and expedite requests for help in locating information that is not readily available.

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Responses to any vendor request for support in locating information are to be carefully considered in the context of the Terms and Conditions of the RFR EPC Agreement to ensure that in providing any additional design basis information to the Contractor, OPG does not give direction nor does it take on additional accountability for the result of the output or deliverable and thus liability for the results. See section 2.1(d)(8) of the RFR EPC Agreement for the definition of “OPG Information on which Contractor may rely”.

## 6.0 PROJECT SCOPE MANAGEMENT

### 6.1 OPG Scope Management

### 6.2 Scope Definition

The main scope and critical path of the Nuclear Refurbishment (NR) Execution Phase is Re-tube and Feeder Replacement (RFR). This includes the replacement of fuel channels and feeders, as these are life limiting components of the reactor. The timely, cost effective replacement of these components of the RFR core scope is critical to refurbishment success.

RFR Scope is managed in accordance with the Nuclear Projects Scoping Process [R-87], and Darlington Nuclear Refurbishment Program - Scope Control [R-6]. The Change Control Board process is used to approve changes to scope, cost or schedule assigned to the RFR bundle.

Through the NR scope development process identified in the Refurbishment Project Reference Plan – Scope Definition [R-5], individual Darlington Scope Requests (DSR), composed of both core and non-core scope, were bundled together to form the approved scope for the RFR Project. All DSRs are assigned to one of the Refurbishment Project Bundles. The DSRs assigned to the RFR Bundle are listed in Appendix A. The RFR scope has been organized into a suitable Work Breakdown Structure, details of which can be found in Section 7.1.1.

A large portion of the RFR scope has been included in the RFR EPC agreement. The functional, project, and quality requirements have been written into the RFR EPC agreement. The functional and performance requirements have been documented in the Scopes Of Work for the RFR EPC Agreement [R-28] as defined in Exhibit 1.1 (www) Mock-ups Contract and Exhibit 2.1 RFR Scope of Work [R-21].

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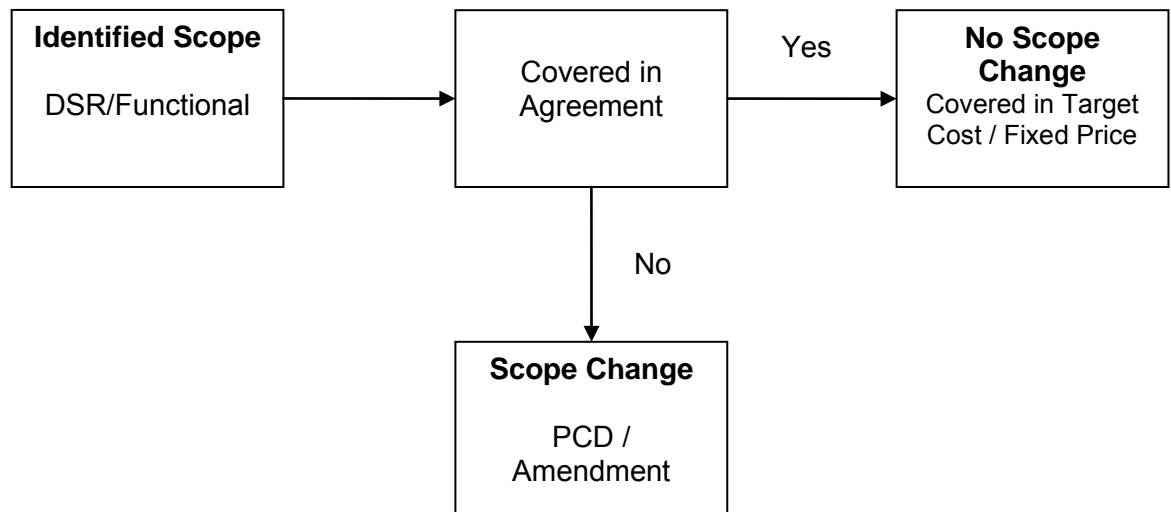
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### 6.3 Commercial Scope Control

The scope change process, including the issuance of Project Change Directives (PCDs), is outlined in Article 4 of the RFR EPC Agreement [R-28]. PCDs are incorporated into future Amendments to the Contract as soon as practical.  
**Error! Reference source not found..** Project Scope Management by the Joint Venture is governed by the JV Scope Management Plan [R-45] and the various sub-plans and work instructions. The commercially relevant scope of the RFR work is defined in the Scope of Work Document [R-21]. Changes to scope are incorporated into the next revision of this SOW document.

### 6.4 Scope Management Integration

Project scope will be managed per the process shown in the flowchart below. As new scope (either DSR or functional) is identified, if it is covered by the agreement no scope change is required. If it is not covered by the Agreement, a Project Change Directive or amendment will be required after a cost-benefit analysis has been performed and the scope has been approved for execution. The project plans will then be updated (as required) to reflect the impact on cost and schedule as a result of inclusion of the new scope.



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#### 6.4.1 Accepted Deliverables

The RFR project team will perform a thorough review prior to declaring elements of scope complete. Refer to RFR Contract Management Plan [R-38] for evidencing requirements for the EPC work and Section 2.9 of the RFR Agreement [R-28]. The Execution Phase Plan will require development of new evidencing requirements for the Execution Phase deliverables.

## 7.0 PROJECT TIME MANAGEMENT

This section supercedes the Project Controls Plan. The contents of the Project Controls Plan Rev 0 was updated to Execution Phase and incorporated in the current Project Management Plan under Cost Management and Time Management sections (PCP to be superseded to this document after issue).

This section details the process involved for the time management of the project through Schedule Development, Schedule Management, monitor and control.

#### 7.1.1 Work Breakdown Structure (WBS)

The project Work Breakdown Structure was developed in accordance with Nuclear Refurbishment Project Work Breakdown Structure Guide [R-19]

The project tasks have been organized according to the WBS in a planned, manageable and logical format using the 100% rule. That allows the integration between EPC Contractor and OPG schedules established to ensure the ability to “roll-up” the Contractor’s schedule into the OPG schedule.

A high level representation of RFR WBS Structure is shown in Appendix C.

## 7.2 Schedule Development –Execution Phase

During the definition phase the contractor developed an execution phase Level 5 schedule as per the requirements stated in the Exhibit 3.5, Article 3 of the RFR Contract [R-28].

The execution phase schedule is developed by the contractor in progression which is submitted along with the various classes of estimates as listed below:

Class 5 Estimate, Level 2 Schedule  
Class 4 Estimate, Level 3 Schedule  
Class 3 Estimate, Level 4 Schedule  
Class 2 Estimate, Level 5 Schedule

Schedule levels are as defined in the AACE recommended practice 37-R and in RFR JV Schedule Management Plan [R-51] .

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Guidance on development, management and control of NR level 3 execution phase schedule is provided in: Schedule Management Plan for Integrated Level 3 Execution [R-86],

RFR project team, NR P & C team and the NR work management team supported the development and review of the execution phase schedule.

The requirements, development process and schedule basis of level 5 schedule is documented in “DNGS RFR PROJECT – Class 2–Schedule Report” [R-68] submitted by the JV as part of the Class 2 Estimate, Level 5 Schedule deliverable.

### 7.2.1 Level 3 Execution Schedules Integration:

- Developed and updated in a single P6 instance, controlled and managed by OPG
- Activities are created using standard WBS and broken into Segments
- Activities are man hour based, resource loaded, and are generally less than one week in duration. Longer duration activities may require additional monitoring mechanism (e.g. Workdown Curve)
- All activities will be represented in Level 2 Summary Work Packages using the WBS structure
- Schedules were baselined (in September 2016) following integration with Ecosys. Baseline will be re-established only upon approval by CCB.
- Activities are generated using 2 methods:
  - Manual Input by the Scheduling Leads
  - Automatic upload of Work Orders from AS7
- Each P6 file will be owned and managed by a single Work Group/Vendor
- Standard P6 templates will be utilized to communicate the scheduling requirements for similar work across different Work Groups
- Activity Code dictionaries, resource codes and calendars will be established in OPG P6 instance and used by all the work groups
- RFR Critical path is divided by “windows” based on the Unit 2 Refurbishment Level 1 Rev 0 schedule.
- Appendix D lists the RFR Windows

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### 7.2.2 Level 3 Interface/Integration:

- All the integration activities (hand-offs) between Work Groups/Vendors will be logically tied through Interface Milestones
- The Interface Milestones are created by the Master Scheduler and each Scheduling Lead will create logic ties between the milestones and their activities
- All the interfaces within the same Work Group will have direct ties between L3 activities
- Milestones will be created using standard WBS and broken into Segments and Systems

### 7.2 Milestones

Nuclear refurbishment program has classified the milestones into tier structure as described in “Nuclear Refurbishment – Milestone Definition Framework” [R-69]. Following are the various tiers of milestones:

- **Program Tier 1** - Commitments to the Board
- **Program Tier 2** – Critical Impact
- **Program Tier 3** – Program Controls
- **Project Tier 4** – Project Gates
- **Project Tier 5** – Standard Project Milestones & Project Manager Milestones

Tier 1, 2, & 3 milestones are managed using the “ milestone definition form” as described in the Milestone Definition Framework document.

### 7.3 Schedule Quality Compliance

All schedules are checked for quality compliance using Acumen Fuse software and Job aid that lists the quality checks required:

- All milestones clearly identified
- Variances from last update, and from baseline
- Minimal or no constraints
- Float is identified
- Activities are cost and resource loaded to the extent practical
- Reflect the WBS



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- Show OPG tasks
- Show critical path and near critical path (within 20 days)
- Logically linked with predecessors and successors (no open ends)

Various layouts are developed to verify the quality of schedule as required on periodical basis.

All changes are recorded in the schedule change log which is updated when any change occurs and placed in share point site.

Any negative trends will be identified to the project team and formal notice provided to the EPC contractor of any findings.

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## 8.0 PROJECT COST MANAGEMENT

This section supersedes the Project Controls Plan. The Project Controls Plan Rev 0 was updated to Execution Phase and incorporated in the current Project Management Plan under Cost Management and Time Management sections (PCP to be superseded to this document after issue).

### 8.1 RFR Cost Model

RFR Project Costs primarily consists of:

- EPC Costs
- OPG Oversight Costs
- Interest & escalation Costs
- Contingency

RFR costs are tracked at Work Package level by the project in OPG's cost Management system 'Ecosys'.

The following table shows the project numbers and phase against which the cost tracking is done.

Project #	Project Description	Phase
73105	OPG Oversight Costs	Definition Phase
73117	OPG Oversight Costs-Retube Waste Processing Building	Definition Phase
73106	OPG Oversight Costs - Unit 2	Execution Phase
73108	OPG Oversight Costs - Unit 1	Execution Phase
73107	OPG Oversight Costs - Unit 3	Execution Phase
73109	OPG Oversight Costs - Unit 4	Execution Phase
73110	Reimbursable Costs	Execution Phase
73111	Mock Up	Definition Phase
73112	Tooling	Definition Phase
73113	Major Retubing Unit 2-Procurement	Definition Phase

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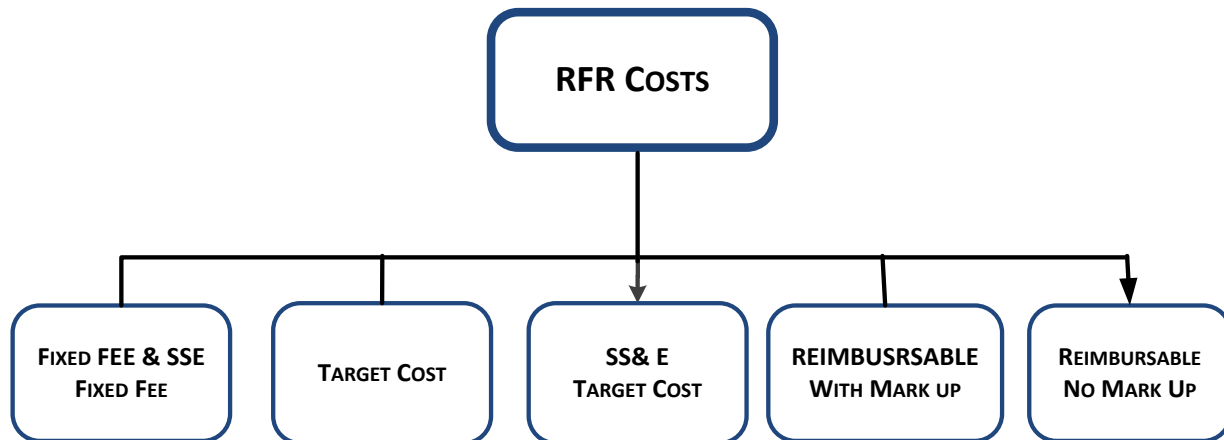
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Project #	Project Description	Phase
73113	Major Retubing Unit 2	Execution Phase
73115	Major Retubing Unit 1	Execution Phase
73114	Major Retubing Unit 3	Execution Phase
73116	Major Retubing Unit 4	Execution Phase
73118	Retube Waste Processing Building	Definition Phase

### 8.1.1 EPC costs

The cost breakdown of RFR project execution phase EPC costs is as illustrated below:



**Fixed Fee** is paid upon achievement of milestones against the fee as prescribed in the Contract Exhibit 3.1 (b)[R-28].

**Target Cost** means the Target Cost for all Reimbursable Work to be performed during the Execution Phase

**SS&E Target Cost** means the target cost, being a subcomponent of the Execution Phase Target Cost, for all Execution Phase Support Services & Equipment Work to be performed during the Execution Phase.

**Reimbursable Costs** means actual costs that are determined to be a Reimbursable Cost pursuant to section 6.3 of the Contract [R-28], which will be payable by OPG to the Contractor.

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Reimbursable costs with markup include costs of Owner-Specified Materials and costs of Goods.

Contractor will procure materials based on specifications provided by OPG and is responsible for competitive sourcing, quality, source surveillance site receipt, etc.

OPG pays actual costs plus fee. A 10 % mark-up on OSM materials and 5 % on goods and services is paid.

OPG reviews and approves any purchases in excess of \$1 Million.

Owner specified materials include pressure tubes, calandria tubes, end fitting, feeders, retube waste containers and other reactor components.

**Reimbursable Costs-No Markup** means the actual costs of:

- (i) travel, accommodation and subsistence (pursuant to lines 6.16, 6.16.1 and 6.17 of the Cost Allocation Table in the contract);
- (ii) Interim Project LC and the Project LC (pursuant to line 8.14 of the Cost Allocation Table); and
- (iii) insurance (pursuant to line 9.1 of the Cost Allocation Table) that are determined to be a Reimbursable Cost-No Markup pursuant to section 6.3, which will be payable by OPG to the Contractor without mark-up

**Support Services & Equipment** means the Costs associated with the support services and equipment as listed below.

- Business Services
- Project Office & Site Establishment
- Office Consumables
- Electronic Equipment
- Construction Tools & Equipment
- Company Vehicle

EPC costs are tracked by the contractor in the contractor cost management system PM+, cost reports are provided to OPG on monthly basis.

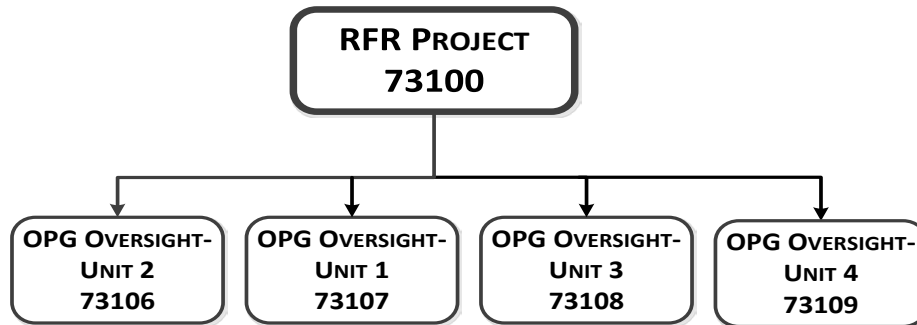
According to the NR cost model, costs associated with Retube waste containers are provisionally funded by Nuclear Waste Management Division and hence are excluded from NR reporting.

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### 8.1.2 OPG Oversight Costs

Oversight costs for execution phase are under the project numbers illustrated below..



Budget for the oversight costs are based on the estimates for full time equivalent of oversight personnel.

Project oversight costs are grouped by WBS Project Management, Engineering, Procurement and Construction.

Actual costs are tracked by assigning appropriate tempus work events as listed below:

<b>73106</b>	10101	Project Management	Oversight costs for Unit 2 execution, includes OPG direct labour, matrix staff, Augmented Staff, and Managed Tasks Staff, expenses,
	30201	Engineering	Oversight costs for Unit 2 Engineering (Field Engineering, Mods Engineering oversight, includes OPG direct labour, matrix staff, Augmented Staff, and Managed Tasks Staff
	40101	Procurement	Oversight costs for Unit 2 procurement includes OPG direct labour, matrix staff, Augmented Staff, and Managed Tasks Staff,
	50101	Construction	Oversight costs for Unit 2 Construction, includes OPG direct labour, matrix staff, Augmented Staff, and Managed Tasks Staff,
	00701	Interest Costs	Interest costs associated with oversight
	00901	Contingency	Contingency tracking

A 44 Digit code is used to track Material requests for services such as augmented staff/managed tasks

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Resp Centre	FAC	Resource Type	Service Unit	WPS	Project Number	Activity Field	SCI	Client	Local Field
2080	17553	XXX	8204	2080	73105	000	0000	2000	XXXX

For Local- Refer the table above 5 digit "WBS"

For Resource Type

010	Labour – Regular
200	Materials & Equipment
310	Managed Task Services/Contract Services
320	Augmented Staff

Appropriate Project number will be applied.

## 8.2 Budget Control

RFR budgets are established during the gated process for the gate period.

Per the NR Gated Process [R-35], the NR Program secures the required funding to support the entire Refurbishment Program, including the funding needs identified by each project and functional organization.

The RFR Project will "apply" for a release of funding from the program to support its work through the gated process. The NR Program will "roll up" these funding requirements across all project bundles and functions, including estimated amount and timing to meet the needs of the project to progress the work in a timely fashion.

The EPC contractor provides the cash flows for the gate period. These cash flows align with the deliverables and schedule forecast for the gate period.

OPG oversight cash flows are estimated using the resource planning and spread sheet provided by the Darlington refurbishment program that contains resource costs by job family and associated rate tables.

OSS organizations provide the cash flows for the gate period with back up information on deliverables and resource costs based on the task request from OPG.

Non EPC contracts are appropriately estimated based on the vendor quotes and negotiated values, included in the overall budgets.

All the costs described above are compiled in "RFR Resource Plan" spread sheet and the summary of the costs by month for the gate period are presented to Gate Review Board for approval. Once the budget is approved at the GRB [R-20][R-70] meeting, the P&C Lead updates the "Released Amount" in Ecosys via the CCF process.

The Ecosys OPG Cost Management system is used as a repository for approved budgets, control budgets, forecasts and approved changes for monthly cost management and analysis on the project.

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### 8.3 Financial Analysis

The Financial Analyst reports to the Controller Financial Major Nuclear Projects – but supports the RFR Project. The Financial Analyst is responsible for invoice reviews including:

- Reconciling the RFR Contractor actual vs. Forecast,
- Reconciling the ONCORE loads vs. cost report from the RFR Contractor,
- Auditing on an ad hoc basis the Reimbursable/Target Costs against the Cost Allocation Table,
- Referencing Section 6 of the RFR EPC Agreement, and
- Referencing RFR EPC Agreement [R-28] Exhibit 3.1, Exhibit 6.1, Exhibit 6.3 and other sections/exhibits as required.

### 8.4 Invoice Payment Process

This section explains the invoice and payment process for the EPC costs portion of the RFR project.

The EPC Contractor costs are collected through the ONCORE at the appropriate summary level in accordance with NR procedure for Contract Administration in ONCORE [R-39].

The ONCORE flow of transactions, approvals and reconciliations are as explained in the flowchart in Appendix E.

A draft invoice package is submitted by the EPC contractor. Following steps are performed:

- Complete the reconciliation check list: (see Appendix F)
- Check Date of Memo, Signed
- Check Invoice - tie all amounts back to the back-up, get clarification on any discrepancies, or add additional backup to the invoice package
- Ensure all of the supporting documents provided in the invoice package reconcile to the Invoice
- Check ONCORE to make sure what is presented in the invoice was input to ONCORE
  - Report to run out of ONCORE - Audit Detail run against NFRA – attach to invoice package

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- If milestones are being claimed on an invoice or Fixed Fees:
  - Validate that milestone certificate(s) are completed and are signed by an OPG Project Manager
  - Report to run out of ONCORE – PO% Spent Summary
    - Validate amounts claimed on invoice match what was input into ONCORE
  - Attach Exhibit from contract to validate the amounts claimed are the negotiated amounts from the contract
- Confidential Salary information
  - Validate the fringe claimed is either 37.51% or 37.18%
  - Validate amounts charged to each PO line item are supported by the Confidential Salary information package.
- Expenses
  - Validate expenses being claimed are allowable expenses on Exhibit 6.3 (a)
  - Indicate the Exhibit 6.3(a) cost allocation reference number for each expensed item
- Meet with Step 2 and Step 3 approvers and go over the invoice package:
  - Follow up with Joint Venture if Step approvers have additional questions
    - Document and attach to invoice package
  - Step 2 and Step 3 approvers sign Reconciliation Summary Sheet
  - Over see approvals in ONCORE

The Contractor invoices monthly forecast costs in accordance with the EPC Agreement.

If OPG does not accept the Contractor's monthly reconciliation, the amount that is not accepted will be offset from the next payment. Any outstanding advance will be deducted in full by OPG from payments to the Contractor, or repaid by the Contractor to the extent deductions are not sufficient to fully reimburse any overpayment.



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Non-Labour costs (materials, subcontracts etc) that incur costs but are not invoiced will be accrued monthly in accordance with OPG's finance governance.

- The Contractor will provide evidence of completion of the work to be invoiced at a future date and the associated costs. Accruals will be performed monthly and reversed upon invoice for those costs

The payment milestones that are accepted are aggregated to the 25<sup>th</sup> of the month and paid on the 25<sup>th</sup> of the following month.

### 9.0 PROGRESS MEASUREMENT AND PERFORMANCE MANAGEMENT

Scope Performance Measurements are done in accordance with "Darlington Nuclear Refurbishment Program-Scope Control" [R-6], Section 7.1 outlines the Health of Scope metrics. The milestones in the RFR schedule are coded to this requirement and metrics are run by the NR Program.

Progress measurement and performance on RFR project is measured through Earned Value methodology.

Earned value measurement is done as per the guide line described in Nuclear Refurbishment Earned Value Management [R-84].

The Earned Value methodology and reporting for the execution phase is outlined in Appendix I of this document. This section will further be updated with more detailed information.

EPC Contractor project performance measurement is done as per the Contract requirements and in accordance with JV Project Controls Plan [R-43]

### 10.0 PROJECT REPORTING

RFR project produces various reports to present the performance and report to the stakeholders on regular frequencies. Besides reports that produced to meet individual project team needs, following reports are produced to report to the NR program :

#### 10.1 Monthly Reports

The RFR Project prepares monthly reports and provides the input to NR Program overall status reports.

Executive Summary on overall project status is provided for:

- KRM (Key Results Meeting)
- NEC (Nuclear Executive Committee)

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- Program Status Report which feeds into Darlington Refurbishment Committee report

Monthly project status report (“quad chart”) is prepared by RFR project controls team in accordance with the format and template provided by NR planning & controls.

Schedule data milestone summary table are electronically extracted with the help of BI tool into the monthly project status report from P6 updates performed on month end by the RFR project control team based on the Contractor updates.

Cost data is electronically extracted with the help of BI tool to monthly project status report from Ecosys based on the input from invoice data and the schedule progress inputs provided by the RFR project control team.

Earned Value data is electronically extracted with the help of BI tool to monthly project status chart report from Ecosys and Earned Value application based on progress complete input provided by the RFR project control team.

Reporting requirements and structure for the execution phase will further be developed during execution.

## 10.2 Contractor Reporting

### 10.2.1 Monthly Progress Report

The RFR EPC Contractor provides status updates and reports on monthly basis in the monthly report in accordance with the Contract requirements specified in the RFR EPC Agreement [R-28] Exhibit 2.9(j). The Contractor monthly report contains the following elements:

- Health, Safety & Environmental Performance;
- Schedule Performance including but not limited to:
  - Engineering Activities;
  - Procurement Activities;
  - Permitting Activities;
  - Construction Activities; and
  - Submittals.
- Cost Performance;
- Quality Performance;
- Risk & Contingency;

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- Scope;
- Issues, Assumptions and Decisions; and
- Training Activities

### 10.2.2 Schedule Reporting

The Contractor updates their schedule at the lowest activity level on a weekly basis. These activities all roll into the WBS Summary activities provided to OPG. The following updates are provided by the Contractor:

- P6 (xer) file on a monthly basis. This (xer) file is posted on Sharepoint project team site.
- PDF versions of the monthly updated schedule consist of physical progress percent complete and schedule variance in days for each of the activities.
- Critical Streams and updates on the float.
- Variance explanation on critical path activities whose variance exceeds 20 days in a 30 day period.
- Schedule Performance Index (SPI)

### 10.2.3 Cost Reporting

NR Cost Management and Reporting follows the procedure Nuclear Refurbishment - Cost Management and Reporting [R-72]

Project Cost Management by the JV is governed by the JV Project Controls Plan [R-43] and its subsidiary documents.

The JV provides the cost updates through the PM+ cost report which is attached to the monthly report. This report provides the Original Budget, Approved Changes, incurred costs by period and cumulative, trends and commitments, forecast at completion.

The JV also provides a summary table in the monthly report by category such as Target Cost, Fixed Fee, Reimbursable costs and Fixed Price components.

The monthly report includes the forecast for the next 3 reporting periods and ONCORE reconciliation.

The JV provides the cash flows and the raw data as required.

OPG Oversight costs are available from NFRA reports produced by OPG Finance.

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### 10.3 Forecasting

This section outlines the process adopted for forecasting of cost and schedule on the RFR project.

Schedule progress is updated on monthly basis. Milestone completion dates are forecasted in the JV schedule based on the logic ties from predecessor activities.

Cost forecasts are done on a monthly basis to determine forecast to complete (FTC) and estimate at completion (EAC) for the gate period for which funding is approved.

Forecasts are assessed and reported for each sub-project as per the Cost Breakdown Structure.

OPG oversight cost forecasts are done based on the assessment of the requirement of full time equivalents required to perform the oversight.

EPC cost forecasts are done based on assessment of the schedule and inputs from JV.

Cost forecasts are assessed on monthly basis from the input from the JV and the project teams for the oversight costs. Forecast at completion is calculated for each month end period at the Work Package level.

Cost variances are measured and reported against the approved budget at the Control Account level.

The Ecosys cost management tool is used currently for reporting forecasting data.

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## 11.0 CHANGE MANAGEMENT

This section outlines the change control process followed on the RFR project.

RFR Change Control process follows the Nuclear Refurbishment Change Management Process [R-71].

RFR JV change control is in accordance with Scope Management Plan [R-45]  
Schedule Changes

Schedule baseline is changed only when:

- There is scope change: Changes when the activities are impacted by scope changes, scope transfers, scope removal, Contract Milestone changes and program milestone changes.
- The current plan is no longer valid: Changes when activities are impacted due to the changes in execution strategy, for example, procurement/manufacturing strategy is changed after vendor development process.
- When a new plan/budget is approved at the Gate: Changes due to the new gating strategy.

JV schedule baseline may be changed with the approval from OPG in any of the scenarios described above.

Gate Review Board approval process is used for the approval of the baseline. In case of changes after the GRB [R-70], a Change Control Form (CCF) is used to record and approve the changes.

### 11.1 Budget Changes

A budget baseline is created with approval from the Gate Review Board. Any further changes are managed through CCF process described above.

Target Cost changes to the Contract are handled through the PCD process.

Scope/Budget transfers between Nuclear Refurbishment project bundles are handled through the CCF process.

### 11.2 Joint Venture Cost Management

Project Cost Management and integration by the JV is governed by the Project Controls Plan [R-43]

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## 12.0 PROJECT QUALITY MANAGEMENT

Quality Management includes the following activities:

- Reviews of JV-produced deliverables against requirements, standards, and best practices.
- Planning and executing surveillance on JV with follow-up on findings.
- Self-assessments against OPG procedures and audit findings

### 12.1 Approach to Quality Management

The project has defined requirements during the Definition Phase and these are included in various project documents including the Scopes Of Work, the EPC Contract, and applicable referenced OPG governance.

Implicit project requirements include meeting applicable Codes and Standards as prudent practices/best practices are employed to perform the work.

Explicit project requirements include technical, functional, performance, and commercial requirements that must be verified during the project execution. The oversight, auditing and verification of the work should occur as early as possible (prevention vs. inspection) in the project work so that if changes are required, they are identified early and the impact to the cost and schedule will be minimized.

Wherever possible, evidence criteria should be clarified collaboratively with the JV and agreed to in writing to ensure that all aspects of quality required to meet milestones are explicitly understood by all relevant stakeholders.

### 12.2 Requirements Traceability and Verification Methods

The explicit project requirements will be identified throughout the project, be tracked by the project team, and verification methods will be used to ensure each deliverable is achieved. Some examples of verification methods include:

- Design review
- Design Authority
- Analysis review
- Calculation
- Demonstration
- Inspection
- Functional test
- Mockup acceptance test
- Performance test
- Destructive or non-destructive examination
- Review of report

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All design requirements will have a dedicated Requirements Traceability Matrix established for each design package, and it will be managed through the engineered change control process and associated governance and process support documents. Other items such as SOW commitments will be tracked separately in a centralized location (at the time of revision of this PMP this tracking is happening in different formats across the sub-bundles, consolidation is in progress). The verification activities for completion of commitments/requirements throughout the project will be planned in numerous vehicles including but not limited to the JV schedule, the OPG schedule, the procurement look ahead plans, and the RMO oversight and actions tabs.

A sample template of a requirements matrix is included below for reference:

Requirement ID	Explicit Requirement Reference	Requirement Description	Verification Methods	Document Reference	Requirement Met?
1	SOW 2.2(a)	The deliverable shall achieve a speed of X	Review of Design, Performance Test	Design EC #, COMS Reference, ITP #	Yes
2	EPC Exhibit 3.5	The estimate shall be prepared according to the Plan	Review of report	Report # Rev 1	Yes
...	...	...	...	...	...
N	Etc	Each Requirement tracked shall be unique and measureable	Review of X, Y, and Z	Document references provided by team performing the work and provided Submittals	Track requirement as project progresses and reviews are completed

Note that there may be multiple Verification Methods for each requirement so as to reduce the residual risks as the work progresses, for example a design may be reviewed against the requirements and then subsequently inspected or tested against the requirements later in the project execution.

Note that some Explicit Requirements may start off as functional and be elaborated as the project progresses to become specifications or detailed functional requirements documents (also referred to as derived requirements) so that each of the detailed specifications or requirements are verified later in the project execution prior to acceptance and signoff.

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Note that this traceability matrix is a live document and can be updated and tracked as the project progresses so that the project team knows what outstanding requirements are to be met by the end of the project. This provides a view of the potential risk to the schedule and project performance based on what is outstanding and how long it may take to achieve all of the requirements. Also, it provides a predictor to discover if there may be concessions required as the project progresses.

### 12.3 Compliance to Standards and Plans

It is recognized that Quality Management on the RFR project is composed of the following distinct areas.

1. OPG Quality Management - This is accomplished through compliance with the standards and procedures listed throughout the project plans, in particular the Darlington Refurbishment Management Systems And Performance Improvement Program Management Plan [R-92]. The Management System Oversight (MSO) group provides an independent mechanism to ensure project quality objectives are met. These plans also provide guidance on the appropriate use of Corrective Action Programs (both OPG and the vendor's), and direct the MSO organization to set up a schedule for self-assessments [R-18] as well as internal audit and to support internal audits by OPG Performance Assurance.
2. Contractor Quality Management
  - a. Joint Venture – This is verified through all of the OPG project team's activities working with the Joint Venture. Trust through verification is obtained through a variety of methods including design reviews and Design Completion Verification, acceptance of ITPs, field oversight at manufacturers to verify proper oversight being applied by the JV, "deep dives/audits" of the Joint Venture following their project plans and quality management system. The RFR Project Oversight activities perform checks from time to time based on risk associated with JV compliance to their own applicable procedures and processes. Additional quality assurance is provided by other supporting teams such as MSO, Supply Chain quality services, internal audit, external audit, self-assessments, and third-party reviews.
  - b. OSS – The type of QA applicable depends on the task. The RFR OSS scope is generally performed under the OPG QA program, with specific activities performed under the OSS QA program. Additional quality assurance is provided by other supporting teams such as MSO, Supply Chain quality services, internal audit, external audit, self-assessments, and third-party reviews.

### 12.4 Management System for Quality

The Quality Management of the project will be in compliance to:

- N-CHAR-AS-0002 - Nuclear Management System [R-8],
- N-CHAR-AS-0003 Darlington Refurbishment Managed System [R-9]



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- N-PROG-AS-0001 - Managed Systems [R-10],
- N-PROG-AS-0007 - Project Management [R-11],
- RFR EPC Agreement [R-28].

Along with the following Standards and Guideline documents:

- N-STD-AS-0028 - Project Management Standard, [R-12]
- N-STD-AS-0029 – Contract Management Standard [R-13],
- N-STD-AS-0030 – Project Oversight Standard [R-14],
- NK38-DP-09701-10001 – Retube & Feeder Replacement (RFR) Design Plan [R-4],
- N-MAN-09701-10002 – Nuclear Project Oversight Guide [R-16],
- NK38-NR-PLAN-09701-10001 Sht: 0010, Darlington Refurbishment Management System Oversight and Performance Improvement Program Management Plan [R-92]
- N-PROC-MM-0010 – Establishing and Maintaining Ontario Power Generation Nuclear Approved Supplier List [R-17].

## 12.5 Quality Assurance

For EPC work on RFR, the JV has prepared a project Quality Assurance Plan [R-54] that addresses the interface responsibilities with external organizations. The Plan addresses all applicable requirements of CSA 299.1, CSA N286-05 and CSA N286.7 standards identifying what quality program and procedures will be followed, including the contractor's and their sub-contractor's personnel responsibilities under the various quality programs.

The Contractor's QA program will be audited by OPG as required.

The Project team, jointly with the Functional teams, will work to ensure the quality of design, quality of materials and services provided and the quality of installation and commissioning work performed are meeting OPG standards, Purchase Order requirements, and compliance to codes and standards as applicable.

In the instance of a Quality system failure or a breakthrough event occurring for which the Contractor is accountable, the adverse conditions will be documented per the Contractor's QA Program . The Contractor will be asked to initiate a Corrective Action as per their program for any identified quality issues. When there is a systemic failure of their implemented Quality System, a formal Non Conformance and Corrective Action Request process will be initiated by OPG Supply Chain Quality Services as per N-PROC-MM-0010 [R-17].

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To ensure compliance to OPG requirements, the contractor interface will be controlled by the Contractor Owner Interface Requirement (COIR) document [R-26] forming part of the Agreement and deviations, additions, exceptions, revisions thereto will be accepted by both OPG and the Contractor.

### 12.6 Quality Control

Quality on the project is achieved through the implementation of OPG's Program and project plans and the JV's Plans.

As the great majority of the work is executed under the JV's Quality Assurance program, OPG will perform oversight and witness key aspects of the work program. For example, witness points will be included in Manufacturing Inspection & Test Plans for Reactor Components.

The specific metrics used to track performance on quality are currently being developed by the Refurbishment Program. To date, numbers of SCRs and numbers of non-conformances have been used by the project to track performance on quality.

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## 13.0 PROJECT HUMAN RESOURCES MANAGEMENT

### 13.1 OPG Human Resources Management

#### 13.1.1 Team Resourcing

In Nuclear Refurbishment, OPG has made Project Directors/Managers accountable for overseeing all EPC Contractor work. The EPC Contractors will be responsible to deliver the contracted work as per the individual EPC Agreements.

The OPG RFR Project Organization is shown in Section 13.2 below. The key roles and their respective accountabilities are described in the following sections.

Nuclear Refurbishment has elected to employ a strong Matrix organizational model to execute the Refurbishment Program. RFR has staffed the project team with OPG staff, supplemented by augmented staff and OSS Managed Task activities to meet the project schedule and needs. OPG staff will either be embedded in the team or will perform functions matrixed from the NR functional organizations. Where NR functional staff are unable to fulfill a specific need, due to unavailability or missing skill sets, the project will work with the accountable Functional Manager to either utilize managed task contracts to maximize outside experience or attempt to find staff within other OPG business units. In the strong matrix model, it is the accountability of the Functional Manager to acquire the required resource.

At this phase of the RFR project, project human resource management will include:

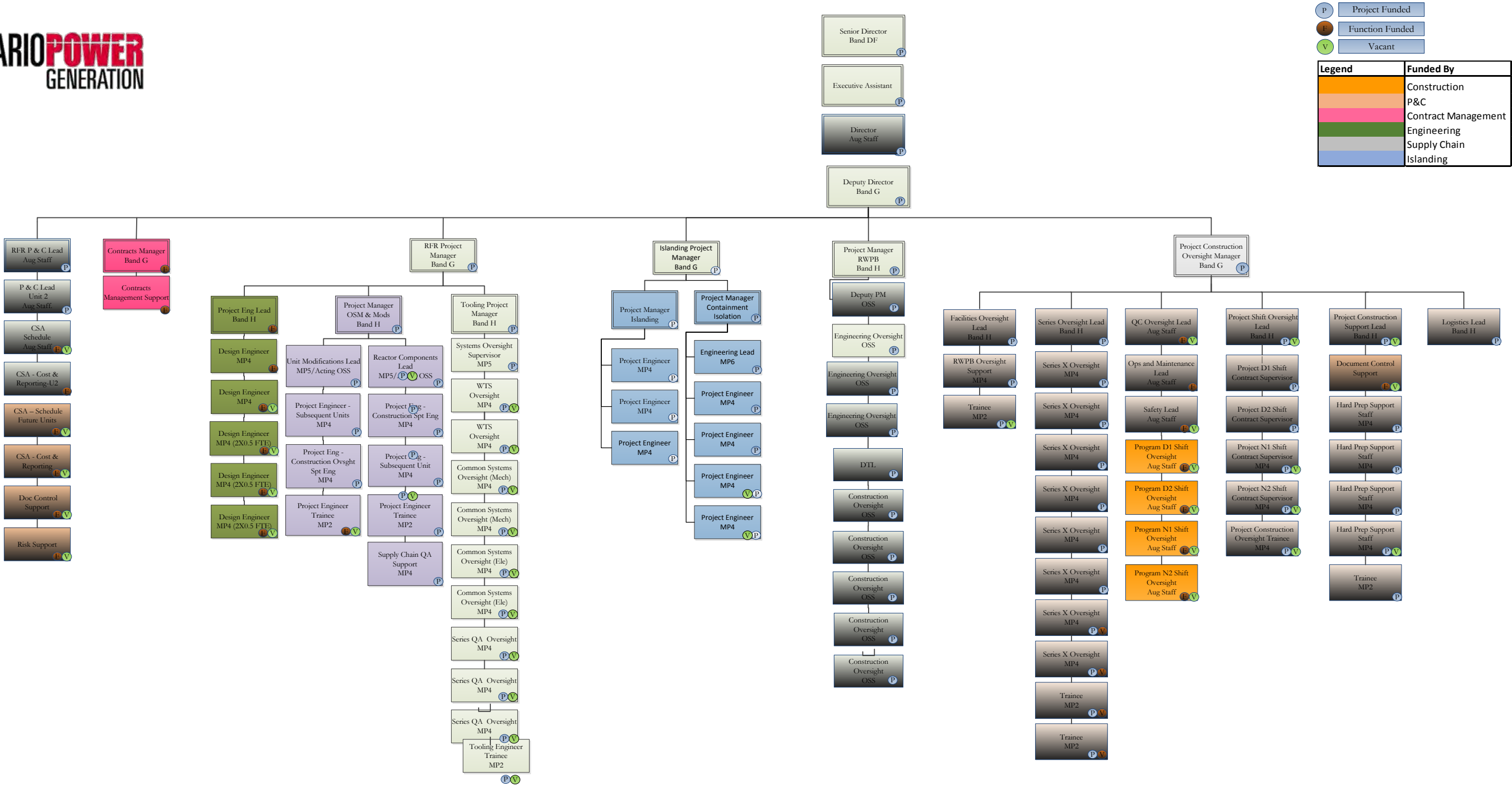
- Identify and documenting in this PMP the project roles, responsibilities, required skills, and reporting relationships
- Confirming human resource availability and obtaining the team necessary to complete the project activities
- Developing the team through improving competencies, improving team member interaction and overall team environment to enhance project performance
- Managing and tracking the project team member performance, providing feedback, resolving issues, and managing changes to optimize project performance

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13.2 Project Organization Chart



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### 13.3 Project Organization- Roles & Responsibilities

#### Sr. Project Director / Project Director / Deputy Project Director

- Overall responsibility of all areas of the project (scope, contract, resourcing, risk, etc...)
- Budget owner per gate
- Project Signing Authority

#### Planning and Controls Lead [Matrixed Role]

- Reports to Project Director.
- Reports to functional manager in the P&C line to ensure standards and governance related to P&C are adhered to. Any requirements from functional management that could impact project duties needs to be vetted and coordinate with the PD.
- Project Reporting
- Primary interface with Contractor P&C Manager and scheduling
- Invoice review coordination and approval
- Schedule management (incl. Oversight of vendor cost and schedule management)
- Weekly interfacing with each PM on cost, schedule, and risk including trend analysis
- Risk Management
- Routine interfacing with function
- Gate package cost and schedule preparation

#### Contracts & Commercial Manager [Matrixed Role]

- Reports to Project Director
- Delegated project signing authority from Project Director
- Responsible to interface with Project team to ensure adherence to Agreement.
- Advises Project management on commercial strategy
- Reports to functional line in the contracts/commercial organization to ensure standards and governance related to contracting are adhered to. Any requirements from functional management that could impact project duties needs to be vetted and coordinated with the Project Director.
- Responsible for preparing and issuing PCDs, commercial/contracts letters, Amendments.
- Primary interface with contractor contracts manager

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### Project Manager RFR [Direct Project Role]

- Reports to RFR Project Director RFR/Islanding
- Responsible for RFR scope, cost, risk, quality, safety, schedule
- Responsible for Engineering and Procurement oversight (routine, process, strategic)
- Succession Planning and Staff Training and Development
- Staffing Strategy for accountable areas
- Gate preparation
- Preparation of OPG management plans
- Monthly preparation of RFR project status quad chart

### Project Manager Islanding [Direct Project Role]

- Reports to RFR Project Director RFR/Islanding
- Responsible for Islanding scope, cost, risk, quality, safety, schedule
- Responsible for Islanding oversight (routine, process, strategic)
- Succession Planning and Staff Training and Development
- Staffing Strategy for accountable areas
- Gate preparation
- Preparation of OPG management plans
- Monthly preparation of Islanding project status quad chart
- Note that Islanding project organization is elaborated in more detail in the Islanding PMP.

### RFR Project Engineering Lead [Matrixed Role]

- Reports to Project Manager RFR
- Manages engineering resources (including qualifications) to execute oversight and vendor deliverable reviews.
- Coordinates any decision making with PM to ensure alignment to Contract.
- Reports to functional managers in the engineering line to ensure standards and governance related to Engineering are adhered to. Any requirements from functional management that could impact project duties needs to be vetted and coordinate with the PM.

### Project Manager – OSM & Modifications [Direct Project Role]

- Reports to Project Manager RFR
- Responsible for OSM and modifications scope, cost, risk, quality, safety, resources, schedule
- Scope is delivering as per Agreement:

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- Engineering modification oversight and review
- Engineering associated with procurement of OSM (tech specs)
- Field initiated changes (process and oversight of)
- Procurement management and oversight of:
  - OSM
  - All Goods including waste, Modifications and infrastructure related

### Project Manager – Tooling [Direct Project Role]

- Reports to Project Manager RFR.
- Responsible for tooling scope, cost, risk, quality, safety, resources, schedule.
- Responsible for oversight of JV Tool Management Organization: including oversight of ECR process, WO process, Tool Tracking/Readiness process, and EPICOR software system.
- Support for Series Leads during execution readiness and troubleshooting: this includes providing tooling technical expert support for series leads when SIR or HIT teams are required.
- Support Series Leads in AFS for category 1 tools.
- PM lead for Tooling Change Control process during execution.
- PM level lead for RFR Risk Management and Oversight (this is an assigned role at time of PMP issue, the role may be rotated to another member of the team at the discretion of the Project Director RFR/Islanding)
- Responsible for integration of the Waste Tooling System (WTS) into the RWPB construction.

### Project Manager – RWPB [Direct Project Role]

- Reports to Project Director RFR/Islanding
- Responsible for RWPB scope, cost, risk, quality, safety, resources, schedule
- Responsible for implementation of Owner Only execution model for construction and operation of the RWPB through the full refurbishment project
- Oversight of JV work planning in compliance with MA22 for RWPB tie ins to station systems requiring coordination with operating units through IPG schedule
- Responsible for oversight and coordinating reviews of deliverables (e.g. estimates, cost reports, engineering products)

### Project Construction Oversight Manager

- Reports to Project Director RFR/Islanding.
- Functional reporting relationship with NR Construction Director
- Responsible for construction oversight (routine, process, strategic)

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- Delegated RFR Project Director OHSA accountability for Owner/Constructor
- Facility interface w/OPG Facilities (e.g. DEC, RFRISA)
- Develop bridging strategy to transition from definition to execution phase
- Readiness management (e.g. tooling to DEC, RWPB in service, OSM on site, facilities ready for use such as RFRISA,...)
- Interface with other projects re: schedule, logic, etc
- Safety Plan
- JV Gang Owner (currently executed by RFR Project Manager, PM has initiated request for this role to be self performed by the JV as it is only a communication tool for RP, OPG training, security and tool overdue notices for which JV has full accountability)
- COMS input/oversight focused on Construction
- COIR – oversight of and changes to Construction section
- Dose/ALARA/RP planning oversight
- Labour agreements (requirements, involvement in establishment)
- Transition planning for program construction management oversight

**Construction - Facilities Oversight Lead [Direct Project Role]**

- Reports to Project Construction Oversight Manager
- RWPB Oversight Support following building AFS
- DEC warehouse and mockup oversight and support

**Construction – Series Oversight Lead [Direct Project Role]**

- Reports to Project Construction Oversight Manager
- As Counterpart to JV Series Lead, accountable for oversight of series readiness, training, execution and closeout
- Development of construction execution metrics (in collaboration with Project Construction Support Lead for alignment with Program requirements)

**Construction – QC Oversight Lead [Functional Role]**

- Reports to Project Construction Oversight Manager
- Lead in oversight of JV Quality program activities including compliance with JV Quality Plan, governance, ITPs (which will require targeted shift coverage during execution)
- has matrixed Operations and Maintenance reports to this role but supports the entire project in alignment with RFR priorities
- Safety Lead, performing oversight on JV compliance with safety management plan, in close coordination with NR Safety organization to optimize alignment on focus areas and sharing of observations to allow efficient cross program trending



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### Construction – Project Shift Oversight Lead [Direct Project Role]

- Reports to Project Construction Oversight Manager
- Lead of Construction oversight personnel that will be on shift with JV
- Oversight of field activities, primarily inside the protected area, coordinating oversight efforts with Series Leads, QC oversight, logistics lead

### Construction – Project Construction Support Lead [Direct Project Role]

- Reports to Project Construction Oversight Manager
- Integration of project reporting into program focus areas (e.g. RQE, Hard Preps)
- Oversight of JV work planning in compliance with MA22 for work requiring coordination with operating units through IPG schedule (e.g. RCC installation, weather enclosure, excluding RWPB tie ins) in collaboration with P&C lead for scheduling requirements
- Doc Control Support

### Construction - Logistics Lead [Direct Project Role]

- Reports to Project Construction Oversight Manager
- Lead RFR logistics activities across RFR projects, including OPG and JV staff accommodations, oversight and support for logistic areas with high interaction with operating units (e.g. waste interstation transfer route to RWPB)

### Manager Design Projects - RFR [Functional Role]

- Dedicated Band G Design Manager to RFR, direct interface with NR Design Authority to ensure project execution in accordance with OPG engineering governance defined in RFR COIR,
- works with project to prepare engineering products (e.g. DCAVR) and recommends to the DA acceptance of said products
- Working with engineering peers and design authority, supports timely escalation and resolution of engineering issues
- Ensuring design staff matrixed to the project (design engineering, resident engineering) are fully qualified and trained to perform required duties
- For Tooling, Modifications, OSM, Waste, Containment Isolation, provides reviews and recommendations to Design Authority to accept design deliverables, or disposition deviations to the specs.
- Interface with RFR Project Manager to ensure function actions are consistent with project needs and priorities

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### Components & Equipment Manager [Functional Role]

- As Engineering Authority for nuclear refurbishment, approves OSM specifications, manufacturing DDRs (requests for deviations from specification) and NCRs (one off non-conformances to specifications)
- As a SPOC for all component engineering issues, ensures alignment between project, vendors, plant engineering and nuclear support (MCED and FCLMP) and regulatory affairs.
- Interface with RFR Project Manager to ensure function actions are consistent with project needs and priorities

### **13.4 On-boarding New Team Members**

Onboarding of staff onto the project is done in accordance with established processes, OPG staff per HR process, augmented staff per augmented staff MSA requirements, OSS through RFR OSS project manager.

Initial focus is dependent on assignment, however key areas for all staff include familiarity with high level understanding of RFR Agreement, role of OPG in performing oversight on EPC vendor, RFR COIR, RFR SOW, RFR organization and RFR schedule.

The JV have issued a Trades On Boarding and Training Plan [R-60] and a Mockup Training Plan [R-66] to document the process by which trades will be engaged and trained for RFR Execution.

### **13.5 Off-boarding Team Members**

Offboarding of staff will be done in accordance with established processes, OPG staff per HR process, augmented staff per augmented staff MSA requirements, OSS through RFR OSS project manager.

Change in matrix staff assigned to the project is performed by functional organization at the request of the project

### **13.6 JV Resource Management**

The JV have issued a Resource Management Plan for the RFR Project [R-44]

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## 14.0 PROJECT COMMUNICATIONS MANAGEMENT

At this phase of the RFR project, project communications management largely consists of managing communications with the JV and stakeholders in a manner that optimizes prompt completion of activities and resolution of issues, with records generated in a manner that supports future retrieval of relevant information. In addition, project status communication is accomplished by maintenance of reporting infrastructure (e.g. P6 schedule, ECOSYS) to allow automated centralized reporting by the P&C Function, with variance explanations provided as required by the project. In light of the fact that RFR activities make up over 80% of the NR critical path and the largest proportion of NR costs, it is understood that RFR will be a main area of focus for senior management which may result in communication requirements (e.g. mockup tours for Government officials, DRC presentations) over and above that of other NR project bundles.

### 14.1 OPG Communications Management

### 14.2 Information Control

The main stakeholder communication methods are:

- Telephone and Email communications,
- Submittals,
- Meetings, and
- Publications and Reports.

Emails: Regularly used to document interface with stakeholders, the project team and with the Joint Venture. A RFR Project Mailbox has been set up (NR-RFR PROJECT) which is accessible by all members of the OPG RFR Team to capture emails deemed important for the RFR project.

Submittals: As per the RFR EPC Agreement, Submittals are important communication methods. Submittals are described in Section 2.9 of the RFR EPC Agreement.

Meetings: Conducted face-to-face with available teleconference and videoconference as required. Stakeholder meetings involving the RFR project and its stakeholders are listed in Table 2. Internal RFR Project Meetings are shown in the table below.

Publications and Reports: RFR publications and reports are described in the applicable sections of this PMP. Publications of RFR information are also communicated to internal stakeholders via OPG newsletters (e.g. The Pulse) and Intranet websites (e.g. RFR intranet website).

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Table 2: RFR Stakeholder Meetings		
Meeting Title	Description	Frequency
Executive Oversight Committee	Project Performance Update. Issue resolution. Chief Executive Update.	Quarterly
OPG/JV Steering Committee	Project Performance Update. Issue resolution.	Monthly
Monthly Integrated Project/Functional Communication Meeting	Review of Project Quad-Charts	Monthly
RFR/MCED Interface Meeting	Alignment meeting	Monthly (as required for RFR)
DN Refurbishment/CNSC Meeting	status updates, clarification, issue resolution	As requested by CNSC or RFR Project
RFR/JV Weekly Project Manager's Meeting	Project Performance Update. Issue escalation, and resolution.	Weekly
RFR/JV Team Leads Meeting	Project Performance Update. Issue resolution.	Frequency dependent on area, no less frequently than monthly
RFR PM Risk Meeting	Alignment on RMO strategic issues & status of Risks, Actions, Oversight, Assumptions, Decisions. Include broad stakeholder participation.	Bi-Weekly
MRM Meeting	Review and processing of station condition records associated with RFR. Execution representation rotated through project bundles.	Weekly
DN Refurbishment/ NWMD Coordination Meeting	Alignment meeting	As Required
Nuclear Refurbishment Program Standups	Refurbishment staff communication and alignment	Biweekly

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Table 2: RFR Stakeholder Meetings		
Meeting Title	Description	Frequency
RFR/IMS Interface Meeting	Discussion on tooling and logistics for RFR	As Required
Nuclear Refurbishment All Staff Face-to-Face Meeting	Project update	As Required

Records: The Communication Technology and Information distribution tools that will be used by the project are described in section 5.1. In summary, the following are the main project communication vehicles are as follows:

- Supplier Document Hub (SDH): External environment used for exchange, management of Submittals as per the RFR EPC Agreement and Project Communication Plans
- Electronic Data Management System (VENDM): OPG environment used for exchange, management of Submittals as per the RFR EPC Agreement and Project Communication Plans
- SharePoint 2007: Internal document storage, exchange environment used for storage of project documents, deliverables, schedules, cost information, as well as confidential & commercially sensitive information relevant to the RFR project and contracts.
- PDMC: This is the external instance of SharePoint used by SLN-Aecon JV for their documentation management. Some OPG staff have limited access to this site to facilitate collaborative reviews of preliminary documents.
- OPG Records & Document Management (RDM) are owners of both the SDH, VenDM, and SharePoint, and are responsible for process definition and support, technical support for SDH, VenDM, and Sharepoint as it relates to Submittals, and comments and dispositions as outlined in the RFR EPC Agreement.
- Project Records will be maintained in VenDM, SharePoint and Project Emails. As applicable, project records will be indexed and stored in Asset Suite.

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### 14.3 Performance Reporting

Performance reporting will be done in accordance with the Darlington Refurbishment Communications Program Management Plan, [R-1].

The RFR EPC Agreement Exhibit 2.9(j) specifies regular project reporting requirements in the following areas:

- Health, Safety & Environmental Performance;
- Schedule Performance including but not limited to:
  - Engineering Activities;
  - Procurement Activities;
  - Permitting Activities;
  - Construction Activities; and
  - Submittals.
- Cost Performance;
- Quality Performance;
- Risk & Contingency;
- Scope;
- Issues, Assumptions and Decisions; and
- Training Activities.

### 14.4 Joint Venture Communication Management

Communication by the Joint Venture is done in accordance with their Communication Management Plan [R-48].

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## 15.0 PROJECT RISK MANAGEMENT

RFR project risk management is performed in accordance with Nuclear Projects Risk Management [R-77]. Any RFR specific processes are detailed in this section of the PMP. The Risk Management and Oversight (RMO) tool is the risk register for OPG risks, which includes JV risks where there is residual risk to OPG after JV mitigation.

For most RFR risks related to performing the work in definition or execution scope, the JV is responsible for the primary risk management. The risks identified during the class 2 execution estimate or identified by JV on an ongoing basis are tracked in the JV's risk register in compliance with their Risk Management Plan [R-46].

### 15.1 OPG Risk Management with RMO

#### 15.1.1 OPG Risk Management Process Overview

In alignment with Nuclear Projects Risk Management [R-77], key activities in risk management include:

1. Identifying new risks.
  - Ensure title and description are appropriate: event, cause, impact.
  - Ensure risk rating is compliant with heat maps.
    - Pre Risk Rating – initial values;
    - Post Risk Rating – end state, assuming risk response strategy is effective. This score shall be reassessed if conditions change.
    - Current Risk Rating – best estimate of current state of the risk. This score shall be reassessed regularly, especially when actions are closed or new info indicates risk is more severe.
  - PMs ensure appropriate risk owner and delegate (technical expert).
2. Managing existing risks on a regular basis.
  - PM teams have bi-weekly meetings with minimum of monthly review period.
  - The current risk rating is expected to change as a risk increases (i.e. changing conditions) or decreases (i.e. through mitigating actions).
3. Escalation of high level or urgent risks to senior management.
4. Identifying risk response
  - Preparing mitigation strategies with SMART actions if applicable. OPG actions are tracked to completion in RMO and must be updated with the same frequency as risks.
  - Preparing strategic oversight and generating oversight findings in RMO when appropriate.
5. Closing risks when they are either realized (may be converted to issue), fully mitigated, or no longer relevant.
6. Ensuring contingency plans are prepared and accepted for high level risks should the risk become realized (Risks with post mitigation score  $\geq 15$  per heatmap).

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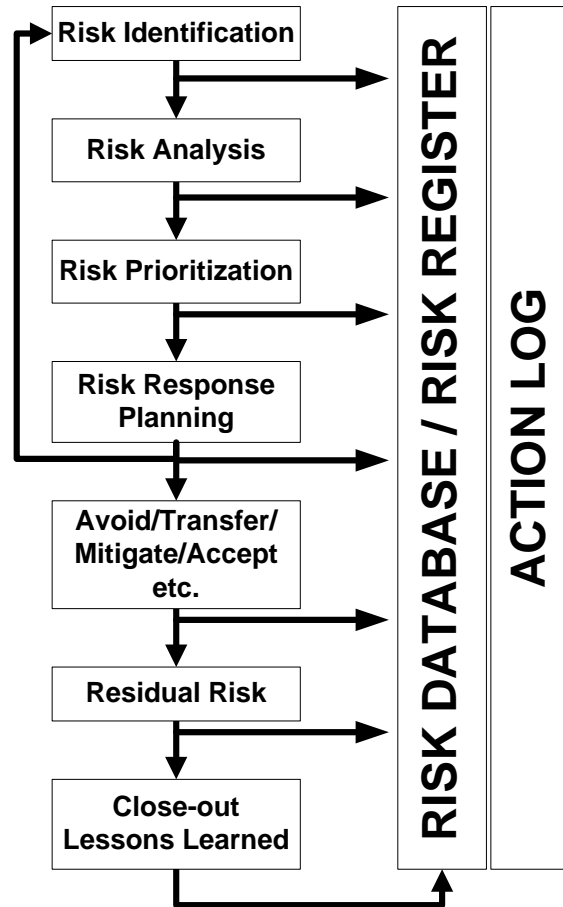


Figure 4: Overall Risk Management Process

- RFR participates in regular bi-weekly alignment meetings with Darlington Refurbishment program.

### 15.1.2 Actions and Oversight in RMO linked to Risks

Risk response actions are actions created and tracked in RMO and must be linked to the risk. At least one action is required for any risks with a response strategy of mitigate (note that these may point to an action in another managed process, with progress and status to be tracked in that managed process e.g. P6 schedule activity). These actions are intended to capture all SMART activities required to complete the mitigation strategy. As actions are completed, it is expected that the risk rating will be modified accordingly (typically it will be partially mitigated by completed actions). When all actions are completed for a 'mitigate' type risk, the expectation is that the risk rating is equal to the post mitigation risk rating. If there is still a gap, then additional mitigating actions should be identified and added.



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Depending on the complexity of the risk, it is recommended that one or a few higher level actions are more readily managed than many low level actions. Details of the actions and routine status updates should be entered in the comments field of the action in RMO on a minimum of a monthly basis.

The target completion dates for actions are intended to be committed targets and missed dates are tracked by refurbishment management. If an action date must be extended, the expectation is that the PM or delegate will seek appropriate approvals for the extension and document the change in the action comments update.

For any medium or high risks with a response strategy of monitor or transfer, the expectation on the PM or delegate is to create at least one action linked to the risk to document increased degree of in-process or routine oversight activities, for example more regular oversight field presence, meetings, recovery plans etc.. Where a strategic oversight activity/finding is applicable, an RMO action is not necessary because the oversight is tracked in the oversight module of RMO and should be linked to the risk.

### 15.1.3 Transfer of Risks and Actions

Risks may be transferred between the JV risk registry and OPG RMO risk register when the other party is more accountable for managing the risk. There needs to be a confirmation of acceptance by the receiving party before the risk in the transferring risk register can be closed. This acceptance takes the form of a new risk with appropriate actions being created in the receiving risk register.

For example, OPG has a risk in RMO and during regular reviews, the PMs agree the JV should be managing the primary risk. The JV would need to create a risk in their risk register with appropriate mitigating actions. The JV risk ID and a brief summary of the JV's action plan must then be listed as closure notes in the OPG risk register, RMO. The risk would then be closed in OPG RMO, or if there was still a significant residual risk to OPG, the risk might remain active in RMO to track the residual risk only with a reduced score - the JV would be responsible for managing the primary risk.

### 15.1.4 OPG Risk Management Roles & Responsibilities

Overall accountability for RFR risk management is the RFR Project Director. A central RFR Project Risk Manager (Risk SPOC) is a delegated role from the RFR Project Director, with accountability to work with all PMs to ensure a consistent and effective approach to risk management and implement continuous improvement.

Each PM is accountable for risks related to their scope including oversight of relevant JV risks. In RMO, the PM is typically the owner of the risk. They are responsible for ensuring compliance with refurbishment governance as per Nuclear Refurbishment Risk Management [R-77] and RFR risk management (this Section). Each PM may assign risks to a delegate who may be any members of the RFR project management team if they are deemed by the PM to be competent to provide appropriate status update for the risk, actions, and oversights. The delegate is typically either a technical expert or a SPOC familiar with the risk process and RMO tool.

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The following roles have been defined for the RFR Project:

- OPG Project Director
- OPG Project Risk Manager (Risk SPOC)
- OPG Risk/Action Owners
- OPG Risk/Action Delegate
- Reviewers and Advisors

### 15.1.4.1 OPG Project Director

The OPG Project Director has overall accountability to ensure that the Project Risk Management process is appropriately implemented.

### 15.1.4.2 OPG Project Risk Manager

The OPG Project Risk Manager (Risk SPOC) is a position delegated by the OPG Project Director to support all aspects of the Project Risk Management process. The specific functions of the Project Risk Manager include:

- Coordinate RFR PM level risk review meetings. This meeting is a strategic forum for PMs, NR program risk representative, the JV risk manager and a broad representation of stakeholders to discuss the highest risks from RFR project, refurbishment program, and vendor risk register as well as opportunities for continuous improvements in RMO and oversight of vendor risk management.
- Assist PMs in tracking compliance of risks, actions, and oversight with governance. For example, through dashboards identify risks not updated in the past month, mitigated risks without actions etc.
- Coordinate timely entries of risks and mitigation actions and updates in the OPG RMO tool (risks and action log).
- Interface with the Contractor Risk Manager on Contractor's Risk Management process. Participate in Contractor's risk meetings and workshops
- Interface with the NR Program Risk Management representative to align RFR Project Risk Management process with the NR Program.

### 15.1.4.3 OPG Risk/Action Owners

All risks and actions in RMO require a OPG Risk Owner identified in RMO by their corporate profile name. The owner is typically a RFR Project Manager (but may be a Director for higher level risks), should be a person knowledgeable about the scope of the risk and with sufficient authority to actively plan responses to the risk, including assigning resources as a risk delegate and to mitigate the risk. The owner of the actions is typically the same person at the owner of the applicable risk.

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The OPG Risk/Action Owner has accountability for managing their risks and actions linked to the risks. The OPG Risk/Action Owner can appoint a delegate, typically either a technical expert or a SPOC familiar with the risk process and RMO tool.

#### 15.1.4.4 OPG Risk/Action Delegate

Risks and Actions may be assigned to a delegate who may be any members of the RFR project management team if they are deemed by the Risk/Action Owner to be competent to provide appropriate status update for the risk, actions, and oversights. The delegate is typically either a technical expert or a SPOC familiar with the risk process and RMO tool.

The responsibility of the delegate includes (but not limited to):

- provide or coordinate expertise to provide a quality status update in the comments field of the risk/action in RMO on a regular basis, minimum monthly. Consult other stakeholders (i.e. SMEs, JV personnel, external experts) as applicable to provide as much detail as appropriate to complexity and significance of the risk and action.
- advise the risk owner if the risk ratings, risk description, or risk response fields in RMO need to be changed. All changes to these fields should be approved by the risk owner as they may impact the escalation and contingency requirements of the risk.
- advise the risk owner when an action or risk is able to be closed and with approval, close the risk/action and enter closure notes in RMO.

## 15.2 RFR Project Oversight of JV Risk Management

The formal interface between OPG and the Contractor has been documented in the Contractor documents: the Darlington RFR – Communication Plan [R-48] and Darlington RFR – Risk Management Plan [R-46] . The main activities include:

- Oversight of the Contractor's Risk Register progression per Exhibit 3.5 in the RFR EPC Agreement.
- Working with the Contractor to assist in planning risk responses to risks, ensure appropriate owners and completion dates for actions.
- Development of the Execution Phase Target Cost and Execution Phase Target Schedule, as specified in Exhibit 3.5 in the RFR EPC Agreement (this was completed as the class 2 estimate).

The Contractor will have their own risk register which houses risks and their mitigation actions. Contractor Workshops are the formal meetings by which risks (including uncertainties) will be jointly reviewed by the Contractor and OPGy. Refer to DNGS RFR Project – Risk Management Plan [R-46] for details.

The Contractor Risk Manager is the owner of the risk register. He or she ensures that it is maintained current with inputs of all the required information through a series of risk meetings and workshops with their Risk Management Team.

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### 15.3 RFR Project Support to Refurbishment Program Risk Management

Alignment between OPG NR Program and OPG RFR Project is key. The Project Risk Management process follows as much as possible the processes directed to projects from the Program. Variations, if any, from the NR Program's Risk Management Plan is detailed in this Risk Management Plan.

- The Release Quality Estimate (RQE) was approved as of early 2016. This included RFR financial and schedule contingency estimates.
- For gate 3a, the program risk management contingency template has been prepared and submitted by RFR with updated values for U2 execution estimate.

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## 16.0 PROJECT PROCUREMENT MANAGEMENT

For the majority of materials being purchased for the RFR Project, OPG's role is oversight of the procurement management performed by the EPC Contractor. Typical activities include:

- Oversight of vendor's procurement processes
- Oversight of vendor warehousing of material procured
- Review of decisions to outsource work ("make vs. buy")
- Approval of vendor recommendations for procurement packages as required by the RFR Agreement
- Review of vendors/suppliers list (especially if single-source)
- Review of submittals related to milestone payments

### 16.1 OPG Procurement Management

The procurement terms and conditions are defined in the RFR EPC Agreement [R-28] (including Exhibit 2.11 – Procurement Work and Contractor/Owner Interface Requirements (COIR) [R-26] Section 4.0, Procurement Interface Matrix), and are in alignment with Procurement Activities [R-22] and Nuclear Procurement [R-36] .

The RFR Project will be performing work for other NR bundles where activities in the vault must be tightly coordinated. Where the procurement is being performed by the other bundle(s), the material will be free-issued to the RFR Contractor in a manner that it is accepted into their quality program for installation as part of the RFR project.

OPG may free issue materials to the vendor where availability or lead time is a factor. This will be done in accordance with contract terms and conditions including the COIR

For all OPG initiated procurement activities, the processes as defined in OPG-PROC-0058 Procurement Activities [R-22] and Nuclear Procurement [R-36] will be followed.

Project-specific plans include NK38-PLAN-31100-10001 Sheet 0015 - RFR at Risk and Long Lead Materials Procurement Management Plan [R-23].

### 16.2 Joint Venture Procurement Management

The JV is accountable for procuring all Owner Specified Materials specified in the RFR SOW [R-21] and all Goods required to execute the Work, including consumables.

The EPC Joint Venture manages procurement according to their Materials and Procurement Management Plan [R-56] and the Materials Control Plan [R-57].

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### 17.0 CONTRACT MANAGEMENT

The OPG RFR project team performs oversight of the RFR EPC Contractor in compliance with the OPG Contract Management Standard [R-13] and the Darlington Refurbishment Contract Management Plan [R-1].

Contract Management for the RFR Project involves the management and oversight of the following key items:

- Contractor adherence to the EPC Agreements terms and conditions
- Risk-based audits, e.g. Contractor adherence to their plans and schedule
- Development and completion of Notices / Project Change Directives
- Development and completion of Contract Amendments
- Reconciliation of Contractor invoicing against EPC Agreements, e.g. allowed / disallowed costs
- Management of Interfaces between OPG and all Contractors in RFR Project

RFR Contract Management is described in detail in the RFR project-specific Contract Management Plan [R-38].

JV contract management is described in their Contract Management Plan [R-58]

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## 18.0 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

AIDA	Actions, Issues, Decisions, Assumptions
BCS	Business Case Summary
CAT	Cost Allocation Table
CBA	Cost-Benefit Analysis
CBS	Cost Breakdown Structure
COIR	Contractor-Owner Interface Requirements
CPI	Cost Performance Index
DAIA	Design Agency Interface Agreement
DEC	Darlington Energy Complex
DSR	Darlington Scope Request
DRAS	Decision Record Analysis Summary
ECC	Engineering Change Control
VENDM	Electronic Data Management System
EPC	Engineer Procure Construct
EV	Earned Value
GRB	Gate Review Board
FTE	Full Time Equivalent
ILW	Intermediate Level Waste
LLW	Low Level Waste
JV	Joint Venture SNC Lavalin Nuclear and Aecon Construction Group, aka RFR EPC Contractor
MCED	Major Components & Equipment Department
MRM	Management Review Meeting
OAR	Organizational Authority Register
OSM	Owner Specified Material
PCCS	Program Coordination and Control Schedule
PHTS	Primary Heat Transport System
PIMS	Program Integrated Master Schedule
PM	Project Manager
PMBOK	Project Management Body of Knowledge

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PMI	Project Management Institute
PMP	Project Management Professional
PMSS	Program Milestone Schedule
PO	Purchase Order
PS	Project Schedule
RCC	Retube Control Center
RDM	Records and Document Management
RFR	Retube and Feeder Replacement
RFI	Request for Information
RMP	Risk Management Plan
RQE	Release Quality Estimate: The Execution Phase Plan is an input to the NR Release Quality Estimate in 2015
RMO tool	Risk Management and Oversight tool
RWPB	Retube Waste Processing Building
SDH	Supplier Document Hub
SOW	Scope of Work
SPI	Schedule Performance Index
T&C	Terms and Conditions
WBS	Work Breakdown Structure
TOR	Terms Of Reference



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## 19.0 REFERENCES – OPG

- [R-1] N-POL-0001 R001, Nuclear Safety Policy.
- [R-2] OPG-POL-0001, Employee Health and Safety Policy.
- [R-3] N-GUID-09701-10011, Darlington Refurbishment - Safety Management Essentials.
- [R-4] NK38-DP-09701-10001, Retube and Feeder Replacement (RFR) Design Plan.
- [R-5] NK38-PLAN-01060-10003, Darlington NGS Refurbishment Project Reference Plan – Scope Definition.
- [R-6] NK38-INS-09701-10001, Darlington Nuclear Refurbishment Program - Scope Control.
- [R-7] R0031-PL-001 R00, Owners Support Services Retube and Feeder Replacement, Project Execution Plan.
- [R-8] N-CHAR-AS-0002 - Nuclear Management System.
- [R-9] N-CHAR-AS-0003, Darlington Refurbishment Management System.
- [R-10] N-PROG-AS-0001 - Managed Systems.
- [R-11] N-PROG-AS-0007 - Project Management.
- [R-12] N-STD-AS-0028 - Project Management Standard.
- [R-13] N-STD-AS-0029 – Contract Management Standard.
- [R-14] N-STD-AS-0030 – Project Oversight Standard.
- [R-15] NK38-DP-09701-10001 – Retube & Feeder Replacement (RFR) Design Plan.
- [R-16] N-MAN-09701-10002 – Nuclear Project Oversight Guide.
- [R-17] N-PROC-MM-0010 – Establishing and Maintaining Ontario Power Generation Nuclear Approved Supplier list.
- [R-18] N-PROC-RA-0097, Self-Assessment And Benchmarking.
- [R-19] NK38-GUID-09701-10006, Nuclear Refurbishment Project Work Breakdown Structure Guide.
- [R-20] NK38-PLAN-09701-10006, Nuclear Refurbishment - Gate Review Board - Terms of Reference.

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- [R-21] NK38-SOW-31100-10016, Darlington Retube and Feeder Replacement Scope of Work.
- [R-22] OPG-PROC-0058, Procurement Activities.
- [R-23] NK38-PLAN-31100-10001 Sheet 0015, RFR at Risk and Long Lead Materials Procurement Management Plan.
- [R-24] 00044-LIST-79146-00001, Assumptions For The Design Of The Darlington Retube Waste Container System.
- [R-25] NK38-PLAN-09701-10152, Retube Feeder Replacement (RFR) Engineering Plan
- [R-26] N-DAI-00150-10008, Retube Feeder Replacement Project Contractor/Owner Interface Requirements
- [R-27] NK38-INS-09701-10009, Darlington Energy Complex Training Area and Warehouse - Work Practices and Management Expectations
- [R-28] *Not an OPG Controlled Document.* RFR Contract Agreement. Engineering, Procurement and Contruction Agreement Darlington Refurbishment Retube and Feeder Replacement Project March 1, 2012 between ONTARIO POWER GENERATION INC. and SNC-LAVALIN NUCLEAR INC. and AECON CONSTRUCTION GROUP INC.
- [R-29] NK38-PLAN-09701-10259, Retube Waste Processing Building (RWPB) Construction Management Oversight Plan
- [R-30] D-PCH-09701-10000, DNGS NR Project Charter
- [R-31] NK38-GUID-01900-10003, Engineering Interface Requirements
- [R-32] N-GUID-09701-10120, Guideline for Construction Oversight
- [R-33] N-PROC-RA-0035, OPG Nuclear Operating Experience Procedure
- [R-34] INPO-09-007, Principles for Excellence in Nuclear Project Construction
- [R-35] N-INS-09071-10005, Nuclear Projects-Gated Process
- [R-36] N-PROC-MM-0016, Nuclear Procurement
- [R-37] NK38-MAN-09701-10006, Nuclear Refurbishment - Requirements For Process Support Controlled Documents
- [R-38] NK38-PLAN-09701-10150, Retube and Feeder Replacement (RFR) Contract Management Plan

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[R-39] N-PROC-LE-0009, Contract Administration in ONCORE

[R-40] NK38-PLAN-09701-10206, Retube And Feeder Replacement Construction Management Oversight Plan (in final draft, to be issued in Q4 2016).

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## 20.0 REFERENCES – JOINT VENTURE

- [R-41] JV Risk Register, *Not an OPG Controlled Document* (updated via regular risk workshops).
- [R-42] 509407-0000-00000-30AG-0001 "Communication Plan"
- [R-43] 509407-0000-00000-30IM-0001 "Project Controls Plan"
- [R-44] 509407-0000-00000-30IM-0002 "Resource Management Plan"
- [R-45] 509407-0000-00000-30IM-0003 "Scope Management Plan"
- [R-46] 509407-0000-00000-30IM-0005 "Risk Management Plan"
- [R-47] 509407-0000-00000-30IM-0006 "Project Management Plan"
- [R-48] 509407-0000-00000-30IM-0009 "Communications Plan"
- [R-49] 509407-0000-00000-30WI-0004 "Lessons Learned & Continual Improvement Work Instruction"
- [R-50] 509407-0000-00000-30WI-0016 "OPEX Management Plan"
- [R-51] 509407-0000-00000-32IM-0001 "Schedule Management Plan"
- [R-52] 509407-0000-00000-34IM-0001 "Cost Management Plan"
- [R-53] 509407-0000-00000-34WI-0010 "Process for Incorporating Project change Directive into the Project Plan"
- [R-54] 509407-0000-00000-38QP-0001 "Quality Assurance Plan"
- [R-55] 509407-0000-00000-40EP-0001 "Engineering Plan"
- [R-56] 509407-0000-00000-50IM-0001 "Materials/Procurement Management Plan"
- [R-57] 509407-0000-00000-50IM-0002 "Material Control Plan"
- [R-58] 509407-0000-00000-51IM-0001 "Contract Management Plan"
- [R-59] 509407-0000-00000-54IM-0001 "Tooling Management Plan"
- [R-60] 509407-0000-00000-60IM-0003 "Trades On-boarding and Training Plan"
- [R-61] 509407-0000-00000-68HP-0001 "Site Specific Safety Plan – Mock-up"
- [R-62] 509407-0000-00000-68HP-0002 "Site Specific Safety Plan (Execution)"
- [R-63] 509407-0000-00000-68HP-0003 "Fire Safety Plan"
- [R-64] 509407-0000-00000-68IM-0001 "Environmental Management Plan"
- [R-65] 509407-0000-00000-68IM-0002 "ALARA Plan"
- [R-66] 509407-0000-00000-73IM-0001 "Mock-up Training Plan"

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[R-67] 509412-0000-00000-30IM-0006 “Darlington RFR – Tool Management Plan“

[R-68] 509407-0000-00000-33RA-0145, “DNCS RFR PROJECT – Class 2–Schedule Report”

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## 21.0 REFERENCES – OPG REFURBISHMENT GOVERNANCE

- [R-69] N-MAN-00120-10001 Sht: 06 Nuclear Refurbishment - Milestone Definition Framework
- [R-70] N-MAN-00120-10001 Sht: GRB Nuclear Projects Gated Process
- [R-71] N-MAN-00120-10001 Sht: PC-12 Nuclear Refurbishment - Program Change Management
- [R-72] N-MAN-00120-10001 Sht: PC-13 Nuclear Refurbishment - Cost Management And Reporting
- [R-73] N-MAN-00120-10001 Sht: RDM-15 Vendor Document Management System Document Submission Process
- [R-74] N-MAN-00120-10001 Sht: RDM-16 VenDM Document Review And Commenting Manual
- [R-75] N-MAN-00120-10001 Sht: RDM-19 VenDM Process Manual - Material - History Dockets
- [R-76] N-MAN-00120-10001 Sht: RDM-20 Nuclear Refurbishment - Data Management Plan
- [R-77] N-MAN-00120-10001 Sht: RISK Nuclear Projects Risk Management Process
- [R-78] N-MAN-00120-10001 Sht: SCH Nuclear Projects Schedule Management
- [R-79] N-MAN-00120-10001 Sht: SCH-01 Task Instruction - Work Breakdown Structure Direction
- [R-80] N-MAN-00120-10001 Sht: SCH-02 Task Instruction - DNG Refurb - Standard Projects Milestone List
- [R-81] N-MAN-00120-10001 Sht: SCH-03 Task Instruction - DNG Refurb - Program And Project Missed Milestones Recovery Process
- [R-82] N-MAN-00120-10001 Sht: SCH-05 Nuclear Program Project WBS Control Accounts And Work Packages
- [R-83] N-MAN-00120-10001 Sht: SCH-06 Nuclear Refurbishment - Milestone Definition Framework
- [R-84] N-MAN-00120-10001 Sht: SCH-07 Nuclear Refurbishment Earned Value Management
- [R-85] N-MAN-00120-10001 Sht: SCH-09 Nuclear Projects Scheduling Requirements From EPC Contractors
- [R-86] N-MAN-00120-10001 Sht: SCH-11 Darlington Refurbishment: Schedule Management Plan For Integrated Level 3 Execution
- [R-87] N-MAN-00120-10001 Sht: SCOPE Nuclear Projects Scoping Process

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## 22.0 REFERENCES – OPG REFURBISHMENT PLANS

- [R-88] NK38-NR-PLAN-09701-10001 Sht: 0002 Darlington Refurbishment Planning And Controls Program Management Plan
- [R-89] NK38-NR-PLAN-09701-10001 Sht: 0004 Darlington Refurbishment - Environmental Program Management Plan
- [R-90] NK38-NR-PLAN-09701-10001 Sht: 0005 Darlington Refurbishment Health And Safety Program Management Plan
- [R-91] NK38-NR-PLAN-09701-10001 Sht: 0008 Nuclear Refurbishment Engineering Program Management Plan
- [R-92] NK38-NR-PLAN-09701-10001 Sht: 0010 Darlington Refurbishment Management Systems And Performance Improvement Program Management Plan
- [R-93] NK38-NR-PLAN-09701-10001 Sht: 0012 Darlington Refurbishment Construction Program Management Plan
- [R-94] NK38-NR-PLAN-09701-10001 Sht: 0013 Darlington Refurbishment Contract Management Plan
- [R-95] NK38-NR-PLAN-09701-10001 Sht: 0023 Darlington Refurbishment Program Quality Plan

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## 23.0 APPENDICES

### Appendix A: DSR List & Status

Please refer to the below mentioned link for the LIVE Database of DSRs

<http://catou-ogwspuwdc:9015/webpublishing/nuclear/projects/ppc/Documents/DSR/DSR%20Quick%20Links.xlsm>



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## **Appendix B. Project Assumptions and Decisions**

### *Assumptions:*

Please refer to Live RMO Assumptions Database:

<http://apps.corp.opg.com/rmo/Assumption.aspx>

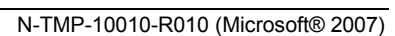
### *Decisions:*

Please refer to Live RMO Decisions Database:

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## Appendix C: Work Breakdown Structure



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**Appendix D: R FR Windows for Unit 2 Execution (Updated September 2016)**

Window ID	Description
013	PHT Bulk Drain
017	Install APT & End Fitting Caps - FM Carriage
023	Install Bulkheads
024	Containment Pre Test, Achieve Dew Point & Containment Test
025	Install Bulkhead Shielding
027	Bulk Interferences Removals
029	HTS Vac Dry
042	Feeder Removal
045	Nozzle Inspection & Weld Preparation
074	Calandria Inspection
076	Upper Feeder Installation
078	Remove Mod Dry Equipment
079	Gross Air Leak Test
080	Fill Calandria
081	Cold Testing & Establish GSS
082	RTP Removals, Bridge Replacement
083	Lower Feeder Installation
084	Fuel Load
085	AL Closed, Shielding Removal & Pressure Test
088	Bulkhead Removal
097	Bulkhead Post-Reqs
098	CTI Release
101	Remove FM Bridge and Install RTPs
104	Vault Projects Before Feeder Removal
105	Vault Projects After Feeder Removal
108	Isolate Calandria from Main Pipework
111	Feeder Cabinet Removal
112	PT Sever
113	Sever Bellows
114	End Fitting Removal
115	Pressure Tube Removal
116	CTI Removal
117	CT Removal
118	CT Install Series
119	Fuel Channel Install Series
121	Vac Dry Moderator Pipe Work

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123	Remove Vac Dry Equip
137	Final Commissioning (VVRS Ph-I, AL&TCD Logic Mods, BU Logic Mod Ph-II)
146	NPC Logic Restoration
149	Tubesheet Bore Cleaning
173	Bulk Interference Removal
174	RFR-Pre-reqs Prior to Islanding
180	Upper Feeder Prep
181	Post Requirements After Containment Isolation
182	Lower Feeder Prep
184	Waste Volume Reduction
185	Clean Room CT and FC Preps
186	Feeder Cabinet Install Phase 2-4
187	TMOD Reversal prior to Bulkhead Removal
188	Feeder Cabinet Install Phase 6-7
192	Install HWT & Dummy Bundle Removal
910	RFR Series Tooling

# Plan

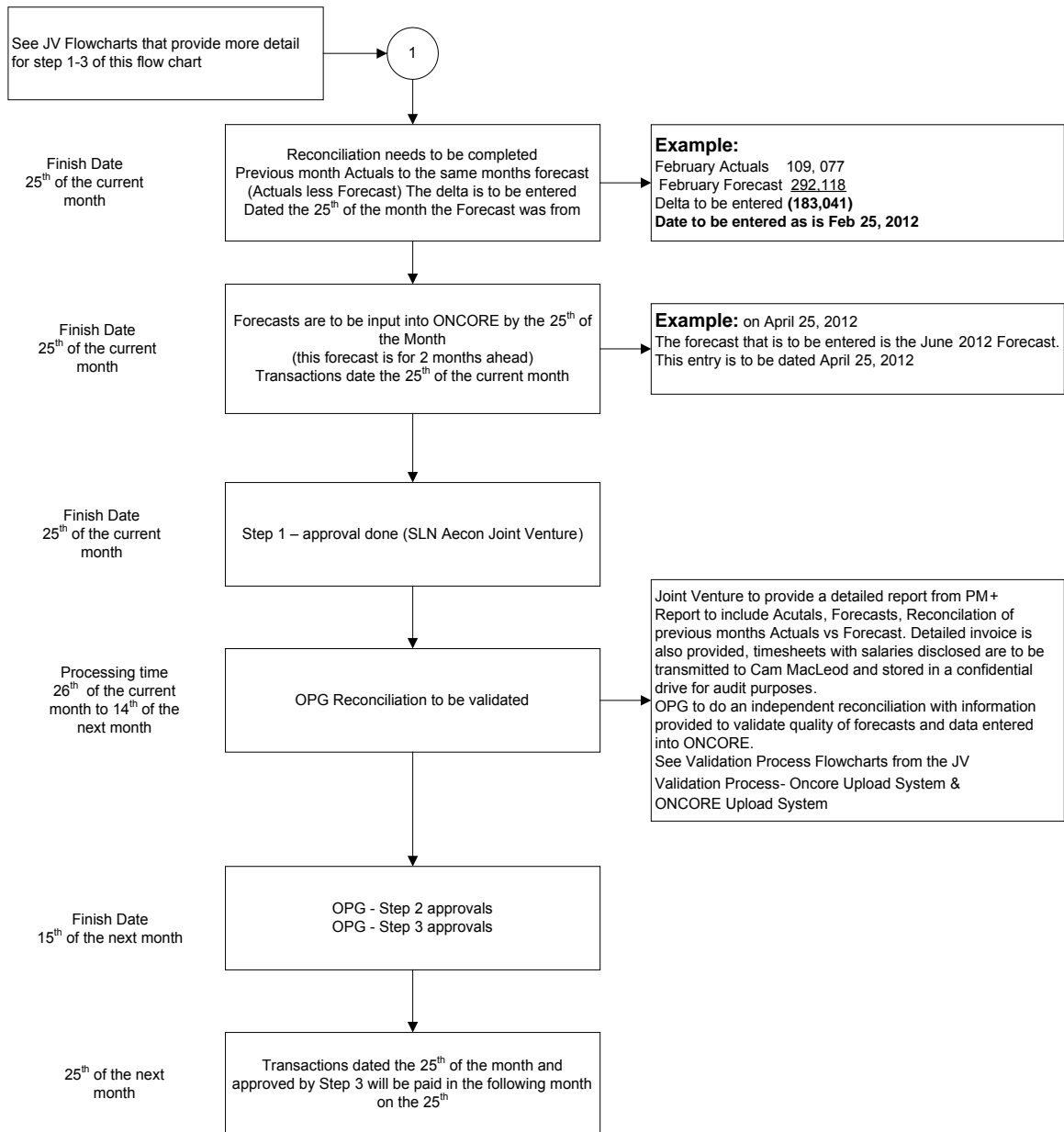
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## RETUBE & FEEDER REPLACEMENT (RFR) PROJECT MANAGEMENT PLAN

### Appendix E: Oncore Flow

#### ONCORE Flow Transactions, Approvals, Reconciliations



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**RETUBE & FEEDER REPLACEMENT (RFR) PROJECT MANAGEMENT PLAN**

## Appendix F : Invoice Reconciliation Summary Check List

### Rconciliation Summary Sheet

**Project**

RFR & Islanding Project

**Invoice #**

**Date**

#### Checklist

Memorandum

Invoice

Application for payment

WSIB documentation attached

#### Statutory Declaration Exhibit 7.1(f)(2)

Signed

Dated current date

#### Statutory Declaration Exhibit 7.1(f)(3)

Signed

Dated current date

#### Statutory Declaration Exhibit 7.1(f)(4)

Signed

Dated current date

#### Reconciliation Documents

Forecast vs Monthly Actuals - application/worksheet

Feburary Forecast - application / Worksheet

#### Milestone Completion Certificate

Fixed Fee Milestones

Fixed Fee Application

Fixed Fee Milestone Completion Certificate

#### Tooling Milestones

Tooling Milestone Completion Certificate

#### Mock-Up Milestones

Mock-Up Milestones Completion Certificate

#### Hours Backup

#### Expenses Backup

#### Salary Information Received

#### ONCORE Invoice Reference Number

Will Be once batch is run on

**Review By:**

Janice Brkljacich

Date

**Approved Signed By:**

Scott Waters (Step 2)

Date

Bert Boston (Step 2)

Date

Ian McCrory (Step 3)

Date

Marc Paiment (Step 3) Date

**Plan**

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## **Appendix G: Contract Milestones**

Please refer to RFR Commercial SharePoint site for a detailed list of Execution Phase Milestones

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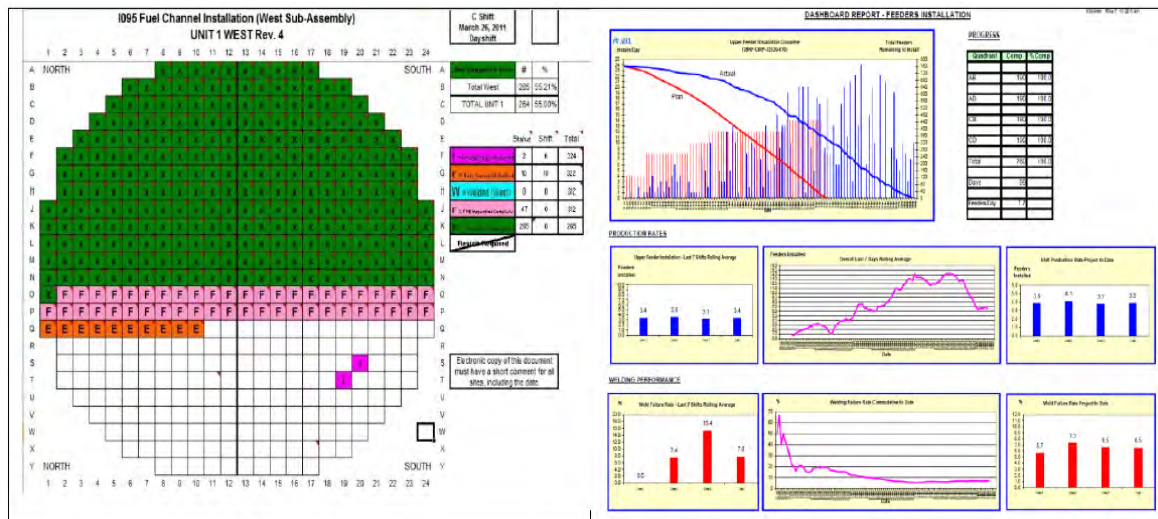
## Appendix I: Summary of RFR Execution Phase Metrics and Reporting

### PSP (Procedure Sequencing Program):

The JV will implement a computer based work management system called "PSP" (Procedure Sequencing Program) which will be used to monitor the work in the field on a step by step basis from the retube control center (RCC) used for series while unit is Islanded

This software suite (PSP) reports:

- Tracks work at the CWP operation level via inputs from supervisors, QC, etc.
- Displays a visual representation of the reactor face, or header map showing status at each site
- Tracks start and finish time for each site, and the start and finish time for each CWP operation
- Linked to P6 through a flagged field that allows cross referencing from PSP activities to P6 activities



Examples of face map report and workdown curves from previous Retube Project

### Asset Suite 7

Implemented for series before breaker open and when plant is not islanded, for example:

- Bulkhead install and removal
- Vault crane upgrade
- FM Carriage removal
- Terminal Point interfaces (PDS hookups, PHT Vac Dry hookups)



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- Will feed JV schedule with updates at this period of time

High-level implementation once plant is islanded:

- Once work-order created with single task for each JV scope "Series"
- Tasks for OPG required support (permittry, Radiation Protection, class 7 shipping, etc...)
- Applies to Face and Feeder series
- Will not feed JV schedule with updates at this period of time

### Labour Reports:

- Report on PMT labour spent vs. budget bi-weekly, report on trades labour on a weekly basis
- Data will come from JV systems – applicable to JV staff and trades
- Average labour rate for trades. Vs. budget labour rate will be reported

### Logic Flow Diagram:

The Logic Flow Diagram will be updated with actual and forecast start and completion dates for each series listed on it, and will serve as a high-level communication report on the overall status of the outage. It will be updated as required, but at minimum it will be updated monthly

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The following table outlines the proposed measurement system during execution phase:

WBS	EV Rules	Metrics		Data Source	Frequency	Comments
Project Management						
General PM Effort, and Management Groups (Project Controls, Training, QA, HSE, HR, Doc Control)	Level of Effort	SPI, CPI, Average labour rate vs. budget	<ul style="list-style-type: none"><li>• Work Hours Planned</li><li>• Work Hours Earned</li><li>• Work Hours Actuals</li><li>• Work Hours Forecast</li></ul>	JV	Monthly for SPI/CPI Bi-Weekly for labour actuals reporting	Internal Mandate in PM+
Quality Assurance	Level of Effort	QA stats as per contract: NCRs/SQORs raised in the month NCRs/SQORs overdue Overall trend		JV	Monthly	
Health and Safety	Level of Effort	HSE stats as per general construction practice		JV	Monthly	
Training -- Completion of series training in preparation for outage work	Earned as per training activity start/finish and % complete in resource loaded schedule	SPI, CPI, Average labour rate vs. budget Report by Work Package in WBS (CWP)	<ul style="list-style-type: none"><li>• Work Hours Planned</li><li>• Work Hours Earned</li><li>• Work Hours Actuals</li><li>• Work Hours Forecast</li></ul>	JV	Monthly for SPI/CPI Bi-Weekly for labour actuals reporting	

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Engineering						
Field Engineering	Level of Effort	No. Of FCNs SPI, CPI, Average labour rate vs. budget	<ul style="list-style-type: none"> <li>• Work Hours Planned</li> <li>• Work Hours Earned</li> <li>• Work Hours Actuals</li> <li>• Work Hours Forecast</li> </ul>	JV	Monthly for SPI/CPI and other metrics Bi-Weekly for labour actuals reporting	
Mods Engineering	Earned as per engineering activity start/finish and % complete in resource loaded schedule	SPI, CPI, Average labour rate vs. budget Work-down curves for various MOD package steps (35%, 90%, Rev.0, DA approved) Report by Work Package in WBS	<ul style="list-style-type: none"> <li>• Work Hours Planned</li> <li>• Work Hours Earned</li> <li>• Work Hours Actuals</li> <li>• Work Hours Forecast</li> </ul>	JV	Monthly for SPI/CPI and other metrics Bi-Weekly for labour actuals reporting and Work Down curves	The activities in the resource loaded level 5 schedule will act as the EV milestones
Procurement						
P.O. Award	Earned as per procurement activity start/finish and % complete and/or LOE	SPI, CPI, Average labour rate vs. budget Work-down curves for RFQ placement and PO award	<ul style="list-style-type: none"> <li>• Work Hours Planned</li> <li>• Work Hours Earned</li> <li>• Work Hours Actuals</li> <li>• Work Hours Forecast</li> </ul>	JV	Monthly for SPI/CPI and other metrics Bi-Weekly for labour actuals reporting	
Manufacture & Delivery	Accruals will be performed based on payment milestones and supplier monthly reports	Work Down Curve with contract commitment date, vs. forecast completion of manufacturing date P6 Schedule report Expediting report with documents due from supplier and documents due back to supplier		JV	Weekly for P6 schedule report Bi-Weekly for Work-Down Curves Monthly for Expediting Reports	
Construction						

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Face Work	Number of sites fully completed	Baseline curves Actual sites completed per shift Forecast to complete curve	Work-down-curve and Face maps	JV	Daily	
Feeder Work	Number of sites fully completed	Baseline curves Actual sites completed per shift Forecast to complete curve Weld Failure Rate	Work-down-curve and Face maps	JV	Daily	
Non-Face and Feeder Work / General overall	Earned as per schedule activities start/finish and % complete in the L5 schedule	SPI, CPI, Average labour rate vs. budget Report by Work Package in WBS (CWP) Shift Log Work down curve for major series	<ul style="list-style-type: none"> <li>• Work Hours Planned</li> <li>• Work Hours Earned</li> <li>• Work Hours Actuals</li> <li>• Work Hours Forecast</li> </ul>	JV	Monthly for SPI/CPI Each Shift for Shift Log Daily for Work Down curves	
Overall		LFD – showing overall schedule logic summarized at level 2		JV	Monthly	



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**SHUTDOWN & LAYUP / SERVICES / REFURBISHMENT SUPPORT FACILITIES PROJECT  
MANAGEMENT PLAN**

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**Shutdown & Layup / Services /  
Refurbishment Support Facilities  
Project Management Plan**

**NK38-PLAN-09701-10238**

2016-04-05

Order Number: N/A  
Other Reference Number:

**Internal Use Only**

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Revision Number	Date	Comments
R000	2015-01-05	Initial issue.
R001	2015-12-01	Revision to Support Gate 2X, Gate 2Y and Gate 3
R002	2016-04-05	Revision to Support Gate 3 U2a

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## 1.0 INTRODUCTION

The Darlington Refurbishment Project Charter, D-PCH-09701-10000, documents the purpose of the Darlington Refurbishment Program.

Darlington NGS (DN GS) is aging and there is a need to assess and make recommendations with respect to the feasibility of continuing to operate beyond the current nominal end-of-service life dates. The goal of the refurbishment project is to extend the service life of the units by an additional 30 years of post-refurbishment operations.

Refurbishment will involve an outage for replacement of life-limiting components, as well as maintenance or replacement of other components which can be most effectively done during the refurbishment outage period.

The Nuclear Refurbishment (NR) organization has been established with the responsibility of assessing, making recommendations to Ontario Power Generation (OPG)'s Senior Management with respect to the feasibility of refurbishing the Darlington units, developing the scope, schedule and estimate for the Refurbishment Program, and providing overall program oversight on the execution of all activities associated with refurbishment. For Darlington, NR will undertake the Darlington Refurbishment Project, in phases per the approved Program Release strategy, to:

- Assess the technical feasibility of refurbishing Darlington and operating it for an additional 30 years of post-refurbishment operations
- Make recommendations as to the lead time required to be prepared to refurbish each unit,
- Fully define refurbishment scope,
- Execute front end planning including developing contract management strategies, cost estimates, schedules, a full risk assessment, and a release quality estimate for the project,
- Manage the refurbishment pre-outage planning and preparation activities,
- Provision of overall program oversight on all execution and commissioning activities, and
- Project Closeout.

The refurbishment is currently planned to begin in 2016. Each of the units will be shutdown in a partially overlapping sequence with the second unit shutdown commencing after removal of all components in the first shutdown unit (i.e. end of the removal phase of the first unit)

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Currently, the approved plan to refurbish the four units, with first two units “unlapped”, is shown in the following table:

Unit	Start of Refurbishment Outage	Finish of Refurbishment Outage	Duration (Months)	Overlap on Previous Unit
D2	October 2016	October 2019	36	
D3	October 2019	October 2022	36	0
D1	March 2021	March 2024	36	19
D4	October 2022	October 2025	36	17

The current reference schedule is as follows:

- Initiation Phase – 2008 - 2009 COMPLETE
- Definition Phase - Preliminary Planning – 2009 - Dec 2011 COMPLETE
- Definition Phase - Engineering and Detailed Outage Planning – 2012 - 2016
- Field Execution and Closeout Phase (four units) – 2016 - 2025
- Operation Phase (Return to Service of Units) - Starting with the first unit in 2019

The goals of the Darlington Refurbishment project (ref: NK38-CORR-09701-0458306, *Common Outage Goals and Objectives for Darlington Refurbishment*), are:

- Station and Refurbishment scope is completed safely, at the specified quality, on time and on budget;
- Transitions of units, work programs and staff between the Station and Refurbishment are planned and controlled to minimize disruption in Refurbishment and Plant Operations;
- Darlington operation post-Life Extension meets OPG documentation requirements and operating objectives, as defined by the Nuclear Performance Index and the Equipment Reliability Index.

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# SHUTDOWN & LAYUP / SERVICES / REFURBISHMENT SUPPORT FACILITIES PROJECT MANAGEMENT PLAN

## 2.0 PROJECT DESCRIPTION

### 2.1 Project Scope and Objectives

The Shutdown Layup/Services/RSF Project (“the Bundle”) consists of a series of projects whose collective purpose is to establish the conditions within plant systems and equipment to ensure continued asset preservation during the refurbishment period, provide increased plant services, and provide support facilities. The various projects in the Bundle are described below:

- Shutdown and Layup Sub-bundle – Establishes dry conditions within plant systems and equipment. Projects include:
  - Steam Generator Secondary Side Layup
  - Monitoring of Permanent Equipment and Laid up Systems
  - Monitoring of Temporary Station Equipment
  - Dry Air Provision to Conventional Side Systems
  - Dry Air Provision to Nuclear Side Systems

NOTE: The following project has been transferred to RFR via DRAS 557 and 685.

- Moderator and PHT Auxiliary Layup (Drain & Dry)

NOTE: The following project has been transferred to BOP via DRAS 517.

- Low Pressure Service Water Layup

NOTE: The following project has been cancelled from scope following RQE via DRAS 728.

- Contingent D2O storage (contingent)

NOTE: The following project has been transferred to SG bundle via CCF 926.

- SG Primary Side Layup

NOTE: The following project has been transferred to TG bundle via CCF 927.

- TG and Auxiliary Layup

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- Services Sub-bundle – Additional services required to support Refurbishment activities. Projects include:
  - Breathing Air
  - Service Air
  - Cranes
  - Temporary Power
  - Moderator Flush
- Refurbishment Support Facilities (RSF) Sub-bundle – Facilities required to support Refurbishment activities. Projects include:
  - Work Control Area (WCA)
  - Non-Contaminated Shops and Work Areas
  - Radiation Protection Teledosimetry (RPT)
  - Contaminated Shops & Contaminated Scaffold Storage Area
  - Decontamination Room S107 Upgrade
  - Washroom facilities (Installation and Removal only, maintenance scope transferred to NR Construction via CCF 938)

Holt Road/South Service Road / Highway 401 Interchange OPG ServicesNOTE:

The following projects have been removed from scope at a Gate Review Board (GRB) meeting on Sep 23, 2014.

- Vestibules, Storage Pad, and Pressure Boundary laydown area
- Off-site Security X-ray Scanner
- Turbine Hall Lunchroom

NOTE: The following project has been transferred to the CIO via DRAS 671.

- Wifi

NOTE: The following project has been removed from scope per DRAS 715.

- Turbine Auxiliary Building (TAB) Elevator

NOTE: The following project has been transferred to NR Construction via CCF 928.

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- Maintenance and Custodial of RSF facilities

## 2.2 Overall Execution Strategy

### 2.2.1 Execution/Contracting Strategy

There are two main execution/contracting strategies for the scopes of work under the bundle:

1. Engineering Contract + Procurement/Construction Contract
2. Engineer/Procure/Construct (EPC) Contract

The first strategy is being applied to modifications where projects can maximize the efficiency in terms of availability of engineering expertise, cost and schedule. The Procurement/Construction Contract will be issued under the Extended Services Master Service Agreement (ES MSA) contracts. This strategy is being applied to these projects:

- Dry Air Provision to Conventional Side
- Dry Air Provision to Nuclear Side
- Moderator Flush
- Holt Road Services
- Temporary Power
- Decontamination Room S107 Upgrades
- Washroom Facilities

All other remaining scopes of work will be executed via the Engineer/Procure/Construct (EPC) model using the ESMSA contracts.

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### 3.0 GOVERNANCE STRUCTURE AND INTERFACES

#### 3.1 OPG Project Management Plans

The Bundle's Project Management Plan has followed the guidance set within the OPG Governance per Figure 1. The content of this PMP is divided into ten knowledge areas as shown below:

- Section 4.0: Safety Management,
- Section 5.0: Project Integration Management,
- Section 6.0: Project Scope Management,
- Section 7.0: Project Schedule Management,
- Section 8.0: Project Cost Management,
- Section 9.0: Project Quality Management,
- Section 10.0: Project Human Resource Management,
- Section 11.0: Project Communications Management,
- Section 12.0: Project Risk Management, and
- Section 13.0: Project Procurement Management.

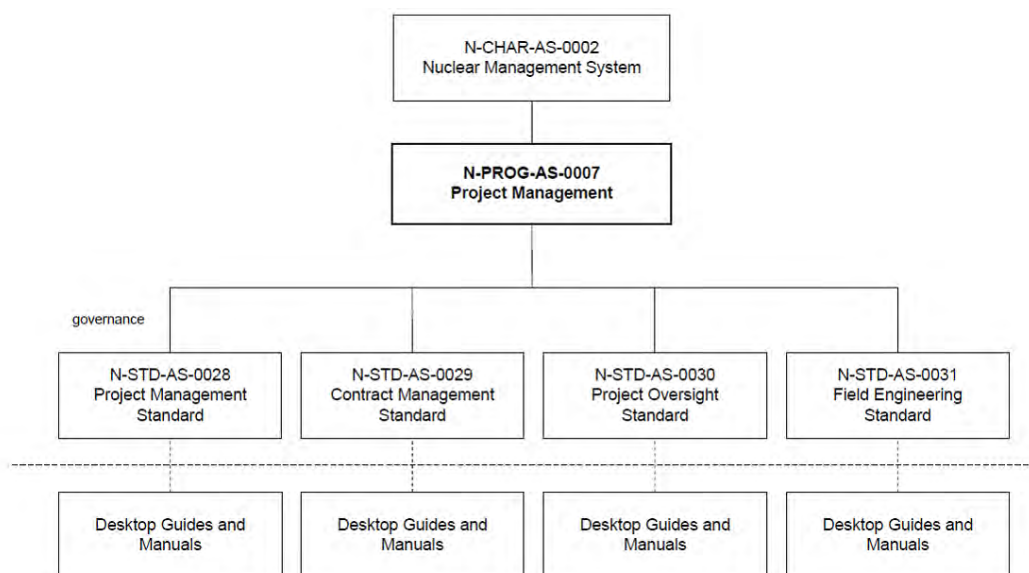


Figure 1 - OPG Management System



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### 3.2 Contractor Management Plans

#### 3.2.1 ES MSA Contractor Management Plans

All ES MSA projects being managed under the SDLU/Services/RSF Bundles will follow the strategy in this plan.

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## 4.0 SAFETY

### 4.1 Safety Management

Safety is a core value at OPG for Nuclear Refurbishment and is reflected in all safety management plans produced by OPG and contractors. The Bundle will adhere to all applicable obligations as defined in the Occupational Health and Safety Act (OHSA), the OPG expectations (N-POL-0001, OPG-POL-0001, and N-GUID-09701-10011), as well as the requirements set out in the EPC contracts terms and conditions.

For work contracted to an ES MSA contractor, each of them will be required to issue a SSSP for OPG acceptance.

Compliance to SSSPs will be monitored by OPG.

### 4.2 Construction Management

The Shutdown Layup/Services/RSF Project will adhere to all applicable obligations as defined in the Occupational Health and Safety Act (OHSA), OPG expectations, and the terms and conditions for each EPC Contract under which Shutdown Layup/Services/RSF work will be executed.

Construction Oversight and Support is being provided by the Construction Department in Nuclear Refurbishment. Should contract monitoring support be required for individual projects, the project will secure the appropriate resources to perform field oversight to ensure that the construction work is being executed according to plan and meeting safety and quality requirements. These field oversight resources will align with the Refurbishment Program strategy for construction oversight:

- NK38-PLAN-09701-10012, Management Plan: Management of Contractors for Darlington Refurbishment Project
- N-GUID-09701-10120, Guideline For Construction Oversight

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## 5.0 PROJECT INTEGRATION MANAGEMENT

### 5.1 Integrated Governance

The integration of OPG and EPC vendor processes will enable coordination of activities between OPG and EPC organizations. The referenced standards in Figure 2 will be applied to ensure contractors are working within OPG governance and within their quality program. Project oversight will be the method utilized to ensure Safety standards are being met.

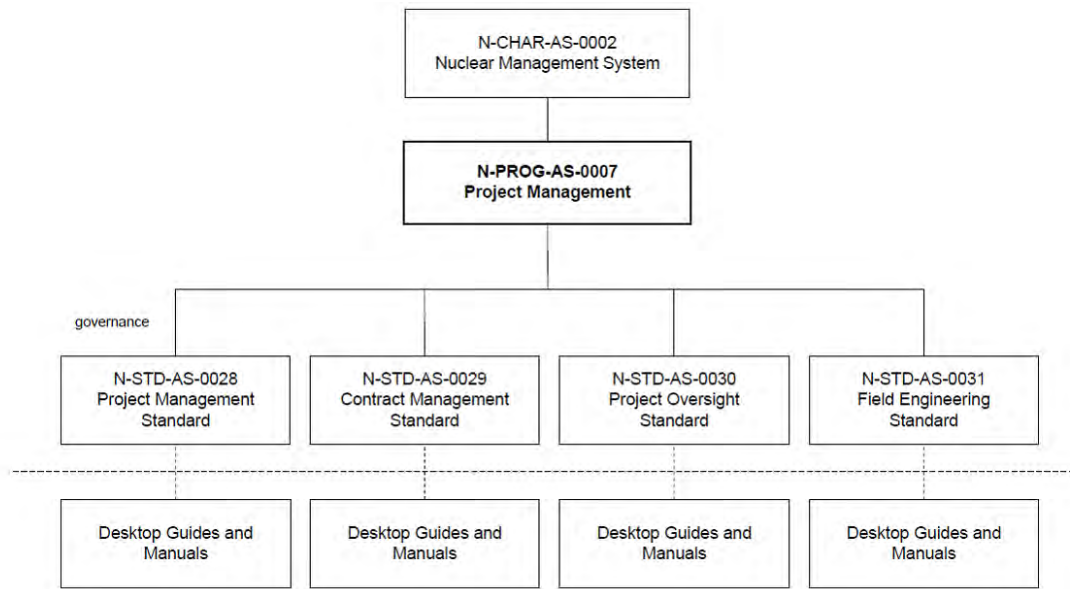


Figure 2 - OPG Management System

### 5.2 Project Management Toolset

The OPG project management toolset is illustrated in Figure 3 below. The toolset will be used to manage OPG internal project activities, facilitate coordination with the EPC vendor activities and document and manage findings resulting from vendor oversight.

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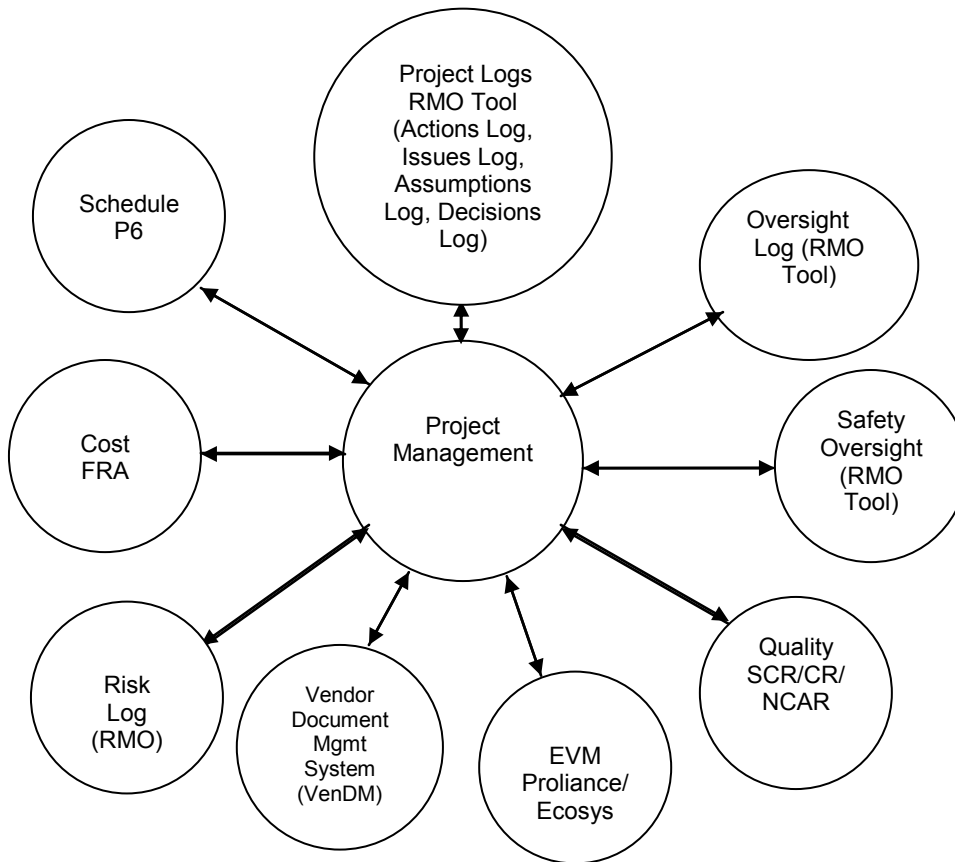


Figure 3 - Project Management Toolset

### 5.3 Project Oversight

The Shutdown Layup/Services/RSF Project team is accountable to provide oversight of the contracted scope to ensure that the Contractor delivers the products and services safely with acceptable technical quality and appropriate project controls critical to success. This Project Oversight Plan will provide a uniform methodology to be used for oversight activities ensuring that the deliverables, as supplied by the Contractor, meet the intent of the ES MSA Agreement.

This plan covers the different stages of Engineering, Procurement, and Construction as it applies to the individual project Scope of Work (SOWs) and ES MSA Contract Terms and Conditions.

The Shutdown Layup/Services/RSF Project team is responsible for the preparation and implementation of the Project Oversight Plans. The Project team, with the support of Management Systems Oversight (“MSO”) and other functional support groups will maintain the Project Oversight Plan to identify oversight activities planned for the project and input Oversight Findings.

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Project Oversight plans and findings are maintained by the project through the [RMO Tool](#).

Historical Project Oversight Plan Activities and Findings can be located through the SharePoint [Project Oversight Plan](#) and [Project Oversight Findings](#).

Project oversight of the Shutdown Layup/Services/RSF Project, regardless of contracting strategy, will be executed by the Shutdown Layup/Services/RSF Project team and Functional Support groups as per the following principles and methodology.

### 5.3.1 Oversight Principles

The following are the principles which will govern the implementation of oversight on all project contracts:

- Oversight is not an exercise in Vendors Quality Assurance (QA) management but a check that the prime contractor is following their own policies and procedures and OPG requirements / procedures if applicable.
- Feedback of findings identified to the contractor's Corrective Action (CA) and Continuous Improvement programs to mitigate risk of reoccurrence.
- Ensure the principles associated with the preparation, verification and approval of design documents follows best proven practices and the contractual procedural requirements per the EPC agreements. (See N-GUID-01920-10000, Guideline for Engineering Oversight)
- The higher degree of risk to the project or complexity of design, the potential greater oversight of the activities
- Feedback on oversight activities provide insight and input into the project risk profile / register.
- Appropriate escalation of identified issues can be addressed at the preliminary stages to mitigate risk to final product.
- Trust through verification.

### 5.3.2 Oversight Methodology

Given the above guiding principles, oversight activities will be separated into two areas of surveillance which will support the optimal use of OPG resources while providing adequate oversight to ensure the final deliverable meets the quality intent of the contracts. The two areas of surveillance are "Routine" and "Strategic". Any "In-Process" activities are driven by issued processes and procedures. Project oversight is intended to focus on the "Routine" and "Strategic" oversight implementation.

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### 5.3.2.1 Routine Oversight

Routine oversight is defined as planned recurring oversight activities undertaken as a part of the execution of the project. The driving factors for Routine oversight activities are as follows:

- Regular “face to face” progress meetings to review risks as well as schedule and cost performance
- Monitor project progression metrics
- Visit or reside in contractor’s offices and engage contractor staff in informal discussions on deliverables
- Cross-pollination of functional groups and project team members
- To help ensure that project risks are dealt with in a timely manner
- To assist in proactive resolution of issues

Formal observations from routine oversight may be documented in minutes of meeting, updates to the risk register and/or comments detailed in the Oversight Log in the RMO Tool.

### 5.3.2.2 Strategic Oversight

Strategic oversight is defined as planned oversight activities undertaken in response to risks identified in the risk register as well as to mitigate perceived risks arising from OPEX and routine oversight activities. The driving factors for strategic oversight activities are as follows:

- Risk mitigation for high project risks.
- To prevent repeat industry OPEX events that specifically pertain to the scope of work.
- To observe and review critical project steps and activities and ensure compliance to project and program requirements

Formal observations from strategic oversight may be documented in updates to the risk register and/or comments detailed in the RMO Oversight Findings.

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### 5.4 Contract Management

The Shutdown Layup/Services/RSF Project will be providing oversight on each EPC Contract in compliance with Contract Management Standard N-STD-AS-0029, to ensure that the terms and conditions of each contract are being followed.

#### 5.4.1 Contract Management Plans

The projects in Shutdown Layup/Services/RSF will have their respective contracts managed under N-PLAN-00150-10001, Extended Services Master Service Agreement: Contract Management Plan.

### 5.5 Engineering Design Management

Engineering Design Management in Darlington Refurbishment follows the modification process outlined in N-PROC-MP-0090. All modifications will have Modification Design Packages (MDP) and Scope of Work (SOW) prepared in advance under the OPG QA program.

Each Contractor working with the Shutdown Layup/Services/RSF Project will issue design plans for each modification in compliance with their respective Contractor \ Owner Interface Requirements (COIRs) and QA programs.

Engineering Earned Value will be implemented in accordance with N-MAN-00120-10001-SCH-07, Nuclear Refurbishment Earned Value Management and required to be documented in each contractor's P6 schedule.

### 5.6 Project Gate Progression Plan

The OPG gated process, described in N-MAN-00120-10001-GRB, is a critical project process and requires integration with the EPC contractor's processes as various contractor inputs will be required for each gate. The gate progression strategy for the Shutdown Layup/Services/RSF Project must take into account the needs and timing associated with the EPC contracts. Additionally, it is important to forecast the required finances as accurately as possible.

Each Gate package will include financial forecasts up to the next planned gate. Overall project estimates will be refined further at each gate review. The details of the gate progression strategy are documented in Appendix A.

## 6.0 PROJECT SCOPE MANAGEMENT

Scope Management is conducted as per N-MAN-00120-10001-SCOPE-01, Nuclear Projects Scoping Process.

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### 6.1 Scope Definition

This PMP only covers the work to be performed during the applicable Gate release. It will be updated routinely and prior to each Gate to ensure it accurately reflects the work and proposed process for managing the work released.

Through NK38-INS-09701-10001, Darlington Nuclear Refurbishment Program-Scope Control, individual Darlington Scope Requests (DSRs), composed of core scope and non-score scope were assigned to the Shutdown Layup/Services/RSF to form the basis of project scope.

Appendix B contains a list of DSRs assigned to Shutdown Layup/Services/RSF. Appendix C contains a complete list of Shutdown Layup/Services/RSF DSRs and their associated groupings by sub-bundle, scopes of work and project numbers. Progression of these DSRs to completion will be executed as per the process defined in NK38-INS-09701-10001. Timelines for progression are as per the Shutdown Layup/Services/RSF Schedule.

#### 6.1.1 Work Breakdown Structure

The Shutdown Layup/Services/RSF Project Work Breakdown Structure has been prepared in accordance with N-MAN-00120-10001-SCH-05 and can be found in the P6 schedule.

#### 6.1.2 Scope Control

The SDLU/Services/RSF project scope is evolving throughout the Definition Phase through the preliminary and detailed engineering process within the realms defined in the Modification Design Requirements (MDRs).

The project scope presented in this PMP has undergone challenges via internal project reviews, cost benefit reviews, the Blue Ribbon scope review, Options Review board reviews and Gate Review Board reviews. The project team will strive to challenge scope, quality, schedule and costs of each project to ensure that we are executing the right work efficiently and safely.

If there are any major scope changes from scope that was approved through the gate process, a gate refresh will be submitted. Minor scope changes will be handled using Change Control Forms per the Change Control Process outlined in N-MAN-00120-10001-PC.



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## 7.0 PROJECT SCHEDULE MANAGEMENT

Project schedule management is the process of defining, sequencing, and estimating resources and durations of the project activities which are integrated in the project schedule. It will require schedule development and monitoring to be integrated with OPG project and functional groups, EPC contractors and other contractors [e.g. Owner Support Service (OSS)] schedules.

Shutdown Layup/Services/RSF project schedule management will be performed in accordance with NK38-NR-PLAN-09701-10001 Sht: 0002, Darlington Refurbishment Planning And Controls Program Management Plan.

The scheduling development and process shall follow the Scheduling procedures under N-MAN-00120-10001-SCH.

### 7.1.1 Three-level schedule Overview

#### Level 1 - Management Summary Level

The level 1 schedule provides a high-level management summary of the project. It will represent all Units, Phases, Bundles, Program and key project milestones.

The level 1 schedule is a roll up of the Level 2 schedule.

The schedule is prepared by OPG as part of the initial planning phase of the project and updated to reflect the progression of planning, i.e. as projects are better defined, the Level 2 Schedule is updated.

#### Level 2 –Schedule

The Level 2 schedule is a roll-up of the Contractors detailed Level 3 schedule at the work package level. This covers the full scope of work by Phase, Unit, and Type of work and contains full Critical Path Method (CPM) logic. It is the schedule which will be used, at the Phase and Unit level, to track the overall schedule status of the Program.

#### Level 3 – Detailed Schedules

The level 3 detailed schedules will be prepared by the groups executing the work, including in-house OPG resources and EPC Contractors.

The schedule must be prepared in accordance with the Program's Work Breakdown Structure ("WBS") and coding guideline. This schedule contains the lowest level of detail required to manage and execute the work. It is structured in a way to allow summarizing of the activities at the work package level in order to roll up to the Level 2 schedule.

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The Level 3 will include the full scope of each vendor / contractor showing all interfaces with other contractors / OPG, and be resource loaded to the lowest level of the defined Work Breakdown Structure as applicable to the contract type.

After being captured as a baseline, the schedule will be regularly updated, providing the basis for status reporting, progress physical percent complete at the activity / Work Package Level, forecasting, and change management.

All vendor / contractor baseline schedules need to be approved by OPG to ensure program milestones, WBS and scheduling guidelines and coding are followed.

Schedule variances and mitigation plans will be analyzed from the Level 3 schedule.

Daily, Weekly and Monthly look-ahead reports will be generated from Level 3 schedule.

### 7.2 Schedule Change Control

Changes to the project scope will be managed through a formal Change Control process as per N-MAN-00120-10001-PC, and implemented at all levels of schedule.

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## 8.0 PROJECT COST MANAGEMENT

Project cost management is concerned with budgeting and controlling overall project costs. Cost estimates and cash flow forecasts will need to integrate OPG, EPC contracts and other contracts (i.e. OSS) costs in order to obtain overall cost inputs for the Shutdown Layup/Services/RSF Project.

### 8.1 OPG Cost Management

The Shutdown Layup/Services/RSF Project cost management and integration is governed by the Cost Procedures listed under N-MAN-00120-10001-PC and NK38-NR-PLAN-09701-10001 Sht 002, Darlington Refurbishment Planning And Controls Program Management Plan.

EPC contractor costs will be integrated with internal OPG Shutdown Layup/Services/RSF Project costs to provide a total estimated cost for the project. Costs associated with efforts of the OPG functional groups are not currently included at the project level (managed by the respective functional group). Costs for external contracts to prepare modification design requirements and conceptual design reports are included in the project cost estimates.

EPC contractor costs will be incorporated in the project cost management system and updated monthly based on the OPG Financial Reporting and Analytics (FRA) Cost Reports. Costs for work packages, organized by Work Breakdown Structure (WBS), are aligned to the Oncore load sheet provided by each EPC contractor. This allows the EPC contractor costs to be captured at the work package level as determined by the project.

### 8.2 EPC Contractor Change Management

The Shutdown Layup/Services/RSF Project schedule baselines and cashflows will reflect the EPC Contract values. Estimates requested at the gates will be updated (if required) via Change Control Forms once the purchase orders are issued and the actual values are known.

Shutdown Layup/Services/RSF Project work will follow the ESMSA process for cost management.

### 8.3 Cost Contingency

Project level Contingency funding may be identified within the Definition and Execution phases via the Gated Process. Contingency funding is based on known risks and the level of scope definition in the project. There is also Management Reserve funding which is set based on "unknown-unknowns" that could impact the viability of the project. The strategies for managing Contingency and Management Reserve are defined in N-MAN-00120-10001-RISK-04, Nuclear Refurbishment Risk Management and Contingency Development Guide.

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**8.4 Cost Change Control**

Changes to the baseline scope and costs will be managed through N-MAN-00120-10001-PC, Nuclear Refurbishment - Cost And Schedule Change Control.

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## 9.0 PROJECT QUALITY MANAGEMENT

The overall OPG quality management process will apply to all work in the Shutdown Layup/Services/RSF Project; however, the particular QA requirements will be specified in each EPC Contract according to the nature of the work.

### 9.1 OPG Quality Management

The Quality Management of the Shutdown Layup/Services/RSF Project will be in compliance to:

- N-CHAR-AS-0002 - Nuclear Management System,
- N-PROG-AS-0001 - Managed Systems,
- N-PROG-AS-0007 - Project Management,
- N-STD-AS-0028 - Project Management Standard,
- N-STD-AS-0029 – Contract Management Standard,
- N-STD-AS-0030 – Project Oversight Standard,
- N-MAN-09701-10002 – Nuclear Project Oversight Guide
- N-PROC-MM-0010 – Establishing and Maintaining Ontario Power Generation Nuclear Approved Supplier list.

### 9.2 Quality Assurance

EPC Contractors shall perform the awarded scope of work under an OPG-approved quality assurance program. Compliance with applicable quality assurance requirements will not relieve the respective Contractors from any of their obligations or liabilities under the established agreement between OPG and the Contractors. The Contractors will be responsible for ensuring that their Sub-Contractors are working under the Contractor's quality assurance program or have implemented an appropriate quality assurance program acceptable to the Contractor and OPG.

#### 9.2.1 Quality Assurance Plan

Each contractor will be required to prepare a project Quality Assurance Plan that addresses the interface responsibilities with external organizations. All EPC quality assurance plans will address all applicable codes and standards including CSA Z299, CSA N286-05 and CSA N286.7 standards, as required, identifying what quality programs and procedures will be followed, including the contractor's and their sub-contractor's personnel responsibilities under the various quality programs. OPG will review and accept the contractor's project quality assurance plans.

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## 9.2.2 Quality Control and Surveillance

During the different phases of project work, the project team, jointly with the functional groups will work to ensure that the quality of design, materials, and services provided and the quality of installation and commissioning work performed meet OPG standards, purchase order requirements, and are in compliance to applicable codes and standards.

In the instance of a quality system failure or a breakthrough event occurring for which the contractor is accountable; such adverse conditions will be documented per the contractor's QA Program and per N-PROC-RA-0022, Processing Station Condition Records. The contractor will be asked to initiate a Corrective Action as per their program for any identified quality issues. When there is a systemic failure of their implemented Quality System, a formal Non Conformance and Corrective Action Request process will be initiated by OPG Supply Chain Quality Services as per N-PROC-MM-0010, Establishing And Maintaining Ontario Power Generation Approved Suppliers List.

To ensure compliance to OPG requirements, the contractor interface will be controlled by the Contractor Owner Interface Requirement (COIR) document forming part of each agreement.

For internal quality issues the OPG Station Condition Record (SCR) and corrective action process will be followed.

The contractor will follow their own Quality Assurance Program as stated in ESMSA. As listed in the COIR, a Construction Quality Assurance Plan will be provided for each design package prepared by the ESMSA contractor.

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## 10.0 PROJECT HUMAN RESOURCES MANAGEMENT

The Shutdown Layup/Services/RSF Project human resources management will be in accordance with NK38-NR-PLAN-09701-10001 Sht: 0016, Darlington Refurbishment Staffing Program Management Plan and NK38-NR-PLAN-09701-10001 Sht: 0019, Darlington Refurbishment - Training Program Management Plan.

## 10.1 OPG Human Resources Management

### 10.1.1 Team Resourcing

The Shutdown Layup/Services/RSF Project Organization is shown in Figure 4 below.

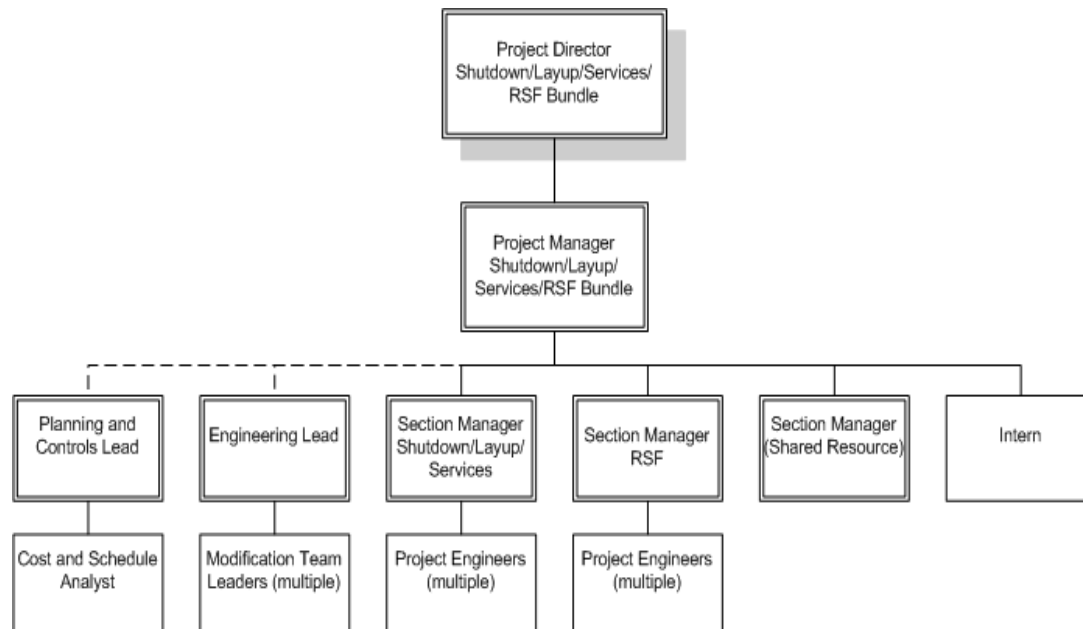


Figure 4 - Project Organization

Nuclear Refurbishment has elected to employ a Matrix organizational model to execute the Refurbishment Program. It is the intent of the Shutdown Layup/Services/RSF Project management team to staff the project team with OPG staff, and if required, supplement by augmented staff to meet the project schedule. OPG staff will either be embedded in the team or will be matrixed from the NR functional support organizations. Where NR functional support staff are currently unable to fulfill a specific need, due to unavailability or missing skill sets, the project will either utilize managed task or augmented staff contracts to maximize outside experience or attempt to find staff within other OPG business units.

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### 10.1.2 Team Development

Each team member will be qualified by their functional manager. As additional requirements are determined, the project manager will request training for team members. The Project Manager will periodically review the team qualifications against project needs to identify gaps in the training program. Training methods may include internal training, external training, and on-the-job training.

The project team will be assembled from experienced staff and junior staff to ensure that oversight of the EPC contractor is effective and to develop the junior personnel.

AIP, PPR, Monthly reports, SOWs and contract performance will be used to assess and develop the project team.

### 10.2 EPC Contractor Human Resources Management

The EPC contractor in the ESMSA for Shutdown Layup/Services/RSF projects will develop a Resource management plan for all staff and subcontractors in accordance with the ESMSA terms and conditions.

## 11.0 PROJECT COMMUNICATIONS MANAGEMENT

Shutdown Layup/Services/RSF Project communication management will be consistent across each project except if there are differences stipulated in each EPC contract. If major differences exist they will be documented in this plan.

### 11.1 OPG Communications Management

#### 11.1.1 Communication Protocol

##### Correspondence

All formal correspondence (official memorandums) shall be issued to OPG via the Vendor Document Management System (VenDM). Each memorandum must clearly indicate the intended recipient. OPG staff will route the correspondence accordingly, and ensure a record copy is kept on file.

Informal correspondence issued via email, can be sent directly to the appropriate project team member.

##### Requests for Information

Requests for information (RFI) originating from OPG and contractors must be issued in a manner that may be recorded, and therefore transmitted via VenDM.



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Responses to RFIs through VenDM shall be managed as per contractual durations outlined in the contract / agreement documents.

RFI's originating from the EPC contractor will be addressed to the Project Manager or Engineering Lead, with cc's to other OPG project team members as applicable. Each RFI will contain related items.

OPG RDM staff will ensure the RFI is routed to the appropriate Project contact for action. OPG will return RFI responses via the VenDM as official memoranda.

#### **Meetings:**

Meetings should be conducted face-to-face with available teleconference and videoconference as required. Minutes of meeting should be documented, reviewed and distributed and actions tracked. Table 1 below tabulates the series of meetings planned for the management of the Shutdown Layup/Services/RSF Project.

Meeting Title	Description	Frequency
SDLU/Services/RSF Schedule Update meeting	Schedule status meeting	Weekly
SDLU/Services/RSF Project Team Meeting	Discussion on project progress, risks and status of major milestones	Bi-Weekly
Change Control Board	This includes the related Options Review Board, Technical Screening Committee and Funding Screening Committee meetings. Scope addition, removal, modification processing.	Bi-weekly or (or as required)
MRM Meeting	Review and processing of station condition records associated with SDLU/Services/RSF	Weekly
Darlington Refurbishment Monthly Program Status Meeting	Project Performance Updates, Issue resolution.	Monthly
Options Review Board	Presentation and review of options to execute/not execute scope.	Monthly (or as required)
PCC Meeting	Discussion of field readiness and execution update.	Daily
Project Risk Review Meeting	Alignment meeting	Bi-Weekly
DN Refurbishment/CNSC Meeting	Alignment meeting	Monthly (or as required)
Nuclear Refurbishment All Staff Face-to-Face Meeting	Project update	Quarterly
DN Refurbishment Execution Three-Stratum Meeting	Project Performance Updates, Issue resolution.	Quarterly (or as required)
Bundle Progress Review Meeting	Bundle Progress and Performance Updates	Weekly

**Table 1 - List of Planned Meetings**

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#### 11.1.2 Stakeholder Inputs

Stakeholder inputs are gathered through the various meetings conducted by and with the project team. Actions, issues and risks are then tracked in the appropriate system as described N-MAN-00120-10001-RISK-07, Nuclear Refurbishment Actions Issues Decisions And Key Assumptions Management.

The major stakeholders for the SDLU/Services/RSF Project are listed below.

Identification	Main Expectations	Potential Influence & Phase of Most Influence	Stakeholder Classification
Darlington Nuclear Generating Station (DNGS)	Return of units 1-4 as per Refurbishment Program Charter	Owners of Plant Systems; Execution Phase	Internal
ESMSA Contractors	Coordination with OPG and other EPC Vendors as per ESMSA Agreement	Throughout the entire project	External
NR Function Groups: Engineering, Nuclear Safety, Ops, Maintenance, Rad Protection, Reg Affairs	Consultation, input required for review of deliverables	Required to perform oversight activities; Throughout the entire project	Internal
Darlington Engineering, Operations, Work Control and Maintenance Staff	Consultation when implementing modifications on the operating stations	Owners of the Plant Systems; Throughout the entire project	Internal
Darlington – Mechanical Design Group	Provide input on pressure testing requirements	Owners and operators of station pressure testing equipment. Key stakeholder in developing pressure test strategy	Internal
Government of Ontario	Performance of Program on Time, on Budget, within Scope, and without Safety Incidents	Major influence in making go, no-go decision for Execution Phase	External
OSS Contractors	Coordination with OPG as per OSS Contract	SME support and support on Technical Assessments; Definition Phase	External
Unions	Upholding of Collective Bargaining Agreements	Entire Project	External
Canadian Nuclear Safety Commission	Compliance with Regulations	Throughout the Project	External

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Identification	Main Expectations	Potential Influence & Phase of Most Influence	Stakeholder Classification
Technical Standards and Safety Authority (TSSA)	Compliance with Regulations	Throughout the Project	External
Municipality of Clarington	Compliance with Codes and By-laws	Throughout the Project	External
Ministry of Environment	Compliance with Regulations	Throughout the Project	External
Ministry of Labour	Compliance with Regulations	Throughout the Project	External
Electrical Safety Authority	Compliance with Regulations	Throughout the Project	External

## 11.2 EPC Contract Communication Management

It is expected that each EPC contractor will issue individual communication management plans as required by the Contract Terms and Conditions.

## 11.3 Performance Reporting

Performance reporting will be executed in accordance with NK38-NR-PLAN-09701-10001 Sht: 0002, Darlington Refurbishment Planning And Controls Program Management Plan.

Project cost and schedule performance will be gauged and monitored using the Earned Value Management technique in accordance with N-MAN-00120-10001-SCH-07, Nuclear Refurbishment Earned Value Management.

## 12.0 PROJECT RISK MANAGEMENT

Risk Management for the Shutdown Layup/Services/RSF Project will require the integration of the Shutdown Layup/Services/RSF Project Risk Management process and the EPC contractor risk management processes.

### 12.1 OPG Risk Management

OPG Risk Management follows the procedures outlined in N-MAN-00120-10001-RISK OPG Risk Management Processes.

Risks in Shutdown Layup/Services/RSF are managed per the governance of OPG Risk Management. The [RMO Tool](#) is a program used to track risks during the entire life cycle of all projects. (Ref. Appendix D)

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## 12.2 EPC Contractor Risk Management

EPC contractors will provide risk management plans as required in the Contract Terms and Conditions.

### 12.2.1 Risk Management Integration

EPC contractors will manage risks per their internal processes. Each EPC contractor may communicate risk to OPG through various methods which will be determined once the EPC contracts are awarded. If the identified EPC contractor risks will impact the Shutdown Layup/Services/RSF Project then those risks will also be added to the Shutdown Layup/Services/RSF project risk register. In general risk communication can take place via the following methods:

- Review risks as part of project communication meetings
- Regularly scheduled risk work shops
- Project reporting

## 13.0 PROJECT PROCUREMENT MANAGEMENT

For all OPG procurement activities, the processes as defined in OPG-PROC-0058, Procurement Activities will be followed.

The EPC contractor will be required to follow their internal Procurement Process, and develop specific procurement management plans for each project as required per the Contract Terms and Conditions and as detailed in N-COI-00120-00001 Contract Owner Interface Requirements.

### 13.1 OPG Procurement Management

Material to be procured by OPG to fulfill Shutdown Layup/Services/RSF scope will be procured using existing OPG processes and procedures.

### 13.2 EPC Contractor Procurement Management

Procurement terms and conditions between OPG and the ESMSA contractor are specified in the ESMSA Appendix 1,2,4,6,8.

## 14.0 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

AACE	Association for the Advancement of Cost Engineering
C&C	Coordination and Control

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CA	Corrective Actions
CCF	Change Control Form
CNSC	Canadian Nuclear Safety Commission
COIR	Contractor Owner Interface Requirements
CPM	Critical Path Method
CSA	Canadian Standards Association
DNGS	Darlington Nuclear Generating Station
DSR	Darlington Scope Request
EDMS	Electronic Document Management System
EPC	Engineering, Procurement and Construction
ESMSA	Extended Services Master Service Agreement
GRB	Gate Review Board
LL	Lessons Learned
MDP	Modification Design Package
MDR	Modification Design Requirements
NCAR	Non-Conformance Corrective Action Requests
NFRA	Nuclear Financial Reporting and Analytics
NR	Nuclear Refurbishment
OHSA	Occupational Health and Safety Act
OPEX	Operating Experience
OPG	Ontario Power Generation
OSS	Owner Support Service
PEPC	Project Management, Engineering, Procurement & Construction
PHT	Primary Heat Transport
PMP	Project Management Plan

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PPR	Personal Performance Review
QA	Quality Assurance
RADAR	Risk Assessment Database And Register
RFI	Request for Information
RFR	Reactor and Feeder Replacement
RMP	Risk Management Plan
RMO	Risk Management and Oversight Tool
RQE	Release Quality Estimate
RSF	Refurbishment Support Facilities
SCR	Station Condition Record
SDLU	Shutdown Layup
SG	Steam Generators
SME	Subject Matter Expert
SG	Steam Generator
SOW	Scope of Work
SSSP	Site Specific Safety Plan
TG	Turbine Generators
TSSA	Technical Standards & Safety Authority
WBS	Work Breakdown Structure

**15.0 REFERENCES**

<b>Document Number</b>	<b>Document Title</b>
D-PCH-09701-10000	Darlington Refurbishment Program Charter
ESMSA Appendix 1,2,4,6,8	
N-CHAR-AS-0002	Nuclear Management System
N-FORM-11390	Decision Record and Analysis Summary Form
N-GUID-01920-10000	Guideline For Engineering Oversight

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N-GUID-09701-10011	Darlington Refurbishment - Safety Management Essentials
N-GUID-09701-10120	Guideline For Construction Oversight
NK38-CORR-09701-0458306	Common Outage Goals And Objectives For Darlington Refurbishment
NK38-INS-09701-10001	Darlington Nuclear Refurbishment Program-scope Control
NK38-NR-PLAN-09701-10001 Sht: 0002	Darlington Refurbishment Planning And Controls Program Management Plan
NK38-NR-PLAN-09701-10001 Sht: 0016	Darlington Refurbishment Staffing Program Management Plan
NK38-NR-PLAN-09701-10001 Sht: 0019	Darlington Refurbishment - Training Program Management Plan
NK38-PLAN-09701-10012	Management Plan: Management of Contractors for Darlington Refurbishment Project
NK38-PLAN-09701-10074	Retube And Feeder Replacement (RFR) Project Management Plan
NK38-PLAN-09701-10150	Retube And Feeder Replacement (RFR) Contract Management Plan
NK38-PLAN-09701-10164	Steam Generator - Project Management Plan
NK38-PLAN-41000-10001	Turbine Generator Project Management Plan
NK38-PLAN-41000-10002	Turbine Generator Engineering Services And Equipment Supply Agreement: Contract Management Plan
N-COI-00120-00001	Contractor Owner Interface Requirements
N-MAN-00120-10001-GRB	Nuclear Projects Gated Process
N-MAN-00120-10001-PC	Nuclear Refurbishment-cost And Schedule Change Control Processes
N-MAN-00120-10001-PC-01	Nuclear Refurbishment-Cost And Schedule Change Control
N-MAN-00120-10001-RISK	Nuclear Refurbishment Risk Management Processes
N-MAN-00120-10001-RISK-04	Nuclear Refurbishment Risk Management And Contingency Development Guide
N-MAN-00120-10001-RISK-06	Darlington Refurbishment Processing Operating Experience And Key Lesson Learned
N-MAN-00120-10001-RISK-07	Nuclear Refurbishment Actions Issues Decisions And Key Assumptions Management
N-MAN-00120-10001-SCH	Nuclear Refurbishment Scheduling Processes
N-MAN-00120-10001-SCH-05	Nuclear Program Project WBS Control Accounts And Work Packages
N-MAN-00120-10001-SCH-07	Nuclear Refurbishment Earned Value Management
N-MAN-00120-10001-SCOPE-01	Nuclear Projects Scoping Process
N-MAN-09701-10002	Nuclear Refurbishment Project Oversight
N-PLAN-00150-10001	Extended Services Master Service Agreement: Contract Management Plan
N-POL-0001	Nuclear Safety Policy

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N-PROC-MM-0010	Establishing And Maintaining Ontario Power Generation Approved Suppliers List
N-PROC-MP-0090	Modification Process
N-PROC-RA-0022	Processing Station Condition Records
N-PROG-AS-0001	Managed Systems
N-PROG-AS-0007	Project Management
N-STD-AS-0028	Project Management Standard,
N-STD-AS-0029	Contract Management Standard
N-STD-AS-0030	Project Oversight Standard
N-STD-AS-0031	Field Engineering Standard
OPG-POL-0001	Employee Health And Safety Policy
OPG-PROC-0058	Procurement Activities



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## Appendix A: Shutdown Layup/Services/RSF Gate Progression Strategy Plan

### A.1.0 INTRODUCTION

The Gate Strategy outlined in this document meets the intent of N-MAN-00120-10001 “Nuclear Projects – Gated Process” and outlines the gating strategy to be used for the Shutdown Layup & Services Project (SDLU) and Refurbishment Support Facilities (RSF) Project (the “Bundle”) during Nuclear Refurbishment (NR). The tasks and milestones in this gated process will be incorporated into the Level 3 schedule and will be updated as they are clarified and confirmed.

The Bundle is split into 2 sub bundles consisting of a) Shutdown Layup and Services and b) Refurbishment Support Facilities (RSF). This plan will document the overall strategy to achieve and progress the 2 sub-bundles through each respective gate, the deliverables associated with each gate, and the anticipated timing of each gate. As each project is unique in scope, cost, and schedule, the gate strategy will be unique for each. As such, this document will identify the deliverables and requirements that will be either pulled ahead of each gate, pushed to future gates or condensing of gates based on the overall project strategy.

This plan was initially issued to support Gate 1. It is now being updated to reflect the revised Gate Strategy based on the most updated information and NR Program strategies.

The scope definition phase is now complete. The Bundle has completed preliminary engineering, detailed engineering and installation planning under the funding acquired under Gate 2, Gate 2X and Gate 2Y.

At Gate 3, each project’s estimate is refined based on the engineering deliverables completed to provide a Release Quality Estimate (RQE) and Unit 2 Execution Estimate.

### A.2.0 PROJECT FUNDING RELEASE APPROACH

#### A.2.1 Shutdown Layup and Services Program Roles and Responsibilities

- Project Manager
  - Develop/update gate progression strategy plan
  - Identify funding requirements & timing
  - Identify deliverables/activities to support successful completion to the next gate on the schedule
  - Monitor and drive completion of deliverables/activities to achieve gate completion, release of funding and continuance of the work
  - Oversight

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- Integration across project bundles
  - Support NR Program
- Director Planning & Controls
  - Review gate progression strategy plan for funding requirements and timing
  - Create Program release strategy that secures funding to meet project needs as identified in gate progression strategy
  - Release funding upon successful gate completion
  - Establish Gate Review Board and process
  - Implement Gate Review process, scheduling meetings as required
- Gate Review Board
  - Establish meetings, terms of reference and ensure quorum obtained
  - Review and approve project gate progression strategy plan
  - Monitor gate deliverables and upon successful completion, approve progression through gate
  - Authorize release of funding for next staged gate deliverables and work

### A.2.2 Timing of the Gates by Project/Sub Bundle

The 2 sub-bundles encompassing many systems will progress through their project lifecycles at different rates due to the nature of each sub bundle and the requirements identified by each project during the assessment period with the significant contractors. The Shutdown Layup sub-bundle was previously submitted as separate packages for Gate 1 in Sep 2013 and the Services sub bundle and Refurb Additional Facilities Project were submitted as a combined Gate 1 package in Nov 2013. A Gate 1A was approved in July 2014 for a portion of the total bundle scope. Gate 2 was submitted and approved in September 2014 for all scopes in both bundles.

Gate 2X for both sub-bundles was approved in July 2015. This released funding for Execution Mobilization activities for all SDLU & RSF Projects with class 3 estimates and level 3 schedules.

At Gate 2Y, funding requested for deliverables in the Execution Mobilization Phase to the start of Unit 2 Breaker Open was requested at the GRB for certain SDLU & RSF Projects. Deliverables included:

- Planning efforts (i.e. Comprehensive work packages completion, engineering completion)
- Procurement of Long Lead Materials for Unit 2

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At Gate 3, funding for all deliverables in the Execution Phase to the start of Unit 2 Breaker Open was requested at the GRB for SDLU & RSF Projects which had Class 3 estimate and Level 3 schedule. Deliverables include:

- Installation / Commissioning of pre-requisite work, where pre-requisite work is defined as a project with execution work starting prior to Unit 2 breaker open
- Mobilization/Training of Execution Staff

At Gate 3X, all remaining project funding (for projects which have cleared Gate 2Y) required for deliverables in the Execution Phase to the start of Unit 2 Breaker Open will be requested at the GRB. Deliverables include:

- Installation/Commissioning of pre-requisite work, where pre-requisite work is defined as a project with execution work starting prior to Unit 2 breaker open
- Mobilization/Training of Execution Staff

At Gate 3U2a, remaining funding for all remaining Unit 2 Deliverables will be requested.

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**A.2.3 Shutdown/ Layup/Services (SDLU) and Refurb Support Facilities (RSF)**

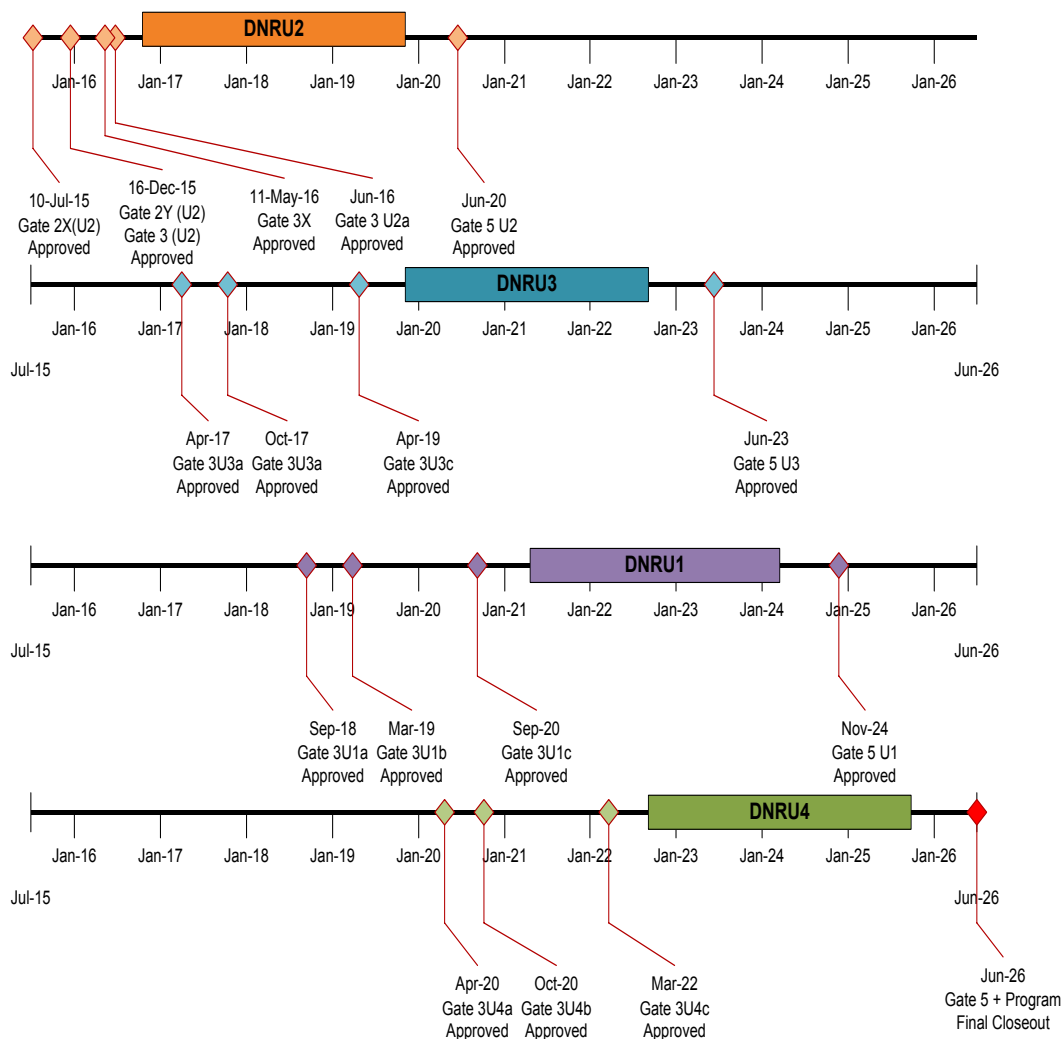


Figure 5 - SDLU and RSF Release Strategy Life Cycle

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Gate	TCD	Approval at GRB to Perform the Following:
SDLU <b>Gate 1</b>	14 Aug 2013 (completed)	<ul style="list-style-type: none"> <li>Project Management activities for entire Project for the period Sept 2013 to May 2014 inclusive.</li> </ul> <p><b><u>Shutdown Layup</u></b></p> <ul style="list-style-type: none"> <li>Prepare Gate 2 deliverables.</li> <li>Complete SCI based Integration Studies.</li> <li>Complete Design Requirements/Layup Plans.</li> <li>Complete MDP's.</li> <li>Independent Assessment of Project Strategy</li> <li>Prepare RFP's, &amp; Bid Evaluations for DSR's included in the RFR, TG, SG contracts and in ESMSA contracts (ESMSA will only be utilized for work not included in RFR, TG, SG). To meet the time line funding will be requested at Gate 1 to commit Contract award of these projects based on class 5 estimates.</li> <li>Request agreement from GRB to commit for RFR, TG, SG, and ESMSA Contract Award and issue of PO's as req'd.</li> <li>Funding for Preliminary Engineering for Shutdown Layup sub bundle DSR work included in RFR, TG, SG Contracts and in ESMSA Contracts.</li> <li>Funding to start Detailed Engineering for specific Shutdown Layup sub bundle DSR work included in RFR, TG, SG Contracts and in ESMSA Contracts. (Only requested to allow work to progress if Preliminary engineering is completed prior to Gate 2)</li> </ul> <p><b><u>Services</u></b></p> <ul style="list-style-type: none"> <li>Funding for Sept, Oct, Nov 2013 to prepare Services Gate 1 deliverables.</li> <li>Funding for Sept, Oct, Nov 2013 to complete Services Conceptual Studies (Electrical, HVAC, Water, Air, Washrooms).</li> <li>Funding for Sept, Oct, Nov 2013 to complete Services Non Traditional Services Studies.</li> <li>Complete MDP's.</li> <li>Reassessment of Services Conceptual Study due to delinking Unit 2 &amp; Unit 1</li> <li>Prepare RFP's, &amp; Bid Evaluations, and Issue of PO's for Cranes and for Dehumidification included in the ESMSA pilot project. To meet the pilot project timeline funding will be requested at Gate 1 to commit Contract award of these projects based on class 5 estimates.</li> <li>Request agreement from GRB to commit for ESMSA Contract Award.</li> <li>Funding of Services sub bundle ESMSA pilot project Preliminary Engineering up to the Services Gate 1 GRB anticipated in Nov 2013.</li> </ul> <p><b><u>Refurb Additional Facilities</u></b></p> <ul style="list-style-type: none"> <li>Funding for Sept, Oct, Nov 2013 to prepare Refurb Additional Facilities Gate 1 deliverables.</li> <li>Funding for Sept, Oct, Nov 2013 to progress Refurb Additional Facilities MDP's through OSS.</li> </ul>

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Gate	TCD	Approval at GRB to Perform the Following:
Services RSF <b>Gate 1 (U2)</b>	29 Nov 2013 (Complete)	<ul style="list-style-type: none"> <li>Project Management activities</li> <li>Prepare Gate 2 deliverables.</li> <li>Funding of Services sub bundle ESMSA projects start of Preliminary &amp; Detail Design up to Gate 2 GRB anticipated in May 2014.</li> <li>Funding of Refurb Additional Facilities Project for P&amp;M start of Preliminary &amp; Detail Design up to Gate 2 GRB anticipated in May 2014.</li> <li>Prepare RFP's/Work Requests, &amp; Bid Evaluations, and Issue of PO's for balance of Services DSR's. To meet this time line funding will be requested at Gate 1 to commit Contract award of these projects based on class 5 estimates.</li> <li>Request agreement from GRB to commit for Contract Award of Preliminary &amp; Detail Design up to Gate 2 GRB anticipated in May 2014 for balance of Project.</li> <li>Start of preliminary design for balance of Projects.</li> <li>Start procurement of long lead materials as req'd.</li> </ul>
SDLU Services RSF <b>Gate 1A (U2)</b>	31 Jul 2014 (Complete)	<ul style="list-style-type: none"> <li>Project Management activities</li> <li>Prepare Gate 2 deliverables</li> <li>Issue Definition Phase contracts for: <ul style="list-style-type: none"> <li>Moderator and PHT Layup</li> <li>SG Primary Side Layup</li> <li>TG and Aux Layup</li> <li>Breathing Air</li> <li>Service Air</li> <li>Work Control Area</li> <li>TAB Elevator</li> <li>Holt Road Services</li> </ul> </li> </ul>
SDLU Services RSF <b>Gate 2 (U2)</b>	23 Sep 2014 (Complete)	<ul style="list-style-type: none"> <li>Project Management activities for both sub-bundles for the period Oct 2014 to Apr 2015 inclusive</li> <li>Prepare Gate 3 deliverables</li> <li>Issuing of remaining Definition Phase contracts to complete Detailed Engineering</li> <li>Ordering of LL materials and equipment (if required)</li> </ul>
SDLU Services RSF <b>Gate 2X</b>	30 Jun 2015 (Complete)	<ul style="list-style-type: none"> <li>Planning efforts (i.e. Comprehensive work packages completion, engineering completion)</li> <li>Procurement of Long Lead Materials for Unit 2Prepare Gate 3U2a Deliverables</li> </ul>
SDLU Services RSF <b>Gate 2Y</b>	16 Dec 2015 (Complete)	<ul style="list-style-type: none"> <li>Planning efforts (i.e. Comprehensive work packages completion, engineering completion)</li> <li>Procurement of Long Lead Materials for Unit 2</li> </ul>
SDLU Services RSF <b>Gate 3 (U2)</b>	16 Dec 2015 (Complete)	<ul style="list-style-type: none"> <li>Acquire funding for Installation/Commissioning of pre-requisite work, where pre-requisite work is defined as a project with execution work starting prior to Unit 2 breaker open</li> <li>Mobilization/Training of Staff</li> </ul>

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Gate	TCD	Approval at GRB to Perform the Following:
SDLU Services RSF <b>Gate 3X (U2)</b>	May 2016	<ul style="list-style-type: none"> <li>Acquire remaining Unit 2 Execution Phase Funding for Installation/Commissioning of pre-requisite work, where pre-requisite work is defined as a project with execution work starting prior to Unit 2 breaker open</li> <li>Mobilization/Training of Staff</li> </ul>
SDLU Services RSF <b>Gate 3U2a</b>	June 2016	<ul style="list-style-type: none"> <li>Acquire remaining Unit 2 Execution Phase Funding, including funding for closeout and removal activities</li> <li>Prepare Gate 5 deliverables, including lessons learned and project completion declaration</li> </ul>
<b>Gate 5 (U2)</b>	June 2020	<ul style="list-style-type: none"> <li>Project Close Out</li> <li>Post Implementation Review</li> </ul>
<b>Gate 3U3a</b>	30 months before U3 Breaker Open	<ul style="list-style-type: none"> <li>Initial release to initiate a planning organization to commence Unit 3 Planning (Program Release Only)</li> </ul>
<b>Gate 3U3b</b>	24 months before U3 Breaker Open	<ul style="list-style-type: none"> <li>Definition Phase for Unit 3 to complete unit specific planning and procurement of long lead materials. Each project would notionally have a release amount for the unit specific planning, as required</li> </ul>
<b>Gate 3U3c</b>	6 months before U3 Breaker Open	<ul style="list-style-type: none"> <li>Check Estimate on Unit 3 and Release of Unit 3 Funds</li> </ul>
<b>Gate 5 (U3)</b>	June 2023	<ul style="list-style-type: none"> <li>Project Close Out</li> <li>Post Implementation Review</li> </ul>
<b>Gate 3U1a</b>	30 months before U1 Breaker Open	<ul style="list-style-type: none"> <li>Initial release to initiate a planning organization to commence Unit 1 Planning (Program Release Only)</li> </ul>
<b>Gate 3U1b</b>	24 months before U1 Breaker Open	<ul style="list-style-type: none"> <li>Definition Phase for Unit 1 to complete unit specific planning and procurement of long lead materials. Each project would notionally have a release amount for the unit specific planning, as required</li> </ul>
<b>Gate 3U1c</b>	6 months before U1 Breaker Open	<ul style="list-style-type: none"> <li>Check Estimate on Unit 1 and Release of Unit 1 Funds</li> </ul>
<b>Gate 5 (U1)</b>	Nov 2024	<ul style="list-style-type: none"> <li>Project Close Out</li> <li>Post Implementation Review</li> </ul>
<b>Gate 3U4a</b>	30 months before U4 Breaker Open	<ul style="list-style-type: none"> <li>Initial release to initiate a planning organization to commence Unit 4 Planning (Program Release Only)</li> </ul>
<b>Gate 3U4b</b>	24 months before U4 Breaker Open	<ul style="list-style-type: none"> <li>Definition Phase for Unit 4 to complete unit specific planning and procurement of long lead materials. Each project would notionally have a release amount for the unit specific planning, as required</li> </ul>
<b>Gate 3U4c</b>	6 months before U4 Breaker Open	<ul style="list-style-type: none"> <li>Check Estimate on Unit 4 and Release of Unit 4 Funds</li> </ul>
<b>Gate 5 (U4)</b>	June 30 2026	<ul style="list-style-type: none"> <li>Project Close Out (All units)</li> <li>Post Implementation Review</li> </ul>

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**Appendix B: Contracting Strategy by Scopes of Work**

Sub-Bundle	Dsr_Line	Title	Grouping	Eng Vendor	PC Vendor
1-SDLU	TS0050-01	Darlington Steam Generators: Layup/Preservation Activities - SG Primary Side Drying Tool	Dry Air Nuclear	Worley Parsons	ESFOX
	TS0800-03	Modifications for Common Systems: Breathing Air	Breathing Air	Worley Parsons	ESFOX
	TS0830-01	Unit Lay-up Modifications for Conventional Systems: Condensate, Feedwater, and Extraction Steam Systems	Dry Air Conventional	OPG	ESFOX
	TS0830-02	Unit Lay-up Modifications for Conventional Systems: HP, LP Turbines and Turbine and Piping Drains System	Dry Air Conventional	OPG	ESFOX
	TS0830-03	Unit Lay-up Modifications for Conventional Systems: Main Condenser, Condensate Make-Up and Reject System and Condenser Ait Extrusion System	Dry Air Conventional	OPG	ESFOX
	TS0830-04	Unit Lay-up Modifications for Conventional Systems: Main Steam System	Dry Air Conventional	OPG	ESFOX
	TS0830-05	Unit Lay-up Modifications for Conventional Systems: Moisture Separator and Moisture Separator Reheaters	Dry Air Conventional	OPG	ESFOX
	TS0830-06	Unit Lay-up Modifications for Conventional Systems: Circulating Water System	CCW	CANCELLED	CANCELLED
	TS0830-07	Unit Lay-up Modifications for Conventional Systems: Generator Stator Cooling System	Dry Air Conventional	OPG	ESFOX
	TS0830-08	Unit Lay-up Modifications for Conventional Systems: Turbine Lube Oil System and Generator	Dry Air Conventional	OPG	ESFOX
	TS0830-09	Unit Lay-up Modifications for Conventional Systems: Generator Hydrogen Cooling System	Dry Air Conventional	OPG	ESFOX
	TS0830-10	Unit Lay-up Modifications for Conventional Systems: Generator Excitation System	Dry Air Conventional	OPG	ESFOX
	TS0830-11	Unit Lay-up Modifications for Conventional Systems: Steam Generator Emergency Cooling System (SGECS) and SG Secondary Side	SG Secondary + SGEC	RCMT	ESFOX
	TS0890-01	Unit Layup Modification for Nuclear Systems: Moderator Drain and Dry	Mod Flush	AMEC	ESFOX
	TS0890-02	Unit Layup Modification for Nuclear Systems: Drying of HT Auxiliary Circuit	Dry Air Nuclear	Worley	ESFOX
	TS0930-01	Common Services: Additional Service Air	Service Air	Worley	ESFOX



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		and Instrument Air Capacity		Parsons	
	TS1020-02	Preparation of Station Cranes for Refurbishment: Execute Maintenance for Each Crane	Cranes	N/A	OPG
	Various DSRs	Monitoring of Permanent Station System Components and Equipment	Permanent Equipment Layup	N/A	Aecon
	TS2580-01	Contingent D2O Storage	Contingent D2O	CANCELLED	CANCELLED
		Temporary Power	Temporary Power	OPG	TBD
2-RSF	CP0050-01	Washroom Facility	Washroom	OPG	Aecon
	CP0410-01	Additional Facilities Required to Support Nuclear Refurbishment: Control Maintenance Shop	Shops and Work Areas	Worley Parsons	ESFOX
	CP0410-02	Additional Facilities Required to Support Nuclear Refurbishment: Mechanical Maintenance Fitting/Machine Shop	Shops and Work Areas	Worley Parsons	ESFOX
	CP0410-03	Additional Facilities Required to Support Nuclear Refurbishment: Civil Maintenance Shop	Shops and Work Areas	Worley Parsons	ESFOX
	CP0410-04	Additional Facilities Required to Support Nuclear Refurbishment: Hot Shop	Contam Shops/Work Areas	HSL	ESFOX
	CP0410-05	Additional Facilities Required to Support Nuclear Refurbishment: Decontamination Shop	Decontam Room S107	HSL	ESFOX
	CP0410-07	Additional Facilities Required to Support Nuclear Refurbishment: Safe Work Area Depot	Shops and Work Areas	Worley Parsons	ESFOX
	CP0410-08	Additional Facilities Required to Support Nuclear Refurbishment: Clean Scaffold Material Storage Area	Shops and Work Areas	Worley Parsons	ESFOX
	CP0410-09	Additional Facilities Required to Support Nuclear Refurbishment: Contaminated Scaffold Storage Area	Contam Shops/Work Areas	HSL	ESFOX
	CP0410-10	Additional Facilities Required to Support Nuclear Refurbishment: CM, MM, MC, OPS, Assessing Offices	Shops and Work Areas	Worley Parsons	ESFOX
	CP0410-11	Additional Facilities Required to Support Nuclear Refurbishment: Nuclear Refurbishment Work Control Area	Work Control Area	HSL	ESFOX
	CP0480-01	Add'l Facilities Required to Support Nuclear Refurbishment: Radiation Protection Teledosimetry Facility	Rad Protection and Teledosimetry	HSL	ESFOX
	CP0480-02	Additional Facilities Required to Support Nuclear Refurbishment: Pressure Boundary Laydown Area	Vestibules/Stg Pd/PB LD Area	CANCELLED	CANCELLED
	CP0480-04	Additional Facilities Required to Support Nuclear Refurbishment: Turbine Lunch Room	Lunchroom	CANCELLED	CANCELLED
	CP0480-05	Additional Facilities Required to Support Nuclear Refurbishment: Personnel/Cargo Elevator - Turbine Auxiliary Bay Hoistways	TAB West Ele Elevator	Tetratek	NOT REQUIRED

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	CP0480-06	Additional Facilities Required to Support Nuclear Refurbishment: Off Site X-Ray Scanner	X-Ray Scanner	CANCELLED	CANCELLED
	CP0480-07	Additional Facilities Required to Support Nuclear Refurbishment: Entry Vestibules	Vestibules/Stg Pd/PB LD Area	CANCELLED	CANCELLED
	CP0480-08	Additional Facilities Required to Support Nuclear Refurbishment: Land/Sea Container Storage Pad	Vestibules/Stg Pd/PB LD Area	CANCELLED	CANCELLED
	CP0490-01	Holt Road/South Service Rd./Highway 401 Interchange OPG Services Impact	Holt Road Services	Worley	MTO/ESFOX

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**Appendix C: Scopes of Work by DSR and Project Numbers**

Sub-Bundle	Dsr_Line	Title	Grouping	U0 Project #	U2 Project #	U3 Project #	U1 Project #	U4 Project #
1-SDLU	TS0050-01	Darlington Steam Generators: Layup/Preservation Activities - SG Primary Side Drying Tool	Dry Air Nuclear	-	73539 (E) 73540 (PC)	73541 (E) 73542 (PC)	73543 (E) 73548 (PC)	73658 (E) 73659 (PC)
	TS0800-03	Modifications for Common Systems: Breathing Air	Breathing Air	-	73537	-	-	-
	TS0830-01	Unit Lay-up Modifications for Conventional Systems: Condensate, Feedwater, and Extraction Steam Systems	Dry Air Conventional	-	73535 (E) 73545 (PC)	73546 (E) 73547 (PC)	73651 (E) 73652 (PC)	73653 (E) 73654 (PC)
	TS0830-02	Unit Lay-up Modifications for Conventional Systems: HP, LP Turbines and Turbine and Piping Drains System	Dry Air Conventional	-	73535 (E) 73545 (PC)	73546 (E) 73547 (PC)	73651 (E) 73652 (PC)	73653 (E) 73654 (PC)
	TS0830-03	Unit Lay-up Modifications for Conventional Systems: Main Condenser, Condensate Makr-Up and Reject System and Condenser Ait Extrusion System	Dry Air Conventional	-	73535 (E) 73545 (PC)	73546 (E) 73547 (PC)	73651 (E) 73652 (PC)	73653 (E) 73654 (PC)
	TS0830-04	Unit Lay-up Modifications for Conventional Systems: Main Steam System	Dry Air Conventional	-	73535 (E) 73545 (PC)	73546 (E) 73547 (PC)	73651 (E) 73652 (PC)	73653 (E) 73654 (PC)
	TS0830-05	Unit Lay-up Modifications for Conventional Systems: Moisture Separator and Moisture Separator Reheaters	Dry Air Conventional	-	73535 (E) 73545 (PC)	73546 (E) 73547 (PC)	73651 (E) 73652 (PC)	73653 (E) 73654 (PC)
	TS0830-06	Unit Lay-up Modifications for Conventional Systems: Circulating Water System	CCW	-	CANCELLED	CANCELLED	CANCELLED	CANCELLED
	TS0830-07	Unit Lay-up Modifications for Conventional Systems: Generator Stator Cooling System	Dry Air Conventional	-	73535 (E) 73545 (PC)	73546 (E) 73547 (PC)	73651 (E) 73652 (PC)	73653 (E) 73654 (PC)
	TS0830-08	Unit Lay-up Modifications for Conventional Systems: Turbine Lube Oil System and Generator	Dry Air Conventional	-	73535 (E) 73545 (PC)	73546 (E) 73547 (PC)	73651 (E) 73652 (PC)	73653 (E) 73654 (PC)
	TS0830-09	Unit Lay-up Modifications for Conventional Systems: Generator Hydrogen Cooling System	Dry Air Conventional	-	73535 (E) 73545 (PC)	73546 (E) 73547 (PC)	73651 (E) 73652 (PC)	73653 (E) 73654 (PC)

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	TS0830-10	Unit Lay-up Modifications for Conventional Systems: Generator Excitation System	Dry Air Conventional	-	73535 (E) 73545 (PC)	73546 (E) 73547 (PC)	73651 (E) 73652 (PC)	73653 (E) 73654 (PC)
	TS0830-11	Unit Lay-up Modifications for Conventional Systems: Steam Generator Emergency Cooling System (SGECS) and SG Secondary Side	SG Secondary + SGEC	-	73513	73530	73531	73532
	TS0890-01	Unit Layup Modification for Nuclear Systems: Moderator Drain and Dry	Moderator Flush	-	73685 (E) 73689 (PC)	73686 (E) 73690 (PC)	73687 (E) 73691 (PC)	73688 (E) 73692 (PC)
	TS0890-02	Unit Layup Modification for Nuclear Systems: Drying of HT Auxilliary Circuit	Dry Air Nuclear	-	73539 (E) 73540 (PC)	73541 (E) 73542 (PC)	73543 (E) 73548 (PC)	73658 (E) 73659 (PC)
	TS0930-01	Common Services: Additional Service Air and Instrument Air Capacity	Service Air	-	73538	-	-	-
	TS1020-02	Preparation of Station Cranes for Refurbishment: Execute Maintenance for Each Crane	Cranes	-	73536	73674	73675	73676
	Various DSRs	Monitoring of Permanent Station System Components and Equipment	Permanent Equipment Layup	-	73519	73669	73672	73673
	TS2580-01	Contingent D2O	Contingent D2O	-	73520 (E) CANCE LLED (PC)	-	-	-
		Temporary Power	Temporary Power	-	73704 (E) 73643 (PC)	73693 (E) 73644 (PC)	73694 (E) 73645 (PC)	73695 (E) 73646 (PC)
2-RSF	CP0050-01	Washroom Facility	Washroom	-	73716	73722	73724	73726
	CP0410-01	Additional Facilities Required to Support Nuclear Refurbishment: Control Maintenance Shop	Shops and Work Areas	-	73715	73727	73729	73730
	CP0410-02	Additional Facilities Required to Support Nuclear Refurbishment: Mechanical Maintenance Fitting/Machine Shop	Shops and Work Areas	-	73715	73727	73729	73730
	CP0410-03	Additional Facilities Required to Support Nuclear Refurbishment: Civil Maintenance Shop	Shops and Work Areas	-	73715	73727	73729	73730

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	CP0410-04	Additional Facilities Required to Support Nuclear Refurbishment: Hot Shop	Contam Shops/Work Areas	-	73714	73725	73736	73737
	CP0410-05	Additional Facilities Required to Support Nuclear Refurbishment: Decontamination Shop	Decontam Shop S107	-	73741 (Eng) 73742 (PC)	-	-	-
	CP0410-07	Additional Facilities Required to Support Nuclear Refurbishment: Safe Work Area Depot	Shops and Work Areas	-	73715	73727	73729	73730
	CP0410-08	Additional Facilities Required to Support Nuclear Refurbishment: Clean Scaffold Material Storage Area	Shops and Work Areas	-	73715	73727	73729	73730
	CP0410-09	Additional Facilities Required to Support Nuclear Refurbishment: Contaminated Scaffold Storage Area	Contam Shops/Work Areas	-	73714	73725	73736	73737
	CP0410-10	Additional Facilities Required to Support Nuclear Refurbishment: CM, MM, MC, OPS, Assessing Offices	Shops and Work Areas	-	73715	73727	73729	73730
	CP0410-11	Additional Facilities Required to Support Nuclear Refurbishment: Nuclear Refurbishment Work Control Area	Work Control Area	-	73711	-	-	-
	CP0480-01	Add'l Facilities Required to Support Nuclear Refurbishment: Radiation Protection Teledosimetry Facility	Rad Protection and Teledosimetry	-	73712	73720	73721	73731
	CP0480-02	Additional Facilities Required to Support Nuclear Refurbishment: Pressure Boundary Laydown Area	Vestibules/Stg Pd/PB LD Area	-	CANCELLED	CANCELLED	CANCELLED	CANCELLED
	CP0480-04	Additional Facilities Required to Support Nuclear Refurbishment: Turbine Lunch Room	Lunchroom	-	CANCELLED	CANCELLED	CANCELLED	CANCELLED
	CP0480-05	Additional Facilities Required to Support Nuclear Refurbishment: Personnel/Cargo Elevator - Turbine Auxiliary Bay Hoistways	TAB West Ele Elevator	-	CANCELLED	CANCELLED	CANCELLED	CANCELLED
	CP0480-06	Additional Facilities Required to Support Nuclear Refurbishment: Off Site X-Ray	X-Ray Scanner	-	CANCELLED	CANCELLED	CANCELLED	CANCELLED

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		Scanner						
	CP0480-07	Additional Facilities Required to Support Nuclear Refurbishment: Entry Vestibules	Vestibules/Stg Pd/PB LD Area	-	CANCELLED	CANCELLED	CANCELLED	CANCELLED
	CP0480-08	Additional Facilities Required to Support Nuclear Refurbishment: Land/Sea Container Storage Pad	Vestibules/Stg Pd/PB LD Area	-	CANCELLED	CANCELLED	CANCELLED	CANCELLED
	CP0490-01	Holt Road/South Service Rd./Highway 401 Interchange OPG Services Impact	Holt Road Services	-	73728 (E) 73747 (PC)	-	-	-

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## Appendix D: SDLU/Services/RSF Risk Management Plan

The purpose of this Risk Management Plan (RMP) is to document how the SDLU/Services/RSF Project will manage Assumptions, Issues, Decisions, Risks, relevant Lessons Learned (LL) and OPEX for the Darlington Refurbishment Project. Assumptions, Risks and OPEX & LL will be managed in alignment with N-MAN-00120-10001-RISK and NK38-NR-PLAN-09701-10001 Sht: 0002, Darlington Refurbishment Planning And Controls Program Management Plan.

### D.1.0 RISKS

Risks are determined through brainstorm sessions, risk workshops, by individuals in the NR organization, subject matter experts (SME), by vendors and by reviewing relevant OPEX. Once a risk is identified it will be assessed systematically on its impact to the project. Risks can then be given a risk response action and will undergo an appropriate degree of monitoring including a monthly review.

### D.1.1 Roles and Responsibilities

#### SDLU/Services/RSF Project Manager

The SDLU/Services/RSF Project Manager (PM) will serve as the Risk Owner of all SDLU/Services/RSF Project Risks. The PM's responsibilities include:

- The overall project risk management and program risks delegated to the projects
- Ensuring that the Risk Management Plan is established and processes are followed within the project
- Ensuring mitigating actions are developed
- Ensuring that the SDLU/Services/RSF Risk Management Team is updating the risk database (RMO)
- Managing reports and records for project and program risks
- Ensuring that risk monitoring and mitigating actions are implemented into cost and schedule planning tools as well as applicable action tracking databases
- Ensuring that review of risks and actions resulting from risks are carried out, at an appropriate frequency, monthly at a minimum
- Developing the SDLU/Services/RSF Project's RMP

#### SDLU/Services/RSF Risk Management Team

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The Risk Management Team will consist of members of the SDLU/Services/RSF project. They are responsible for:

- Project risk management within their assigned responsibility as delegated by the PM
- Identifying new risks
- Ensuring that risk monitoring and mitigating actions are implemented into cost and schedule planning tools as well as applicable action tracking databases
- Monthly review of risk assessment, scores, and mitigating actions within their assigned responsibility

### **SDLU/Services/RSF Risk Management SPOC**

The Risk Management SPOC is responsible for:

- Overall SDLU/Services/RSF Project risk management
- Coordinating with the Darlington Planning and Controls Risk Section and other Project SPOCs
- Monitoring the project's risk register (RMO)
- Identifying and entering new risks into the risk database (RMO)
- Conducting monthly review of risk assessment, scores and mitigating actions with risk owners

## **D.2.0 RISK CATEGORIES AND BREAKDOWN**

The SDLU/Services/RSF Project's risks are broken down and grouped into the SDLU/Services Sub-bundle or RSF sub-bundles. For risks that apply to both sub-bundles, the risks are duplicated in anticipation that the two sub-bundles will be conducting gate submission at different time intervals

### **D.2.1 Project Risk Management**

Project risks are risks that primarily affect one Project at Refurbishment. Other groups may have minor impact on the risk and are treated as secondary stakeholders for management of the risk. Risks identified at the project level will be entered into the project risk database (RMO) and managed per the guide N-MAN-00120-10001-RISK-04 Nuclear Refurbishment Risk Management & Contingency Development Guide.

### **D.2.2 Program Risk Management**



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Program risks are risks that affect the entire Refurbishment Program as a whole or risks that go beyond the scope of any individual project. For more information on Program Risks please refer to the N-MAN-00120-10001-RISK guides.

### D.2.3 Issues from Risks

Issues can arise from risks that have been realized (Probability = 100 %). Issues and risks will be managed similarly in the RMO Tool. Any potential impacts from Issues to cost and schedule should already be planned for in the project, or documented in a CCF when a risk is realized. In the case that it is not accounted for in the project's cost and schedule (for example an ongoing risk that may occur multiple times, or may occur separately for multiple sub-bundles), then the issue will also be tracked as a risk so that contingency can be identified for the unresolved portion of the issue.

Issues will be treated as risks: they will have owners, actions to resolve them, and will be reviewed as required, be it monthly (or shorter if necessary).

### D.3.0 ASSUMPTIONS, ISSUES AND DECISIONS

Assumptions, Issues and Decisions are important to the Nuclear Refurbishment (NR) program and must be properly documented, reviewed and resolved as per N-MAN-00120-10001-RISK-07, Nuclear Refurbishment Actions Issues Decisions And Key Assumptions Management.

### D.3.1 Roles and Responsibilities

#### **SDLU/Services/RSF Project Manager**

The SDLU/Services/RSF Project Manager responsibilities include:

- Management of the overall Assumptions, Issues and Decisions for the project
- Approval of Assumptions, Issues and Decisions identified by the project
- Assigning required actions to members of the project team
- Ensuring the Assumptions, Issues and Decisions database is being updated
- Ensuring that ongoing review of assumptions, issues, decisions, and actions are carried out

#### **SDLU/Services/RSF Project Team**

The SDLU/Services/RSF Project Team is responsible for:

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- Identifying any Assumptions, Issues or Decisions that will affect the SDLU/Services/RSF Project, and the actions required to address / validate them, including required review frequency
- Review of project's Assumptions, Issues and Decisions in their respective databases

#### **SDLU/Services/RSF Assumptions, Issues and Decisions SPOC**

The SDLU/Services/RSF Assumptions, Issues and Decisions SPOC is responsible for:

- Entering Assumptions, Issues and Decisions into their respective databases
- Coordinating with the Darlington Planning and Controls Risk Section and other Project SPOCs
- Coordinating reviews of Assumptions, Issues and Decisions for updates within their respective databases

### **D.4.0 LESSONS LEARNED & OPEX**

This section will detail the use of Lessons Learned and OPEX (LL & OPEX) in the Nuclear Refurbishment Program, and how SDLU/Services/RSF will implement them into our project. Nuclear Refurbishment and the SDLU/Services/RSF project manage LL & OPEX as guided in N-MAN-00120-10001-RISK-06 Nuclear Refurbishment Processing Operating Experience And Key Lesson Learned.

#### **D.4.1 Roles and Responsibilities**

##### **SDLU/Services/RSF Project Manager**

The SDLU/Services/RSF Project Manager responsibilities include:

- Ensuring LL & OPEX are reviewed regularly by project team and accounted for in project cost and schedule
- Ensuring project plans account for LL & OPEX impacts to quality, cost and schedule
- Ensuring the Project LL & OPEX is captured and shared throughout the organization

##### **SDLU/Services/RSF Project Team**

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The SDLU/Services/RSF Team (referred as SME in N-MAN-00120-10001-RISK-06) is responsible for:

- Identifying any OPEX relevant to the project and sharing it with the project team
- Providing disposition on OPEX entries as requested by Project Manager, Project OPEX SPOC or NR OPEX SPOC

### **Project OPEX SPOC**

The SDLU/Services/RSF OPEX SPOC is responsible for:

- Reviewing new OPEX reports from Nuclear Refurbishment Program OPEX SPOC and forwarding to SDLU/Services/RSF Team members as appropriate
- Identifying new LL & OPEX and provide it to the appropriate groups
- Ensuring that any LL & OPEX are accounted for within Risk Management
- Reviewing SDLU/Services/RSF flagged LL & OPEX from outside the project and providing disposition notes

### **NR OPEX SPOC**

The NR OPEX Section is responsible for:

- Collecting internal and external LL & OPEX reports applicable to Nuclear Refurbishment
- Inclusion of LL & OPEX into Refurbishment OPEX Management Database
- Distributing relevant LL & OPEX to SPOCs monthly
- Managing the Refurbishment LL & OPEX Database
- Preparing and issuing quarterly LL & OPEX report

## **D.4.2 Lessons Learned and OPEX Management**

LL & OPEX discovered by individual SDLU/Services/RSF project team members will be distributed to the rest of the team as appropriate. LL & OPEX can be found from many different sources including other projects (e.g. Balance of Plant, Islanding, etc.), vendors, previous OPG projects (such as Pickering Nuclear Return to Service), other refurbishment projects outside of OPG (Bruce, Point Lepreau, etc), other mega-

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projects (such as the London Olympics), etc. This is an on-going process and the SDLU/Services/RSF Project Team will ensure that OPEX identified by external sources will be collected in the appropriate databases.

#### **D.4.2.1 Integration of Lessons Learned and OPEX**

Once the relevant LL & OPEX has been identified, the Project OPEX SPOC working with the Project Team must determine necessary actions to avoid these issues. Following a review of LL & OPEX any potential Risks, Assumptions or Issues will be identified and documented in their respective database. The mitigating actions developed from the Risk, Assumption or Issue will be assigned to the project team members to ensure that project scope, schedule, cost, quality, nuclear safety and worker safety are all taken into consideration. The project team will share any discovered LL & OPEX with other projects and vendors working with the SDLU/Services/RSF project as necessary.

The Refurbishment OPEX Database can cross-reference RISK ID numbers to the relevant OPEX found from new risks. Similarly any new risks identified from OPEX will be registered into RMO with the corresponding OPEX ID Number. Similar cross-referencing should also be done for any related Assumptions, Issues and Decisions.

#### **D.4.3 Review of Lessons Learned & OPEX**

All LL & OPEX will be reviewed monthly. Older OPEX entries flagged to SDLU/Services/RSF with associated actions will be reviewed as required when the action has been completed.

#### **D.5.0 REFERENCES**

N-FORM-11390, Decision Record and Analysis Summary Form

N-MAN-00120-10001-RISK, Nuclear Projects Risk Management Process

N-MAN-00120-10001-RISK-04, Nuclear Refurbishment Risk Management And Contingency Development Guide

N-MAN-00120-10001-RISK-06, Darlington Refurbishment Processing Operating Experience And Key Lesson Learned

N-MAN-00120-10001-RISK-07, Nuclear Refurbishment Actions Issues Decisions And Key Assumptions Management

NK38-NR-PLAN-09701-10001-SHT-02, Darlington Refurbishment Planning And Controls Program Management Plan



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**STEAM GENERATOR – PROJECT MANAGEMENT PLAN**

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**Steam Generator  
Project Management Plan**

**NK38-PLAN-09701-10164-0001R004**

2016-04-18

Order Number: N/A

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**Revision Summary**

Revision Number	Date	Comments
R00	2013-10-20	Initial issue.
R001	2015-05-15	Revision to incorporate vendor management plan references and to consolidate the following management plans into the project management plan document: NK38-PLAN-09701-10164 Sht. 0003 Steam Generator Quality Management Plan NK38-PLAN-09701-10164 Sht. 0005 Steam Generator Scope Management Plan NK38-PLAN-09701-10164 Sht. 0008 Steam Generator Construction Management Plan NK38-PLAN-09701-10164 Sht. 0009 Steam Generator Communication Management Plan NK38-PLAN-09701-10164 Sht. 0010 Steam Generator Risk Management Plan NK38-PLAN-09701-10164 Sht. 0014 Steam Generator Resource Management Plan  Update also incorporated review and update of program governance.
R002	2015-06-15	Update to Section 12 Quality Management
R003	2015-11-13	Update to Section 9.0 Construction Management
R004	2016-4-18	General formatting and document flow Remove from Table 1 “Steam Generator Cost Management Plan” In Table 2, under Gate 3U2a change “T-6” to “T-4” In Section 7.1.3, update SG project organization chart (proposed) In Figure 6, added vendor resource management plan as a reference In Table 8, changed frequency of SG Risk Meeting to biweekly In Table 8, added ITF review as a meeting In Table 8, removed NR Program Huddles In Table 8, added Execution Steering Committee as a meeting In Table 9, added Work Control as a Stakeholder In Table 9, added Refurb Project Bundles as a Stakeholder In Table 9, under NR Function Groups, added Chemistry and Environment Updated Figure 7 to reflect changes in Table 9 In Figure 6, added vendor PMP as a reference

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## 1.0 INTRODUCTION

The Steam Generator (“**SG**”) project is one of the major projects under the Darlington Nuclear Refurbishment Program. This document covers the Project Management Plan (“**PMP**”) of the Nuclear Refurbishment (“**NR**”) SG Project.

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## 2.0 PROJECT DESCRIPTION

The SG Project is one of the major projects under the Darlington Nuclear Refurbishment Program. The SG Project scope of work has been generated from the SG Life Cycle Management Plan (“**LCMP**”) and the Component Condition Assessment (“**CCA**”) program undertaken by Ontario Power Generation (“**OPG**”) in order to identify elements of the SG and other Heat Exchangers which require inspection, maintenance and/or modifications in order to support the extension of Darlington’s operating life.

Life extension inspection, maintenance and modification to the SG equipment shall endorse the efficient operation of those components supporting the extension of the life of the station.

The SG Project is planned to be executed within the refurbishment window for each unit.

### 2.1 Project Objective

The objective of the SG Project is to complete the entire approved scope during the refurbishment outages: safely, on time and on budget.

### 2.2 Scope of Work

To meet the contracting objectives and project execution requirements, the targeted SG scope bundle is composed of major and minor elements. The Scope of Work (“**SOW**”) for the SG project has been broken down into separate documents detailing the different elements of the work required. These are discussed in more detail in Section 6.0 Scope Management.

#### 2.2.1 Base Scope

1. **Primary Side Cleaning (“PSC”)** – SG PSC is the mechanical cleaning of the inside of the SG primary side tubes to remove magnetite deposits. A presentation made to the OPG Executive Committee on April 14, 2009 recommended to continue pursuing PSC as a method of restoring Reactor Inlet Header Temperature (‘**RIHT**’), Primary Heat Transport Flow, and Neutron Over Power (‘**NOP**’) margin. This shall help extend the SGs End of Life until the end of the plants second life.
2. **Secondary Side Cleaning (Water lancing)** – Water lancing is a process for removing tube sheet deposits. The NR scope requires waterlancing of all 16 SGs with a combination of high pressure lancing and low pressure/annulus flushing with visual inspections.
3. **Access Port Installations** - The ports are required to allow additional incremental visual inspection of SG internals during refurbishment and post refurbishment. Moreover, the ports are also required to provide the ability to clean the upper support plates and pre-heater region through water lancing or

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future chemical cleaning. Lastly, the ports shall also provide access for foreign material retrieval and remote inspection of U-bend region and upper supports.

4. **Inspection and Repair** - Inspection and Repair work is as per the LCMP. An augmented inspection and repair scope for refurbishment has been established.
5. **Divider Plate Inspections, Boiler Open/Close, and Inspection Support** - Primary Side Divider Plate Leakage Measurements using Acoustic Leakage Inspection System (“**ALIS**”) and/or equivalent shall be undertaken during the refurbishment outages to compare measurements conducted in previous outages. Boiler Open and Close shall be required in support of major SG work campaigns. Support shall be required for 4. *Inspection and Repair* (including holder of record, scaffolding, etc).
6. **SG Primary Side Lay-up work** –Lay-up work includes the design, procurement, installation, and removal of isolating bungs and temporary manway covers to support lay-up of primary side of SGs. After the completion of the primary side work, the boilers shall be required to be boxed up.
7. **Bleed Cooler Inspection and Bundle Replacement** - The Darlington bleed coolers have never been inspected due to insufficient recall time. In accordance with the NK38-REP-33320-10009, *Primary Heat Transport Pressure And Inventory Control - Bleed Cooler*, during the Unit 2 Refurbishment Outage, Eddy Current Testing (“**ET**”) (tube side) and Ultrasonic Testing (“**UT**”) wall thickness measurements (shell and nozzles) will be performed on 2-33320-HX2. Based on the results of ET, tube plugging may be required.

Depending on the severity of the degradation observed, the bleed cooler bundle may require replacement. If replacement is required, it shall be replaced by a Contractor during NR.

See Section 6.0, Scope Management, for a summary of the Darlington Scope Requests (“**DSR**”) that are being executed under the SG Project.

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### 3.0 PROJECT MANAGEMENT APPROACH

The PMP describes how the SG Project shall develop, manage, and execute its scope of work. The PMP approach is based on OPG Governance, the Refurbishment Program (NK38-PLAN-09701-10067) processes, and the contract specific requirements detailed in the SG Engineering Procurement and Construction Agreement. The vendor specific PMP shall also be incorporated into the overall management of the SG project.

The SG PMP has been developed as per N-MAN-00120-10001-GRB, *Nuclear Projects - Gated Process* and NK38-PLAN-09701-10227, *Nuclear Refurbishment – Pre-Gate Readiness Review Alignment Meeting - Terms of Reference*.

### 3.1 Management Plans

The PMP integrates and consolidates all the subsidiary management components. These components are described further in detail in the subsequent sections and associated documents. The content of each management plan is subject to change as the project progresses.

The SG management plans are summarized in Table 1.

**Table 1 – SG Management Plan Summary**

Document Number	Sheet	Title
NK38-PLAN-09701-10164	0001	Steam Generator Project Management Plan
NK38-PLAN-09701-10164	0002	Steam Generator Schedule Management Plan
NK38-PLAN-09701-10164	0006	Steam Generator Engineering Management Plan
NK38-PLAN-09701-10164	0012	Steam Generator Safety Management Plan
NK38-PLAN-09701-10164	0013	Steam Generator Environmental Management Plan
NK38-PLAN-09701-10164	0015	Steam Generator Contract Management Plan

### 3.2 Project Integration Management

For each area of the project, a review has been conducted of the relevant OPG, Darlington Refurbishment, SG Project and Contractor Governance, Guidelines and Desktop Guides. Figure 1 shows the hierarchy and integration of this governance for the SG Project. For each sub-management plan, this integration diagram shall be presented to show the governance integration across all areas.

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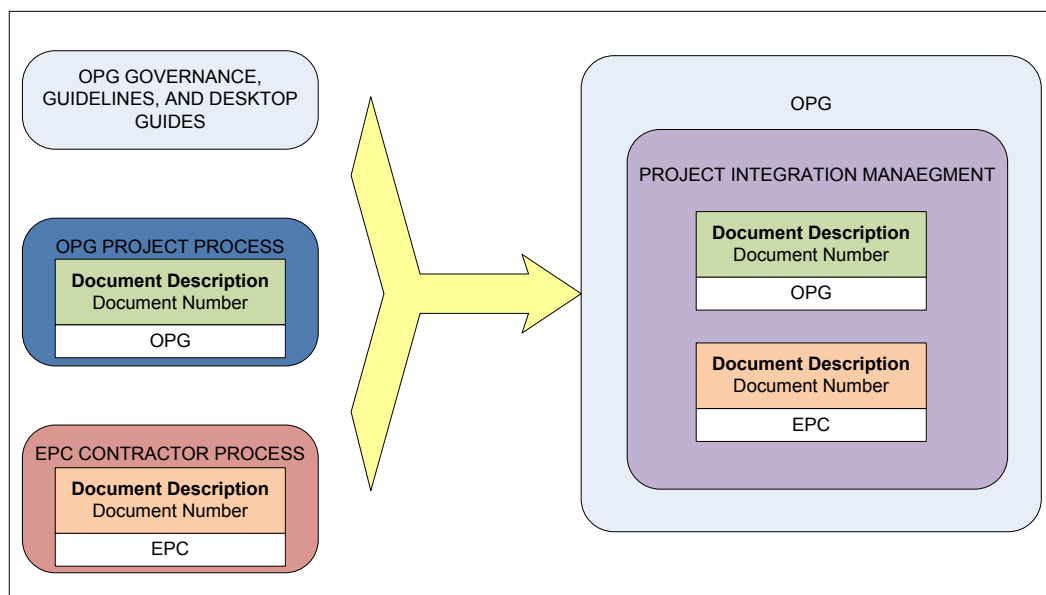


Figure 1 – SG Project Integration Management

### 3.2.1 SG Project Management Integration

Figure 2 shows the integration of project management governance being applied to the SG Project.

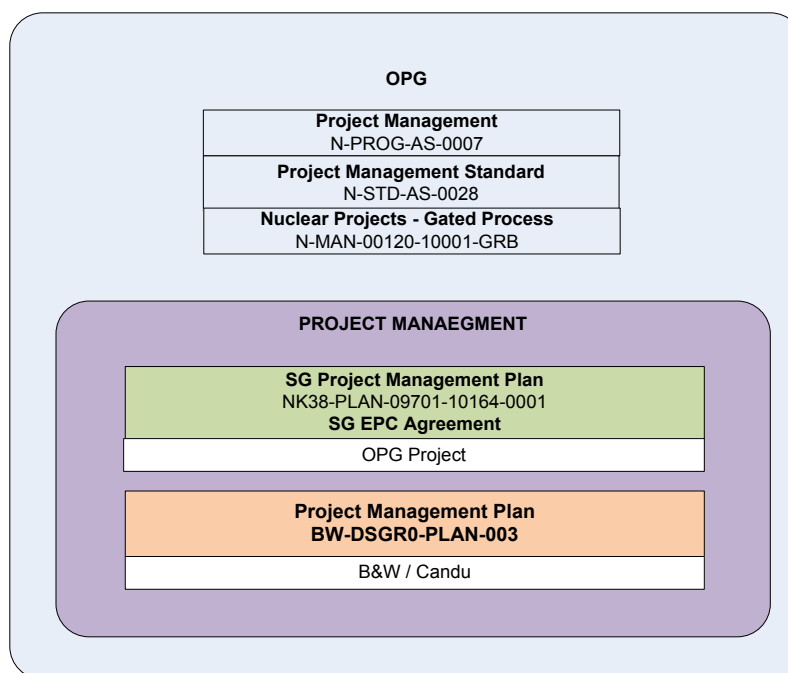


Figure 2 – SG Project Management Integration

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### 3.3 Contracting Strategy

The NR Program Commercial Strategy identified a need to establish separate contracting strategy for each of the major projects under the NR Program. This strategy is a revision of the first SG contracting strategy and incorporates the results of the Expression of Interest (“**EOI**”) process and confirms OPG's decision to continue with its sourcing approach to solicit and evaluate Request for Proposals (“**RFP**”) from selected contractors for the SG project.

The recommended contracting strategy is based on the business drivers and commercial principles set out in the NR Program Commercial Strategy and specific contracting considerations relevant to the SG Project. The Darlington Nuclear Generating Station SG refurbishment scope consists of the following scopes of work:

1. Primary Side Clean
2. Waterlancing, or Secondary Side Clean
3. Access Port Installation
4. SG Inspections and Maintenance
5. Divider Plate Leakage Measurements
6. Lay-up

The SG team examined a number of work packaging options. After an analysis which included evaluating advantages and disadvantages of each option, the SG team recommended pursuing a bundled approach for contracting purposes. A bundled approach for contracting purposes shall allow work to be efficiently scoped, planned, scheduled, and managed in accordance with the NR schedule; while at the same time maintain a single point of accountability with the awarded contractor.

The Engineering, Procurement and Construction (“**EPC**”) contract is the appropriate contracting model given the nature of the SG refurbishment work. Within the framework of the EPC contract, various pricing models were also considered by the SG team. It was decided that the pricing structure of the contract be primarily fixed for the major scopes of work except for the PSC execution work. The PSC execution work shall be cost reimbursable with an established target price given some of the uncertainties such as the coordination effort required for executing PSC work in the vault.

A competitive bidding process for the award of the SG scope was issued through the Request for Purchasing (“**RFP**”) process. The contract for the SG Project was awarded to Babcock and Wilcox and Candu Energy Inc. on December 31, 2013.

For detailed information on the SG contracting strategy, refer to NK38-REP-09701-10024, *Contracting Strategy for Steam Generators*. For more detail on how the SG Contract is being managed, refer to NK38-PLAN-09701-10164-0015, *Steam Generator Contract Management Plan*.



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#### 4.0 PROJECT GATE STRATEGY

The intent of the gated process is to enable flexible management control of funding and gate progression approvals through the project life cycle. The process ensures that projects meet a consistent expectation of quality and performance. Gate progression approval is based on:

1. Meeting previous phase requirements,
2. Instilling confidence that the project team shall deliver quality, safety, cost, value for money, and schedule performance for the next phase(s).

The gated process is supported by a set of project management and functional elements such as planning, schedule, cost, and quality. These assist in establishing work flow expectations for the project management team. These elements are implemented using a graded, risk based approach.

A gate progression strategy for the SG Project must take into account the needs and timing associated with the SG EPC Agreement as well as the progression of the project and overall refurbishment program. Additionally, it is important to forecast the required finances as accurately as possible.

#### 4.1 SG Project Gates

Project Gates are completed in accordance with:

1. NK38-PLAN-09701-10227, *Nuclear Refurbishment- Pre-Gate Readiness Review Alignment Meeting- Terms of Reference*
2. N-MAN-00120-10001, *Nuclear Projects - Gated Process*

Table 2 lists a summary of the phased approach as structured through the gated project phases for the SG contract. It also highlights the work to be completed in each contractual phase and the gates that apply to those phases. The gate strategy is in accordance with the correspondence from G. Rose dated April 27, 2015, Subject: *RQE Strategies regarding Gate 3 Submissions*:

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**Table 2 - SG Project Gates**

<b>GATE</b>	<b>INFORMATION</b>
Gate 1	Initiation Phase
Gate 2	Definition Phase
Gate 3	RQE Funding for all deliverables required in the Execution Mobilization phase to the start of Unit 2 (T-20 Months Execution Window on 1 <sup>st</sup> Unit)
Gate 3U2a	Execution Phase – Mobilization and Installation (T-4 Months Execution Window on 1 <sup>st</sup> Unit)
Gate 3U3a	Unit 3 Execution - Preliminary Unit Specific Planning Initial release to initiate a planning organization to commence Unit 3 planning. (30 months before Breaker Open on Unit 3)
Gate 3U3b	Unit 3 Execution - Unit Specific Planning Definition Phase for Unit 3 to complete unit specific procurement of long lead items. Each project would notionally have a release amount for the unit specific planning, as required. (24 months before Breaker Open on Unit 3)
Gate 3U3c	Check Estimate on Unit 3 and Release of Unit 3 funds (6 months before Breaker Open on Unit 3)
Gate 3U1a	Unit 1 Execution - Preliminary Unit Specific Planning Initial release to initiate a planning organization to commence Unit 1 planning. (30 months before Breaker Open on Unit 1)
Gate 3U1b	Unit 1 Execution - Unit Specific Planning Definition Phase for Unit 1 to complete unit specific procurement of long lead items. Each project would notionally have a release amount for the unit specific planning, as required. (24 months before Breaker Open on

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	Unit 1)
Gate 3U1c	Check Estimate on Unit 1 and Release of Unit 1 funds (6 months before Breaker Open on Unit 1)
Gate 3U4a	Unit 4 Execution - Preliminary Unit Specific Planning Initial release to initiate a planning organization to commence Unit 4 planning. (30 months before Breaker Open on Unit 4)
Gate 3U4b	Unit 4 Execution - Unit Specific Planning Definition Phase for Unit 4 to complete unit specific procurement of long lead items. Each project would notionally have a release amount for the unit specific planning, as required. (24 months before Breaker Open on Unit 4)
Gate 3U4c	Check Estimate on Unit 4 and Release of Unit 4 funds (6 months before Breaker Open on Unit 4)
Gate 4a	Closeout Unit 2 (T+3 Months after Full Power Achieved)
Gate 4b	Closeout Unit 3 (T+3 Months after Full Power Achieved)
Gate 4c	Closeout Unit 1 (T+3 Months after Full Power Achieved)
Gate 4d	Closeout Unit 4 (T+3 Months after Full Power Achieved)
Gate 5	Final Project Close Out

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## STEAM GENERATOR – PROJECT MANAGEMENT PLAN

### 5.0 SCOPE MANAGEMENT

#### 5.1 Introduction

Scope Management for the SG Project and Refurbishment program as a whole identifies the method of defining, managing, and controlling the scope throughout the project. It includes the development of the following:

1. Life Cycle Management Plan
2. Scope Statements
3. SOW documents
4. Work Breakdown Structure
5. Cost Benefit Analysis (“**CBA**”)
6. Decision Record and Analysis Summary (“**DRAS**”)

Furthermore, the SG Scope Management shall be conducted in accordance with:

1. SG Project EPC Agreement
2. NK38-INS-09701-10001, *Darlington Nuclear Refurbishment Program – Scope Control*

#### 5.2 Scope Statements

The goal of the SG Project is to deliver all core and approved non-core SG scope (through the DRAS process) safely, within the allotted timeline, and within budget.

##### 5.2.1 Core scope

Core scope is work that must be completed in order to achieve the Primary Objective of refurbishment as defined in NK38-INS-09701-10001, *Darlington Refurbishment Project – Scope Control*. Core scope includes:

1. **Regulatory scope** – scope that is not optional in order to support station license and regulatory requirements, as agreed with the regulator and documented in the Integrated Improvement Projects based on Environmental Assessment, Integrated Safety Review, and other activities such as Global Assessment which do not require Economic Assessment.
2. **Station Life Limiting Components** – modification, repair, or replacement of station life limiting components that must be replaced in order to allow the extension of station operations beyond its current end of life, including items which have an asset class tied to station life.

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3. **Component Upgrades** – work to upgrade components, which have a high station priority that can only be done during an extended refurbishment outage.
4. **Programmatic work** – Programmatic work typically performed online or in a normal station outage that must be done in the refurbishment period in order to maintain station licence, including mandatory Preventive Maintenance, inspections, etc.
5. **Prerequisite Scope** – scope that must be done in order to enable a successful refurbishment, including pre-refurbishment incremental inspections to determine refurbishment scope, and pre-refurbishment modifications such as islanding modifications or fuel machine upgrades to meet refurbishment production requirements during the refurbishment period.

### 5.2.2 Non-Core Scope

Non-core scope shall be performed in the refurbishment period if:

1. it has no impact on the projects Core Scope critical path
2. it does not add risk to the successful completion of core scope, and
3. cost or resource efficiencies and station priority warrant the work to be executed in the refurbishment period.

A Business Case Assessment or DRAS (**N-FORM-11390**) demonstrating the economic advantage; including risk management and/or reliability improvement, and priority of completing this work during, pre-, during or post-refurbishment shall be required to gain approval.

Non-Core scope shall be assessed against approved criteria to determine whether it is economic and favourable to include it within the scope of the Darlington NR Program. Only after assessment and approval by the Scope Review Board shall this Non-Core scope be added into the NR Program.

### 5.3 Scope of Work

The SOW for the SG project is broken down into separate documents detailing the different elements of the work required. Table 3 lists the SOW documents

**Table 3 - Darlington Refurbishment - Steam Generator Scopes of Work**

Document Number	Title	Scope Type
NK38-SOW-33110-10014	Darlington Steam Generators – Primary Side Cleaning Scope of Work	Core - Programmatic

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NK38-SOW-33110-10012	Darlington Refurbishment – Steam Generator Waterlancing	Core - Programmatic
NK38-SOW-33110-10015	Darlington Refurbishment – Unit 1-4 SG Divider Plate Leakage Measurement, SG Open Close and Support	Core – Prerequisite
NK38-SOW-33110-10016/ NK38-SOW-33110-10024 (Optional) NK38-SOW-33110-100026	Darlington Refurbishment – Units 1-4 Steam Generator Inspection and Repair/ Darlington Refurbishment – Units 1-4 Steam Generator Inspection and Repair (Optional) Darlington Unit 2 - 2016-2019 Refurbishment Outage Steam Generator Scope Of Work	Core – Prerequisite
NK38-SOW-33110-10017	Darlington Refurbishment – Steam Generator Access Port Installations	Non-Core
NK38-SOW-09701-10037	Steam Generator Primary Side Systems Layup- Scope of Work	Core – Prerequisite
NK38-SOW-33300-10002	Darlington Refurbishment – PHT Pressure and Inventory Control - Miscellaneous Scope	Non-Core

### 5.3.1 SG Darlington Scope Requests

The SG Scope of work is derived from Darlington Scope Request (“**DSR**”) Database. Table 4 lists the SG DSRs.

**Table 4 - Steam Generator DSR List**

DSR	Title	Type	Status
TS0500-2	Darlington Steam Generators: Inspection/Maintenance as per LCMP (Augmented for Refurb Scope)	CS04 Mandatory “Construction Period” Outage Work	Approved
TS0050-3	Darlington Steam Generators: Primary Side Cleaning (PSC)	CS02 Life Limiting Components	Approved
TS0050-4	Darlington Steam Generators: Access Ports	VE01 Operations, Outage, Cost, Resource and Maintenance Efficiencies	Approved
TS0100-2	DNGS Primary Heat Transport Pressure and Inventory Control: U2 Bleed Cooler Inspection and Repair	VE02 Safety Improvements beyond Standards	Approved
TS0100-8	DNGS Primary Heat Transport Pressure and Inventory Control:	VE02 Safety Improvements	Approved

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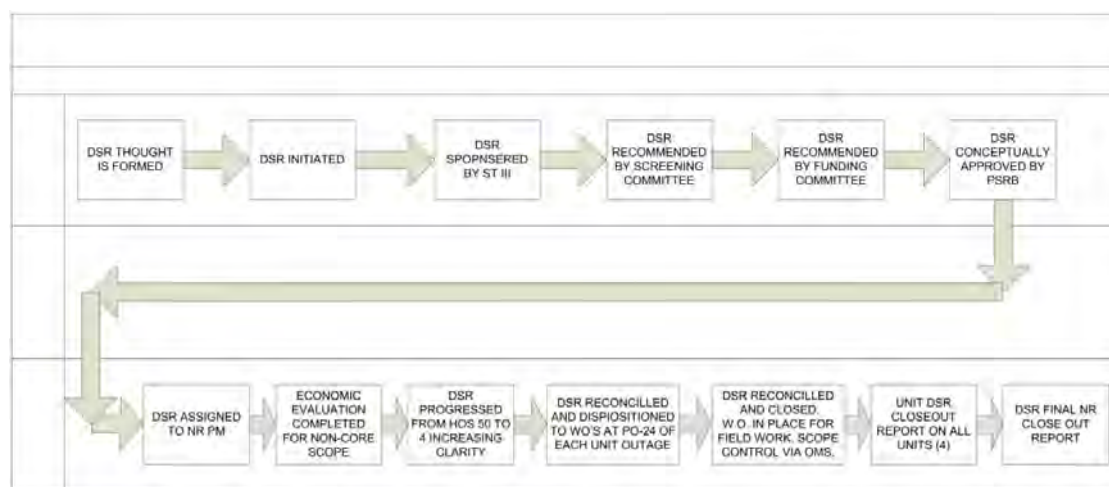
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	Replace Bleed Cooler (Contingency)	beyond Standards	
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The DSRs shall go through a number of transitions from creation to reconciliation against a Work Order for each unit, and to close out as illustrated in Figure 3. There shall be five closeout reports, one per unit, as well as a final closeout report at the end of the project. The DSR managed in the DSR database is the currency of scope control until 24 months prior to the Refurbishment Outage at which time the currency shall change to Work Orders managed in the Outage Management System (“OMS”).



**Figure 3 - DSR Line Item Life Cycle**

### 5.3.2 Health of Scope

Darlington NR scoping strategy includes a Health of Scope (“HOS”) grouping number which is a representative of the work required to progress a DSR from the identification stage to the definition stage. Each DSR in the DSR database has been categorized with a HOS number identifying how well the scope is known and understood. The target is to get the HOS to 4. This shall enable the work to have sufficient clarity that it can enter into the Work Management processes (Engineering Change Control (“ECC”), Work Orders etc.) at the RO-24 OMS Work Order Scope Definition Complete Milestone. Table 5 lists the HOS definitions:

**Table 5 - Health of Scope Definitions**

HOS	Definition
04	All Work Orders input for DSR on all applicable Units or all work completed for DSR
05	DSR is adequately known such that it is ready for Work Order to be input on all Units
10	Work is known at the component / MEL level
20	Work is known at the system or project level but not component
30	Actions to implement selected, may be a component strategy across many systems

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40	Analyze the completed report to determine actions / path forward
50	Assessment is required to build a report for analysis
60	Pure engineering or procedures with no likely field work (i.e. provide CNSC with reports, update procedures, etc)
90	Scope shall not be executed in Nuclear Refurbishment, DSR shall be removed pending PSRB approval

### 5.3.3 Scope Review and Verification

The SG Project scope is expected to change throughout the Definition Phase.

Scope verification shall include quality checks, tracking PCDs, reviewing the Basis of Estimates (“**BOEs**”), and monitoring status against the Release Quality Estimate (“**RQE**”). As the Execution Phase progresses, the final cost of each deliverable shall be compared to the RQE at a high level. For the SG Project, scope verification shall involve continually validating scope against the original estimate and ensuring that the vendor does not complete more work than that which is required to achieve success.

OPG and the Contractor shall collaborate by co-developing risk registers and estimates in order to complete the SG Project successfully. This is expected to prevent surprises, provide value for money, and ensure that OPG receives all agreed-upon deliverables.

### 5.3.4 Scope Control

Scope control is the process of monitoring the status of the program scope. Potential scope changes shall follow NK38-INS-09701-10001, *Darlington Refurbishment Project – Scope Control*.

The Darlington NR Program Scope Review Board (“**PSRB**”) shall provide the initial verification of refurbishment scope, and also support control of scope as the Program is developed and executed. The PSRB shall ensure that all scope additions and deletions have undergone a thorough assessment based on scope impact on plant safety, reliability, regulatory requirements, environmental impacts, refurbishment outage impacts (cost and schedule), and the economic value to support the post refurbishment operation of Darlington Nuclear Generating Station.

### 5.3.5 Scope Change Control

The process for identifying the project scope and the management of scope changes is described in NK38-INS-09701-10001, *Darlington Nuclear Refurbishment Program – Scope Control*. The intent of the instruction is to ensure that proposed scope additions and/or deletions have undergone a thorough assessment based on the return on investment, impacts on plant safety, reliability, project schedule and cost, program resourcing, regulatory requirements, and environmental impacts.

Currently, all work requested to be included in the scope of the Darlington NR Program is initiated via the DSR database. The DSR form (D-FORM-10757) must be completed in order to add new scope to the DSR database. The DSR database provides a



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common format through which DSRs can be submitted and reviewed. Once requested in the database, the scope shall be processed and reviewed by the screening committee, the funding committee, and the PSRB.

Once the SG execution phase begins, OPG shall be required to provide responses to the vendor requests within predefined time intervals; delayed responses could potentially affect the critical path schedule. In an effort to streamline the process and facilitate timely and accurate OPG responses to changes in the work, all SG discovery work shall be initiated through PCDs.

DSR entries shall not be required for PCDs since discovery work items will correspond to an existing DSR database line item. For example, unanticipated work required to relocate materials that block access to a target system (i.e., a system associated with an approved DSR database line item). Costs associated with the PCDs shall be assigned to the specific schedule tasks that require the additional work. Furthermore, when additional discovery work is identified and a PCD has been approved, a variance shall be declared against the original DSR line item and the applicable schedule milestone. The details of the work changes or additional work discovered shall be added to the description of the existing DSR line item and/or the existing milestone deliverable.

For PCDs that demand significant changes in the work and thus significant cost increases, approval must be obtained as per N-MAN-00120-10001-RISK-07, *Nuclear Refurbishment Assumptions and Decisions Management*. See Table 6 for reference:

**Table 6 - Guidelines for Required Approvals of Significant Decisions via the DRAS Process**

IMPACT	<\$1M	\$1M-\$5M	\$5M-\$20M	\$20M-\$50M	>\$50M
TYPES					
SCOPE	<b>P</b> – Initiator (minimum Band H)	<b>P</b> – Initiator (minimum Band H)	<b>P</b> – Initiator (minimum Band G)	<b>P</b> – Initiator (minimum Band G)	<b>P</b> – Initiator (minimum Band G)
STRATEGIC	<b>A</b> – Band G in Initiating Organization	<b>Re</b> – Band G in Initiating Organization	<b>Re</b> – Band E/F in Initiating Organization	<b>Re</b> – Band E/F in Initiating Organization	<b>Re</b> – Band E/F in Initiating Organization
REGULATORY		<b>A</b> – Band E/F in Initiating Organization	<b>Re</b> – Director, P&C	<b>Re</b> – Director, P&C	<b>Re</b> – Director, P&C
TECHNICAL			<b>A</b> – SVP	<b>A</b> – SVP	<b>Re</b> – SVP
RESOURCE					<b>A</b> – EVF
OTHER					

<b>P</b>	Prepared by
<b>Re</b>	Reviewed by
<b>A</b>	Approved by

The requirements for review and approval of decisions vary; refer to Table 6 for guidelines. Generally, the preparation, review, and approval of decisions shall exhibit diligence and prudence in the characterization and analysis of the issue. Documented evidence that a thorough vetting of the technical and economic aspects of the decision has been undertaken is required. This supporting documentation shall be attached to the associated N-FORM-11390, *Decision Record and Analysis Summary* for reference during review and approval activity.

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### 5.3.6 Decision Record and Analysis Summary ( “DRAS” )

DRAS forms are required for any new proposed scope and for the removal or modification of existing scope. There is a requirement for a Cost Benefit Analysis to accompany any new proposed scope. Potential additional program scope may result from gaps identified by the Condition Assessment process and after evaluation by a Cost Benefit Analysis as outlined in NK38-INS-09701-10001, *Darlington Nuclear Refurbishment Program - Scope Control*.

DRAS records can be found in the [RMO Tool – Decision Log](#). Table 7 lists the approved and pending DRAS's associated with SG Project.

**Table 7 - Steam Generator DRAS Summary**

DRAS ID	Description	Status
67	Steam Generator Access Port Installation	Approved
235	SG Project – Blue Ribbon Implementation	Approved
450	SG Project – Scope Removal - Replacement of all Main Steam Pressure Alarm Units	Approved
546	Transfer of Bleed Cooler Inspection and Repair/Replace Scope to Station	Not Approved, but DSRs Updated

### 5.4 Work Breakdown Structure ( “WBS” )

WBS establishes a systematic and hierarchal approach for the identification of all of the work elements within a given Project. The WBS is common at the highest level across all projects within Nuclear Refurbishment. However, the WBS still provides flexibility for additional definition or further breakout of each WBS element to lower levels. The WBS is the foundation of the overall schedule for all phases until closeout and is also used to create Control Accounts for purposes of estimating, collecting, and monitoring costs and earned value. It shall clearly define the deliverables at the program and project levels and serve as an integrator for reporting.

### 5.5 Scope Management Integration

Figure 4 shows the integration of scope management governance being applied to the SG Project.

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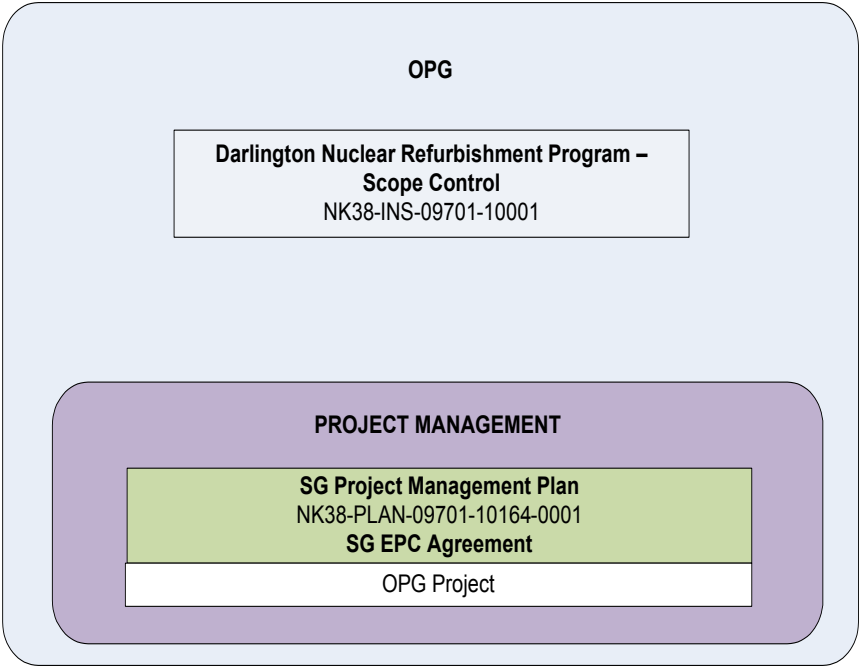


Figure 4 – SG Scope Management Integration

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## 6.0 RESOURCE/STAFFING MANAGEMENT

There are two aspects of resource management for the SG Project. They are the:

1. SG Project Team Resource Management (Internal)
2. EPC Contractor Resource Management (External)

### 6.1 SG Project Management Team

Figure 5 shows the proposed SG Project Organization. The key roles and their respective accountabilities are detailed in Section 7.1.4. NR has elected to employ a matrix organizational model to execute the Refurbishment Program. It is the SG Project's plan to staff the project team with OPG staff, and supplement with augmented staff or managed task activities to meet the project schedule and needs. OPG staff shall either be embedded in the team or shall be matrixed from the NR functional support organizations. Where NR functional support staff are currently unable to fulfill a specific need, due to unavailability or missing skill sets, the project shall either utilize managed task or augmented staff contracts to maximize outside experience or attempt to find staff within other OPG business units.

#### 6.1.1 SG Project - Key Roles

The key roles on the SG Project are as follows:

1. Project Sponsor - Vice President, Nuclear Refurbishment Execution
2. Contract Owner - SG Project Director
3. Design Authority - Director Refurbishment Engineering
4. Accepting Organization - DNGS Director of Operations and Maintenance (DOM)
5. The SG Project Director has the accountability for all aspects of the SG Project.

#### 6.1.2 Limits of Authority

The authority to execute the SG Project resides with the Project Sponsor – Vice President of Refurbishment Execution. As the sponsor, the VP of Refurbishment Execution delegates execution authority to the SG Project Director. This authority includes the following:

1. Determine the structure, size and makeup of the organization required for project execution.
2. Organizational Authority Register (“OAR”) authority for SG Project as per OPG-STD-0017, Organizational Authority Register.

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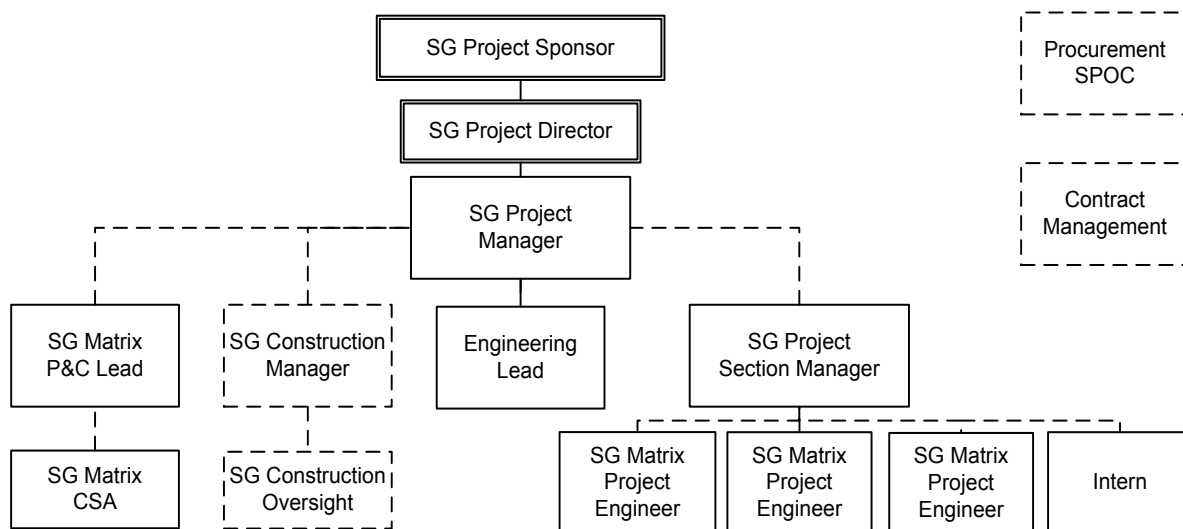
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### 6.1.3 Project Organization

The SG Project staffing structure has been organized to facilitate project execution in the EPC contracting model. The organization has been setup to align with the work packages (“WP”).

It is SG Project’s plan to staff the project team with OPG and Owner Support Services (“OSS”) Managed Task or Augmented Contract staff. OPG staff shall either be embedded in the team or shall perform functions “matrixed” from the NR functional support organization. Where NR functional support staff are currently unable to fulfill a specific need, due to unavailability or missing skill sets, the project shall either utilize managed task contracts to maximize outside experience or attempt to find staff within other OPG business units.

The proposed project organization is shown in Figure 5:



**Figure 5 - SG Project Organization Chart**

This chart reflects the proposed staffing structure as of April 2016, with proposed construction support starting in 2016 throughout the course of the construction planning and execution phase. This structure is expected to change during the subsequent project stages based on project demands.

### 6.1.4 Roles and Accountabilities

**Project Sponsor:** Vice President, Nuclear Refurbishment Execution

1. Ensure the program is fully staffed

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2. Ensure adherence to Nuclear Refurbishment Program
3. Administer monthly Steering Committee meetings.
4. Address any concerns escalated in a timely fashion
5. Administer quarterly Executive Oversight Meetings

**Project Director:** Director, Steam Generators

The SG Project Director has the accountability for all aspects of the Project including:

1. Environment, Health & Safety
2. Scope
3. Schedule
4. Cost
5. Risk
6. Quality
7. Staffing & Resources
8. NR Program Governance adherence
9. Reporting & Communications
10. Oversight
11. Contract Adherence

**Project Manager (PM):** Manager, Steam Generators

The SG project assigned project manager. The PM has the overall accountability for the successful delivery of their sub projects which includes:

1. Environment, Health & Safety
2. Scope
3. Schedule
4. Cost
5. Risk
6. Quality
7. Stakeholder Management
8. Communications & Reporting
9. Vendor oversight

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**Project Controls Lead / Cost and Scheduling Analyst:**

The Project Controls Lead and Cost and Scheduling Analyst are accountable to:

1. Ensure project conforms to NR Program Governance, supported by routine quality
2. checks and self assessments
3. Liaising between functions and project including centers of excellence
4. Gated Process including budget loads and baselines
5. Reporting including Earned Value
6. Analysis and Forecasting
7. Business Planning
8. Project Tools including Information Technology (“IT”) tools, processes and instructions
9. EPC contractor integration within OPG system
10. Scheduling
11. Oversight
12. Plan and Perform oversight on various elements of project controls based on risk

**Procurement Single Point of Contact (“SPOC”):**

The functional Procurement SPOC shall be accountable to:

1. Be the single point of contact with the EPC contractor for all procurement related matters
2. Hold the Contractor accountable to complete procurement activities in accordance with the correct Quality Assurance (“QA”) requirements, procedures and programs
3. Coordinate OPG conducted audits and attend as required
4. Arrange for OPG participation in, and oversee, contractor audits of sub-contractors as required
5. Ensure oversight of EPC contractors sub-contractors procurement process
6. Ensure materials and services are procured per schedule
7. Ensure and coordinate resolution of any Non-Conformances
8. Confirm authenticity of procured material

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### Engineering Lead/Matrix Engineer:

The Engineering Lead/Matrix Engineers shall be responsible for:

1. Ensuring that the Engineering Change Control (“**ECC**”) process required is defined, understood, reflected in the schedule and implemented per process
2. Provide resources and context to perform adequate document reviews within the contractual time frame allotted
3. Ensuring resources and context to perform adequate oversight of EPC contractors to ensure project objectives for cost, scope, schedule, and quality are met
4. Attend Construction, Operability, Maintainability, and Safety (“**COMS**”) reviews and ensure Operating Experience (“**OPEX**”) is embedded in the Engineering deliverables
5. Ensure scope is defined, understood and managed per the applicable scope management governance
6. Ensure all risks associated with Modifications are identified in risk register per appropriate governance; mitigating actions are prepared tracked monthly and updated as required
7. Identify, coordinate and solicit all stakeholder inputs to engineering deliverables reviews
8. Plan and Perform oversight on various elements of the project based on risk

### Contract Management:

Support the project team to ensure key contract elements are managed in accordance with the agreed contractual terms and conditions. Responsibilities include, but are not limited to, facilitating Contract Change Management and Issues/Dispute Resolution, maintaining and implemented the contents of the Contract Management Plan.

For more details, refer to NK38-PLAN-09701-10164-0014, *Contract Management Plan*.

### 6.1.5 Qualifications

Each project member that is matrixed shall be assigned the appropriate qualifications by their respective functional manager to ensure compliance with the applicable standards for that group. A review of the current qualification set that are available for project management, contract owner, and similar functions is performed by the project. In order to effectively provide oversight to the EPC contractors, one would ideally have like experience and training similar to that of the EPC contractor. The project shall explore internal and external opportunities to develop these skills.



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### 6.1.6 Succession Planning, Training and Resource Development

As a result of the SG schedule extending over a long duration, appropriate succession planning strategies need to be assessed and incorporated into the development of the project team members. Project Management shall provide mentorship and on-the-job training opportunities for the project team members to participate in over the course of the project. This shall facilitate the development and growth of internal resources.

As the project team changes over time, internal project team members shall have developed the skills and qualifications necessary to move into new roles with greater responsibilities as vacancies emerge through attrition and organizational changes.

### 6.2 EPC Contractor Resources Management

The SG EPC contractor shall be responsible for the management of their staff. Their resources shall be managed in accordance with their Resource Management Plan, which shall be submitted to the project Post-Award.

### 6.3 Resource Management Integration

Figure 6 shows the integration of resource management governance being applied to the SG Project.

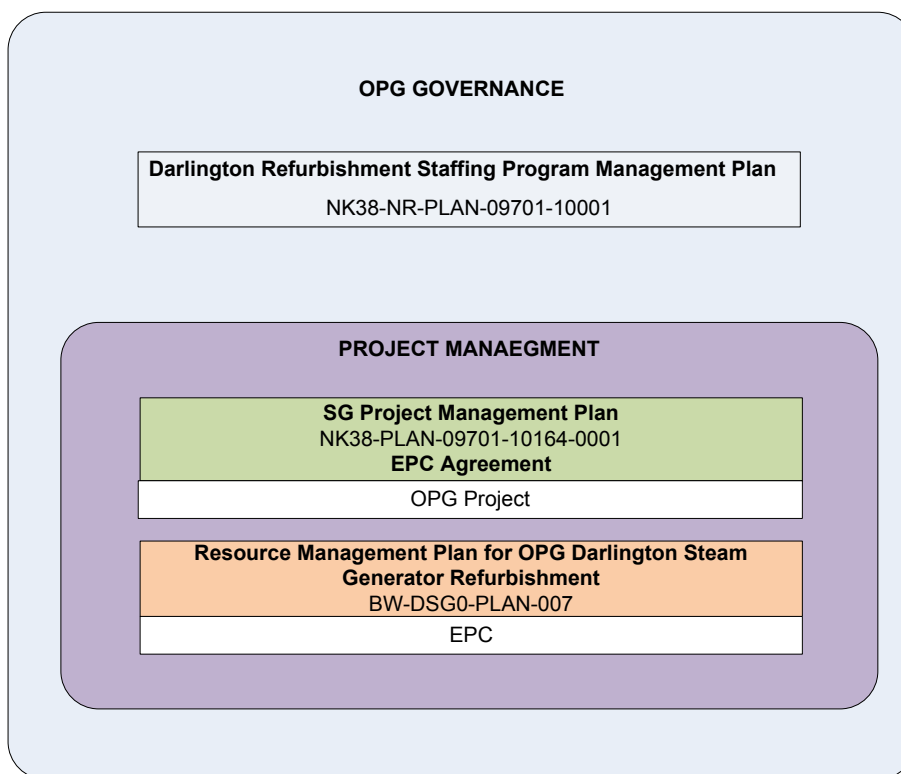


Figure 6 - SG Resource Management Integration

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## 7.0 COMMUNICATION AND STAKEHOLDER MANAGEMENT

The purpose of SG Communication Management Plan is to provide a framework and understanding of the communication methods and requirements to be utilized throughout the course of the project. This includes communication between both internal and external stakeholders.

Communication management shall be in accordance with N-MAN-00120-10001, *Project Communications*

### 7.1 Roles and Responsibilities

Records and document management is a shared responsibility amongst all NR employees in referencing and filing information according to governance and non-governance process documents.

**Project Managers (PM's)** – are responsible to prepare and issue a formal Communication Protocol document to the successful supplier immediately after contract award. The Communication Protocol document shall provide direction on how all project correspondence and documentation deliverables are managed. All suppliers shall comply with the standards and requirements of this plan. PM's shall adhere to and share with suppliers, N-MAN-00120-10001-RDM-03, *Nuclear Projects Supplier Document Submission*.

**NR Records and Refurbishment Document Management (“RDM”)** – shall manage the Darlington Refurbishment records and data provided by OPG and suppliers, perform quality checks, route to the appropriate stakeholders and track the status and performance through the review/acceptance cycle. RDM shall also retain and publish all “Change Papers” and related ECC documentation. RDM is also responsible for registering and managing controlled documents, management of the Vendor Document Management (“**VenDM**”) system, and the population of the Records and Controlled Documents modules in Asset Suite 7. RDM shall adhere to N-MAN-00120-10001-RDM-R000, *Nuclear Projects Records and Document Management*.

**Refurbishment Employees and Vendors**– have the responsibilities to identify, protect, and present their records as intellectual assets; this is accomplished by completion of training, use of training aides, and through adherence to communications issued to guide staff on information management rules or practices.

### 7.2 Information Control

The main stakeholder communication methods are:

1. Telephone and Email communications
2. Submittals and Requests for Information (“**RFI**”)
3. Meetings

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### 4. Publications and Reports

**Emails:** Regularly used to document interface with stakeholders, the project team, and with the SG EPC Contractor. The SG Project shall comply with Nuclear Projects protocol for declaring emails per NK38-PLAN-09701-10067 Sheet 0009, *Program Documentation and Project Closure Management Plan*.

**Submittals and RFIs:** As per the SG EPC Agreement, Submittals and RFIs are important communication methods. Submittals are described in Section 2.8 of the SG EPC Agreement. The internal process for handling Submittals and RFIs is described in Appendix A: Submittals and Request for Information Processing.

**Meetings:** Conducted face-to-face with available teleconference and videoconference as required. The stakeholder meetings involving the SG Project and its stakeholders are listed in Table 8.

**Publications and Reports:** Publications of SG information are communicated to internal stakeholders via OPG newsletters (e.g. The Pulse) and Intranet websites (e.g. SG intranet website).'

**Records** are communication technology and information distribution tools that shall be used by the project. They include:

1. Vendor Document Management System ("**VenDM**"): External environment used for exchange, review, and management of Submittals and RFIs as per the SG EPC Agreement
2. SharePoint 2007: Internal document storage, exchange environment used for storage of project documents, deliverables, schedules, cost information, as well as confidential & commercially sensitive information relevant to the SG contract.
3. OPG RDM are owners of both the VenDM, SharePoint, and are responsible for process definition and support, technical support for VenDM it relates to Submittals, RFIs as outlined in the SG EPC Agreement.
4. Project Records shall be maintained in VenDM, SharePoint and Project Emails. As applicable project records shall be indexed and stored in Asset Suite.

### 7.3 Stakeholder Inputs

Stakeholder inputs are gathered through the various meetings conducted by and with the SG project staff. Actions, issues and risks are then tracked in the appropriate system as described in NK38-PLAN-09701-10164-0010, *Steam Generator Risk Management Plan*. The major stakeholders for the SG Project are listed in Table 9. Figure 7 shows the main groupings and relationships of the major stakeholders determined by stakeholder analysis. When situations arises that specific stakeholder

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input is required but not available, additional resources shall be obtained either internally or externally to ensure that any stakeholder input gaps are managed. An example would be when a specific expertise is required to review an engineering package and an external contractor is utilized for expert review.

## 7.4 Contractor Communication expectations

### 7.4.1 Preparation Phase

Within 10 Business Days of the date the contract is awarded, the Contractor shall:

1. meet with all appropriate parties, including OPG's Representative to confirm the manner and approach in fulfilling the requirements of the contract;
2. meet with individuals designated by OPG's Representative to confirm design requirements and approach;
3. identify and analyse requirements of applicable Governmental Authorities with whom consultation is to be undertaken in respect of the project; and
4. obtain any information that it deems necessary for providing all work.

### 7.4.2 Kick-Off Meeting

The project kick off meeting was held 10 days after Contract Award. The contractor and OPG representatives were in attendance. At this meeting the parties discussed safety and environmental protection programs (including those of subcontractors) and their requirements, the hazards associated with the work, labour matters, design concepts, schedules, procedures for handling Submittals, communication protocols, procedures for processing each Application for Payment, delivery procedures for the site, records maintenance, site security, and any other matter raised by a Party.

Specific agenda items that were addressed during kick-off meeting were:

1. Confirm Scope of Work in the Purchase Order
2. Confirm the Schedule for the work
3. Agree on all deliverables (documents, data, materials, etc.) and services OPG owes the contractor and the required dates for each item
4. Agree on all deliverables (documents, data, materials, etc.) and services the Contractor owes OPG and the required dates for each item
5. Agree on the lines of communication and approval authority for both technical and other contractual matters for both the Contractor and OPG organizations.

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#### 7.4.3 Steering Committee

The Senior Management Representatives of each Party are currently convening in a steering committee (the "Steering Committee"). The Steering Committee is composed of Senior Management Representatives of each Party. The expectation is that the Senior Management Representatives shall attend and shall only use delegates of equal seniority occasionally. The Steering Committee meets at any time at the request of OPG, and shall otherwise meet at least quarterly. The Steering Committee resolves outstanding disputes, reviews progress reports and addresses issues which affect or could affect the Contract schedule or the reimbursable target cost work.

#### 7.4.4 Meetings

In addition to the kick-off meeting, the Contractor shall schedule, attend and conduct such other pre-construction, construction, pre-job mark up (including resolution of jurisdictional issues), hazard review, site co-ordination, weekly (or daily as required by OPG) progress review meetings, and commissioning meetings as are requested by OPG or are otherwise desirable, including any meetings required by the Specifications. The Contractor shall include in the agenda of any such meeting any issue requested by OPG. Progress review meetings shall usually focus on safety, environmental matters, labour requirements, procedures, progress, clarifications of the requirements of this Agreement, and scheduling (including interfaces between Persons providing services at the generating station). The Contractor shall ensure that all Subcontractors and other Persons requested by OPG shall attend these meetings. The Contractor shall ensure that each representative of the Contractor and any Subcontractor attending meetings shall be qualified and authorised to act on behalf of the Party each represents. The Contractor shall provide the space for the meeting. The Contractor shall prepare and distribute minutes of each meeting within three Business Days thereafter.

#### 7.4.5 Performance Reporting

Project reporting shall be performed by the SG Project in accordance with the NR Program as per the N-MAN-00120-10001, *Project Communications*, and by the Contractor according to the SG Project Agreement.

The Contractors shall report periodically, according to the SG Project Agreement, in the following areas at a minimum:

1. Health, Safety & Environmental Performance;
2. Schedule Performance including but not limited to:
  - a. Engineering Activities;
  - b. Procurement Activities;
  - c. Construction Activities;
3. Submittals.
4. Cost Performance;

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5. Installation;
6. Non-conformance and physical discrepancy;
7. Foreign material exclusion (FME) accounting
8. Non-compliance with procedures
9. Quality Performance;
10. Risk & Contingency;
11. Scope;
12. Issues, Assumptions and Decisions;
13. Training Activities

**7.5 Stakeholders**

**7.5.1 Stakeholder Meetings**

Table 8 provides a summary of the various stakeholder meetings required for the SG Project.

**Table 8 – Stakeholder Meetings**

Meeting Title	Description	Frequency
SG Project Meeting	Meeting with Project Team and Contractor to discuss: project status and performance.  Issue identification and resolution.	Weekly
SG Risk Meeting	Review Risk Registry and Mitigating Actions.  Update registry based on new information and oversight findings.	Bi-weekly
Scope Review Board	This includes the related Technical Screening Committee and Funding Screening Committee meetings. Scope addition, removal, modification processing.	Quarterly, as required
MRM Meeting	Review and processing of station condition records	Bi-weekly, as required

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	associated with the SG Project.	
Monthly Integrated Project/Functional Communication Meeting	Discussion of Project Quad-Charts	Monthly
Darlington Refurbishment (DN) Monthly Program Status Meeting	Project Performance Update. Issue resolution.	Monthly
DN Refurbishment/ NWMD Coordination Meeting	Alignment meeting	Bi-Weekly
ITF Review	Review Issue Tracking File progress	Weekly (As Required)
DN Refurbishment Execution Three-Stratum Meeting	Project Performance Update. Issue resolution.	Monthly
Execution Steering Committee	Resolve outstanding disputes. Review progress reports. Addresses issues which affect or could affect the contract schedule or the reimbursable target cost work.	Quarterly

## 7.5.2 Stakeholder Inputs

Stakeholder inputs are gathered from the various meetings conducted by and with the project team. Actions, issues, and risks are then tracked in the appropriate system as described in the Risk Management Plan (NK38-PLAN-09701-10164-0010). The major stakeholders for the SG Project are listed in Table 9.

**Table 9 - Stakeholder Registry**

Identification	Primary Expectation	Potential Influence / Phase of Most Influence	Stakeholder Classification
Darlington Nuclear Generating Station ("DNGS")	Return of units 1-4 as per Refurbishment Program Charter	Owners of Plant Systems;  Execution Phase	Internal

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SG EPC Contractor	Coordination with IMS and Refurbishment Organization per SG EPC Agreement	Throughout the entire project	External
Inspection and Maintenance Services (“IMS”)	Coordination with DNGS and SG EPC Contractor to perform Inspection and Repair.	Execution Phase	Internal
Nuclear Waste Management Division (“NWMD”)	Consultation, input required for SG waste management strategy/deliverables	Throughout the entire project	Internal
Major Components and Equipment Department (“MCED”) – Steam Generators	Consultation, input required for review of deliverables	Throughout the entire project	Internal
NR Function Groups: Engineering, Nuclear Safety, Ops, Maintenance, Rad Protection, Reg Affairs, Chemistry, Environment	Consultation, input required for review of deliverables	Required to perform oversight activities;  Throughout the entire project	Internal
Work Control	Schedule and coordinate between IMS, EPC, to the projects	Throughout the entire project	Internal
Refurbishment Project Bundles (Turbine/Generator, RFR, Layup, Islanding, etc.)	Schedule and coordinate between the projects	Throughout the entire project	Internal
Darlington Engineering, Operations, Work Control and Maintenance Staff	Consultation when implementing modifications on the operating stations	Owners of the Plant Systems;  Throughout the entire project	Internal
Government of Ontario	Performance of Program on Time, on Budget, within Scope, and without Safety Incidents	Major influence in making go, no-go decision for Execution Phase	External
OSS Contractors	Coordination with OPG as per OSS Contract	SME support and support on Technical Assessments;  Definition Phase	External



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Unions	Upholding of Collective Bargaining Agreements	Entire Project	External
Canadian Nuclear Safety Commission (“ <b>CNSC</b> ”)	Compliance with Regulations	Throughout the Project	External
Technical Standards and Safety Authority (“ <b>TSSA</b> ”)	Compliance with Regulations	Throughout the Project	External
Municipality of Clarington	Compliance with Codes and By-laws	Throughout the Project	External
Ministry of Environment (“ <b>MOE</b> ”)	Compliance with Regulations	Throughout the Project	External
Ministry of Labour (“ <b>MOL</b> ”)	Compliance with Regulations	Throughout the Project	External
Electrical Safety Authority (“ <b>ESA</b> ”)	Compliance with Regulations	Throughout the Project	External

Figure 7 provides a representation of the relationships between the internal and external stakeholders of the SG Project.

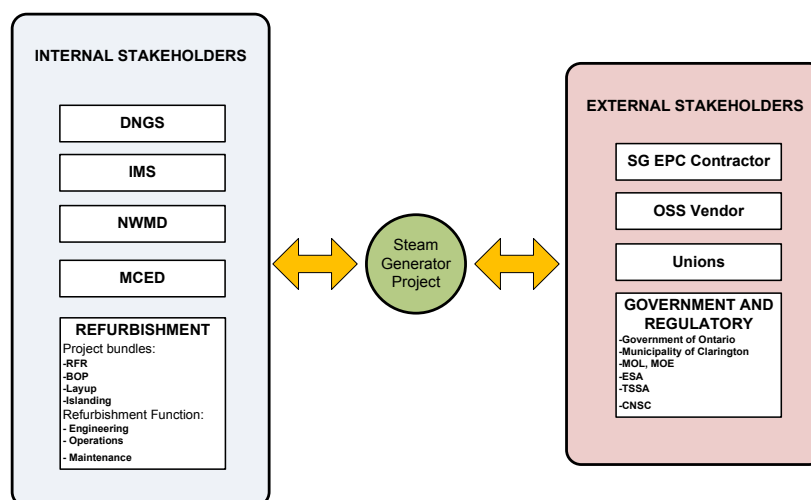


Figure 7 - Stakeholder Relationships

### 7.5.3 Issue Resolution

Issue Resolution between stakeholders associated with the SG Project shall be in accordance with the SG EPC Contractor’s Issue Resolution processes and the SG EPC Agreement.

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#### 7.5.4 Darlington Refurbishment Significant Issue Resolution

In certain circumstances, it may be required that the SG Project follow D-GUID-09701-10018, *Darlington Refurbishment Significant Issue Resolution* (“**SIR**”) for issue resolution. D-GUID-09701-10018 is not a replacement for the EPC vendor issue resolution process. The use of a SIR Team is an enhancement to any vendor process and is a tool made available to the vendor for resolution of a significant issue that cannot be resolved through the vendor’s own issue resolution/corrective action process. OPG reserves the right to initiate a corrective action process at any phase of the NR Project but shall review all impacts to contractual agreements prior to involvement of the EPC vendor.

#### 7.6 Communication Management Integration

Figure 8 shows the integration of communication management governance being applied to the SG Project.

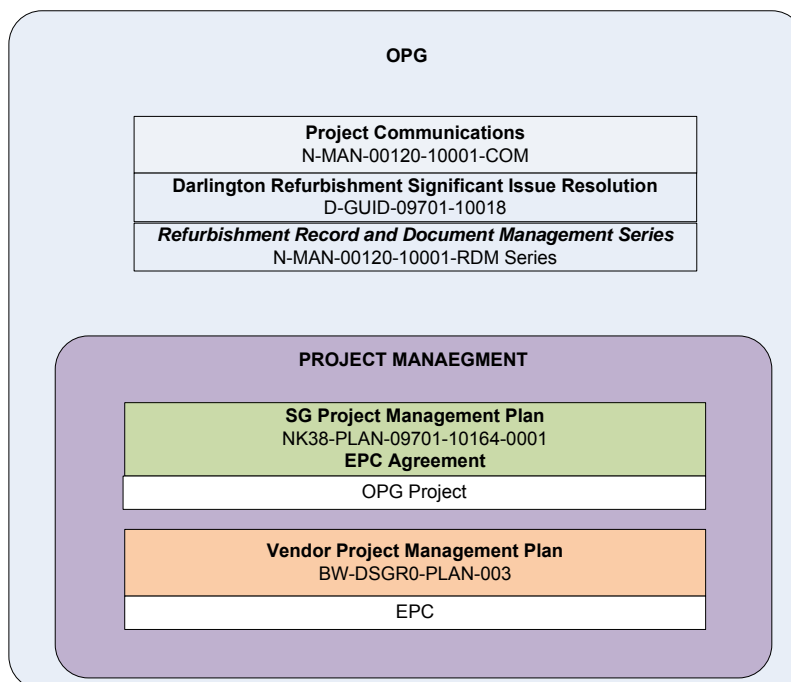


Figure 8 - SG Communication Management Integration

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## 8.0 CONSTRUCTION MANAGEMENT

Through effective management of contractors, the SG Project Team shall ensure that contractors employed on the SG Project execute their work safely, effectively, and in a manner consistent with OPG's and the Contractors policies, procedures, quality requirements, safety values, and objectives.

The project shall be executed in a manner consistent with industry best practices and a culture that embraces the belief that all accidents are preventable. The SG Project Team, and its contractors, shall carry out their refurbishment activities in a responsible manner that minimizes risks to employees, the public and the environment.

### 8.1 Construction Management

For management of the construction phase of the SG Project, the Project shall comply with the requirements provided in:

1. NK38-PLAN-09701-10012, *Management Plan: Management of Contractors for Darlington Refurbishment Project*
2. NK38-PLAN-09701-10223, *Darlington Refurbishment Construction Execution Functional Management Plan*
3. (To Be Issued) Division of Responsibilities
4. N-GUID-09701-10120, *Guideline For Construction Oversight*
5. SG COIR Section 3.0 - Construction Interface Matrix
6. SG EPC Agreement Terms and Conditions
7. Occupational Health and Safety Act ("OHSA")

Through effective management of contractors, OPG shall ensure that contractors employed on the Darlington NR Project execute their work safely, effectively and in a manner consistent with OPG's policies, procedures, safety values and objectives. The project shall be executed in a manner consistent with best industry practices and a culture that embraces the belief that all accidents are preventable. OPG and its contractors shall carry out the refurbishment activities in a responsible manner that minimizes risks to employees, the public, and the environment.

The Construction Management objective is to:

1. Ensure alignment between all the project stakeholders (including the Contractors) executing the construction phase of the project
2. Provide oversight such that the project is completed safely while meeting quality requirements, cost targets and schedule milestones.

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General Construction Management principles related to SG project include:

1. Our ability to influence a positive outcome and achieve all the project objectives starts before execution in the field. If we stop or delay Work after it has started for things that should have been addressed during earlier phases, we have failed. Accordingly, a significant amount of oversight is provided prior to field implementation ensuring readiness.
2. We work hard at building trust and our relationship with the group executing the Work as we believe openness and trust is the only way to meet all the project objectives.
3. The level of oversight applied shall be risk based and be specific to each critical evolution of the SG Projects as detailed in the Project Oversight Plans (“POP”)
4. Oversight shall be performed in accordance with N-STD-AS-0030, *Project Oversight Standard* and N-MAN-09701-10002, *Nuclear Refurbishment Project Oversight*.

The Contractor is required to be self sufficient and adopt industry best practices while performing installation and construction work for SG Project. Based on nuclear industry OPEX regarding execution of EPC contracts, the level of oversight in the POP shall be proportionate with the Contractor’s experience and past performance as well as the measured risk associated with execution tasks.

## 8.2 Construction Oversight

Construction Oversight is discussed in more detail in N-GUID-09701-10120, *Guideline For Construction Oversight*. Specific oversight plans for Construction activities associated with the SG Project can be found the [RMO Tool – Oversight Log](#). The responsibility of oversight plans enteritis is shared between all stakeholders. The ownership of the oversight plan in RMO tool resides with SG Project Director or Delegate.

In accordance with the Darlington Refurbishment Construction Execution Functional Management Plan, the execution oversight team shall be comprised of shared resources between SG and TG projects. Allocation of these resources shall be negotiated between the project directors or delegates based on scheduled activities during respective project execution windows. The numbers of required staff in key positions are listed in Table 10.

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Table 10 - Construction Oversight Resources

<i>Key Resources</i>	<i>Required Numbers</i>
Construction Manager	One
Construction Coordinator	Four
Quality Surveillance Project Technicians	Four
Maintenance Oversight	Four

The roles and responsibilities of key resources mentioned above shall be identified in the Division of Responsibilities document.

### 8.3 Construction Management plan integration

Figure 9 shows the integration of construction management governance being applied to the SG Project.

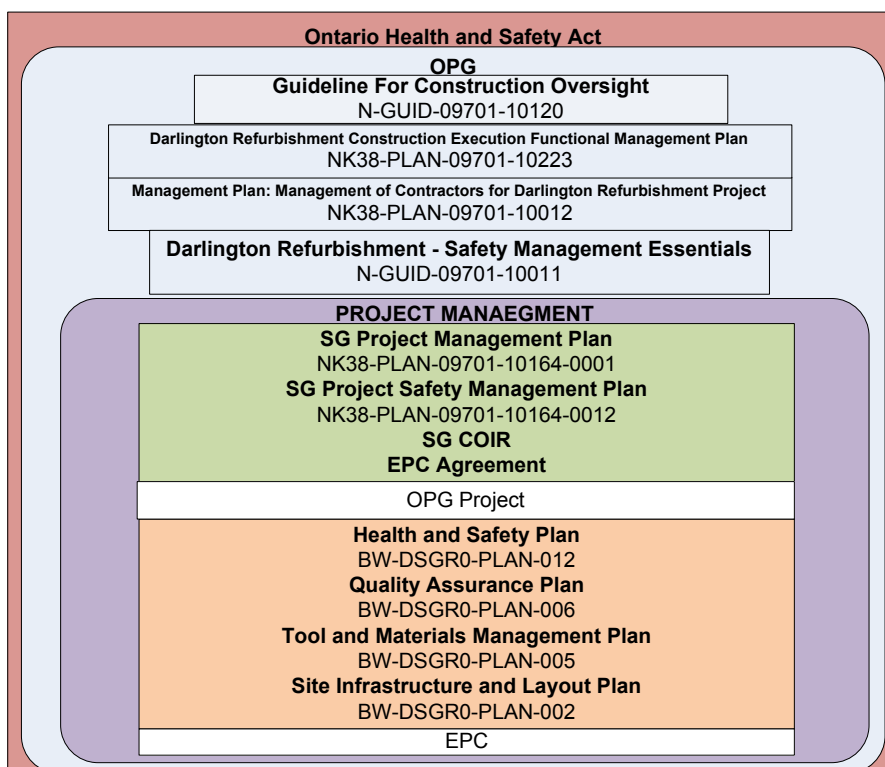


Figure 9 - SG Construction Management Integration

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## 9.0 RISK MANAGEMENT

The method for Risk Management of the SG Project shall ensure risks are identified, assessed, and analyzed for risk response, as well as monitored to a robust and consistent standard to ensure that project objectives are achieved. SG risk management is in compliance with N-MAN-00120-10001, *Nuclear Projects Risk Management Process*.

### 9.1 Risk Management Processes, Procedures and Templates

The following processes, procedures and forms supplement the risk management process for the SG Project for Nuclear Refurbishment:

1. N-MAN-00120-10001, *Nuclear Projects Risk Management Process*
2. N-MAN-00120-10001, *Nuclear Refurbishment Risk Management & Contingency Development Guide*
3. N-MAN-00120-10001, *Darlington Refurbishment Lessons Learned And OPEX Management*
4. N-MAN-00120-10001, *Nuclear Refurbishment Actions Issues Decisions And Key Assumptions Management*

### 9.2 Risk Management Process

Risk management provides projects with forward-looking actions and metrics to reduce the likelihood and minimize the impact of undesirable events during the project life cycle. The goal of risk management is to remove obstacles to project success before they occur in order to minimize their consequential effect on project costs, schedule, quality, and safety targets.

Proactive risk management is used to understand the characteristics of the risk, how to manage them, and plan for *contingency* based on the *residual risks*. As such, risk management can have a significant impact on the financial health of the project.

Risk management should be performed with a graded approach. The intent of this approach is to match the level of effort with the impact to safety, cost, schedule, and success of the project.

Figure 10 shows the overview of the Risk Management Process.

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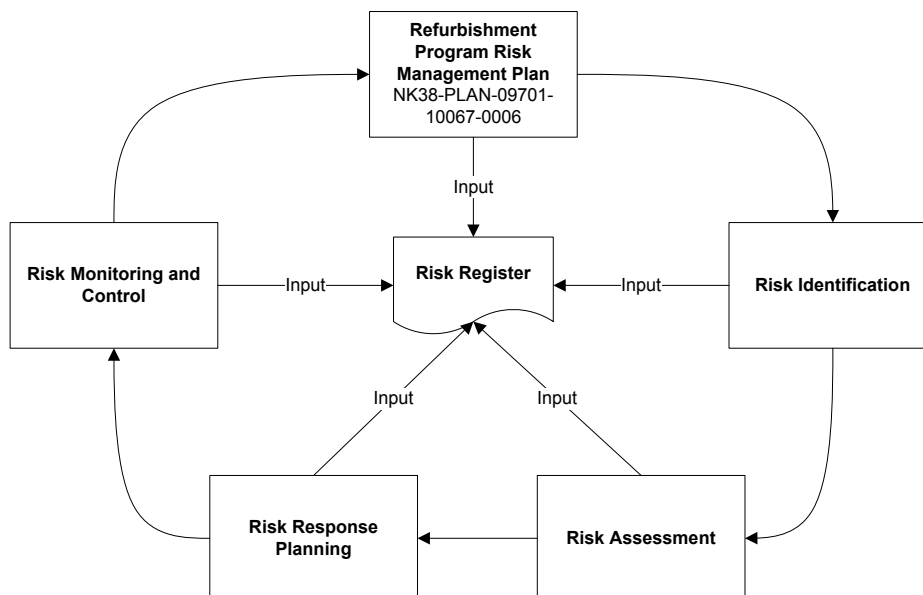


Figure 10 - Risk Management Process Overview

### 9.2.1 Risk Register

The SG Risk Register is created by the SG Project Team, but shall be maintained and updated by the SG Risk Single Point of Contact (“**SPOC**”). Reports can be produced as required by the project/contractor/department to support risk management activity.

The NR Project Planning and Controls shall provide oversight and interface with the local risk SPOC to ensure the risk database is being updated as per the existing risk management governance.

NR Risk Team shall manage the integration between Program Risk Registry and SG Risk Registry.

### 9.2.2 Contractor Risk Register

For the SG Project, a Risk Management Plan has been prepared by the EPC contractor and is managed by the contractor Project Team. The Contractor RMP establishes the method on how the contractor effectively manages the risks that they can control and enables transparency of risks to OPG.

The Contractor's risks shall be incorporated into the SG Project Risk Register on a case by case basis.

### 9.3 Risk Identification

Risk Identification for the SG Project shall follow the process outlined in N-MAN-00120-10001, *Nuclear Projects Risk Management Process*.

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### 9.3.1 Risk Meetings

Risk meetings are scheduled with SG Project team members, functional support (as required) and contractor staff (Post Award) to review the risk register and add any updates (review scoring, mitigating actions, close outs, etc) to existing risks based on new information. Additional risks can be introduced during these meetings.

**Pre-Award** - Prior to Contract Award, the SG Project team participated in quarterly Risk Meetings to review the risk register. Adhoc meetings were held in addition to the quarterly meetings if new information required the immediate: addition of a new risk, revision of an old risk or mitigating actions, or close out of a risk.

**Post Award** - After the SG Contract is awarded, Risk Meetings shall be held on a monthly or quarterly basis to ensure the risk registry is maintained current and that applicable oversight is in place for new and escalating risks. The Contractor shall participate in the monthly risk meetings and take ownership of the risks that are under the Contractor's control.

### 9.4 Risk Assessment

Risk assessment for both SG Project shall follow N-MAN-00120-10001, *Nuclear Projects Risk Management Process*. Risk assessment for the Contractor shall follow the processes outlined in their own RMP. If their RMP has any major gaps in comparison to the Refurbishment Program RMP, then the Nuclear Project RMP shall take precedence, and the Contractor shall be required to follow those processes.

### 9.5 Risk Response Planning

The majority of the SG Project scopes of work have been awarded as fixed price contracts. For fixed price contracts, the risk is inherently built into the contractor's estimate and therefore minimal additional contingency shall be assigned to this portion of the work. For fixed price work, risks shall be tracked with emphasis on maintaining project schedule milestones.

For the Target Price portion of the contract, the Contractor has built risk into their Target Price estimate and agreed to target band. For known project risks that could have adverse financial and schedule impacts to the project, the Project shall manage these risks through allocation of contingency funding. The Contractor shall be responsible for managing their risks to ensure they achieve their target price and schedule, and OPG shall monitor the contractor's adherence to risk management processes as per section 3.5.2 Contractor Oversight. Ongoing management of mitigating actions to potential risks shall be carried out by both the Project Team and Contractor to reduce the impact, should those risks be realized.

### 9.6 Risk Monitoring and Control

Risk monitoring and control for both SG Project and the Contractor shall both follow N-MAN-00120-10001, *Nuclear Projects Risk Management Process*. The following sections address how oversight is managed for both the Project and Contractor.



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### 9.6.1 Project Oversight and the Risk Management Oversight Tool

SG project risks and associated oversight are management through the [Risk Management Oversight Tool](#). This is a living tool that allows the project to provide details on risks, mitigating actions, and the oversight activities in place for the Project to monitor and control risks associated with the contractors work.

### 9.6.2 Contractor Oversight

OPG shall monitor the Contractor's adherence to the risk process (with support from the functional SME) and their internal oversight activities to ensure risks are monitored and controlled appropriately. These activities shall be documented in the POP described in Section 9.6.1.

### 9.7 Risk Management Plan Integration

Figure 11 demonstrates the integration of risk management governance being applied to the SG Project.

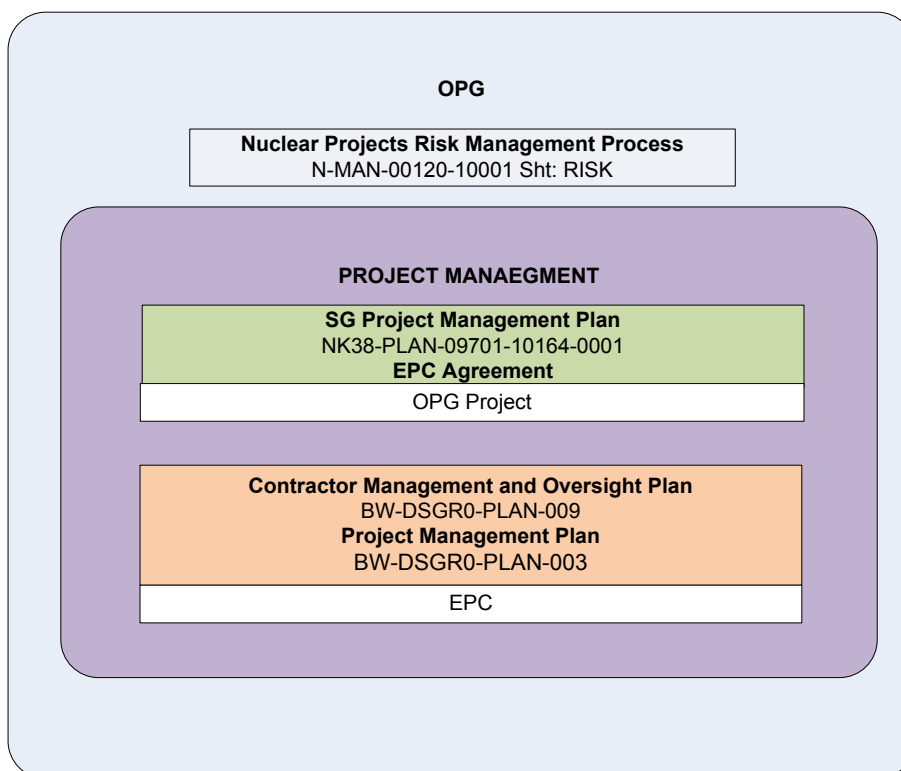


Figure 11 – SG Risk Management Integration

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### 10.0 PROJECT OVERSIGHT MANAGEMENT

The SG Project team is accountable to provide oversight of the contracted scope, via the SG EPC Agreement, to ensure that the Contractor delivers the products and services with acceptable technical quality and appropriate project controls critical to success. This POP shall provide a uniform methodology to be used for oversight activities ensuring that the deliverables, as supplied by the Contractor, meet the intent of the SG Agreement.

This plan is issued to cover the different stages of Engineering, Procurement, and Construction as it applies to the Darlington Nuclear Generating Station SG contract.

The SG Project Manager is responsible for the creation and implementation of the POPs in NR. The Project Manager, with the support of Management Systems Oversight (“**MSO**”) is maintaining the POP to identify oversight activities planned for the project.

POPs and findings are maintained by the project through the [RMO Tool](#).

Historical POP Activities and Findings can be located through the SharePoint [Project Oversight Plan](#) and [Project Oversight Findings](#).

#### 10.1 Project Oversight Plan Integration

Figure 12 shows the integration of project oversight governance being applied to the SG Project.

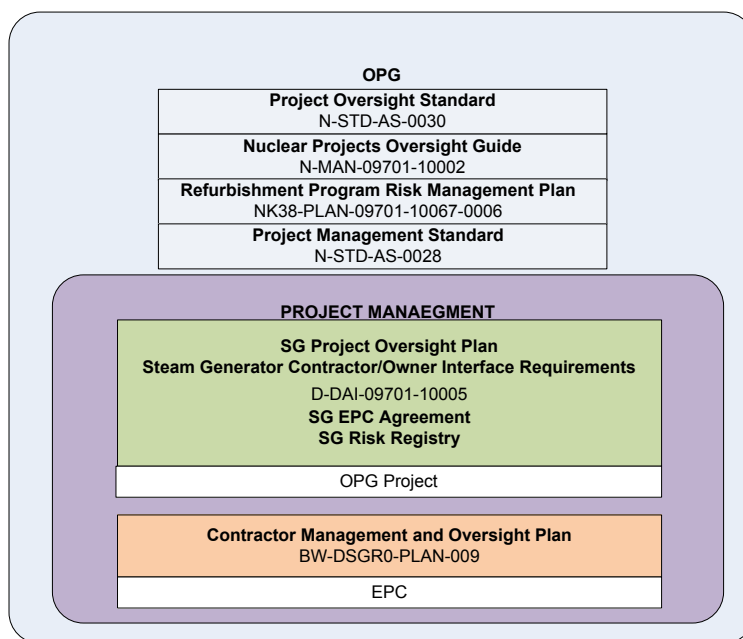


Figure 12 – SG Project Oversight Integration

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## 11.0 QUALITY MANAGEMENT

Quality Management of the SG project team shall implement planned and systematic activities to ensure the project's deliverables are achieved with the expected results. Quality Management has four areas of focus that are monitored, controlled and reported. Those areas are:

4. Design Engineering
5. Procurement
6. Installation, Construction & Completion Assurance
7. Commissioning

The areas of scrutinized focus are as follows:

1. Schedule activities that monitor the development and verification of the Design Requirements into deliverables
2. Evaluation of critical quality activities during Engineering, Procurement and Construction phases of work, and insertion of owner hold and witness points into ITPs and P6 Schedule.
3. Management of non-conformances as they are identified, documented, reported, and designation of responsibility for disposition.
4. The Corrective Action Plan (“**CAP**”) to determine the cause of the non-conformances, the prevention of their reoccurrence, and that the non-conformance shall be corrected within a specified time limit.

The Contractor shall perform the entire scope of work under their approved quality assurance program. The Contractor is responsible for ensuring that its Sub-Contractors are working under the Contractor's quality assurance program or have implemented an appropriate quality assurance program acceptable to the Contractor and OPG. It is the project's expectation that the Contractor shall implement, maintain and comply with the approved quality assurance programs that have been identified and agreed to in the EPC Agreement for the Darlington Refurbishment SG Project

Quality management shall be administered in consultation with the additional following documents:

1. N-STD-AS-0028, *Project Management Standard*
2. N-STD-AS-0029, *Contract Management Standard*
3. N-STD-AS-0030, *Project Oversight Standard*

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4. N-MAN-09701-10002, *Nuclear Project Oversight Guide*

### 11.1 Quality Program

The project quality management approach described in the following section shall demonstrate the following elements:

1. Quality planning to determine the type and frequency of internal and external quality standards and monitoring required for project success.
  - a. Quality Assurance to plan a systematic pattern of means and actions designed to provide confidence that items or services shall meet specified requirements and perform satisfactorily in service. These include quality systems, instruction, training, qualification and checklists.
  - b. Quality Control processes to ensure that specified requirements are met through monitoring, inspections, testing, examinations or verifications. This includes the documentation of non-conformances and corrective actions. Quality Surveillance shall be carried out by OPG to ensure the vendor is performing Quality Control in accordance with their approved processes and procedures.

### 11.2 Quality Planning

The SG Project shall use a combination of industry best practices and OPEX from similar OPG projects to anticipate and plan for potential quality concerns and risks. It is the mission of the SG project team to implement a successful campaign, and this benchmarking shall be one of the components to build this success model which shall be incorporated into the POP.

The EPC Vendor's Quality Assurance Plan (BW-DSGR0-PLAN-006) forms the foundation for QA requirements and governing processes to be followed during the execution of the SG project. When planning quality related oversight activities, the vendors QA plan and the applicable referenced vendor QA procedures shall be utilized to develop criteria and specific areas of focus.

### 11.3 Quality Oversight

Quality oversight activities are planned and documented using the [RMO Tool](#) and may also be incorporated into the P6 schedule, when required.

### 11.4 Quality Assurance

The Contractor shall implement, maintain and comply with an OPG-approved auditable quality assurance program in accordance with its own internal program and the requirements of the EPC Agreement. The contractor is expected to ensure that all of their work is provided in accordance with the applicable quality assurance program.

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Expectations of the Contractor's quality assurance program:

1. Ensure the workmanship used to perform work shall fully meet the requirements of the agreement
2. Meet applicable elements for design (engineering), procurement and construction services of *CSA N286-05, Management System Requirements for Nuclear Power Plants*, as amended, restated or replaced from time to time; (as a guideline with respect to applicable elements of *CSA N286-05 for EPC Services*, refer to memo *N-CORR-01930-0387907 P* dated July 11, 2011);
3. Conform with the requirements of *CSA Quality Standard Z299.1* or such equivalent quality standard agreed to by OPG that may replace said standard;
4. Meet applicable elements for design software (use, modification or development) of *CSA N286.7, Quality Assurance of Analytical, Scientific and Design Computer Programs for Nuclear Power Plants*;
5. Meet the requirements of *CSA N285.0, General Requirements for Pressure Retaining Systems and Components in CANDU Nuclear Power Plants*, as amended, restated or replaced from time to time. All pressure boundary activities shall be carried out in compliance with *CSA N285.0* and where required under a "Certificate of Authorization" issued by the Technical Standards and Safety Authority;
6. Meet the Electric Power Research Institute guidelines with respect to the prevention and detection of *Counterfeit, Fraudulent and Suspect Items (CFSI)*; and
7. Ensure that Subcontractor evaluation and selection is performed in compliance with the requirements of the applicable elements of *CSA N286-05* and *CSA Z299* series of quality standards or such equivalent quality standard agreed to by OPG that may replace said standard.

#### 11.4.1 Non-Conformance

If the Contractor or OPG identifies anything which does not conform to the quality assurance program set out in the EPC Agreement, the Contractor shall promptly correct the non-conformance (unless the Contractor proposes to "use as is") and deliver a notice in the form of "Quality Assurance Non-Conformance Notice" to the Project and report the corrective action proposed to be taken by the Contractor.

#### 11.5 Quality Control/Surveillance

The combination of OPG and EPC Governance, and SG Project and EPC Quality Management Plans shall be used to govern quality on the project. Quality Control shall be performed by the EPC vendor through their QA organization. OPG shall perform

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quality surveillance on the vendors QA processes and activities and may insert witness and hold points during key activities of the work program. These activities shall be strategic and proactively planned and executed using a risk based approach.

## 11.6 Quality Records

The Contractor shall provide OPG with signed and dated legible copies or originals of all inspection documents pertaining to the work performed, including installation and testing. The Contractor shall retain all quality assurance documentation and records for seven years after the Final Completion Date or for any longer period specified in the agreement.

## 11.7 Quality Management Plan Integration

Figure 13 shows the integration of quality management governance being applied to the SG Project.

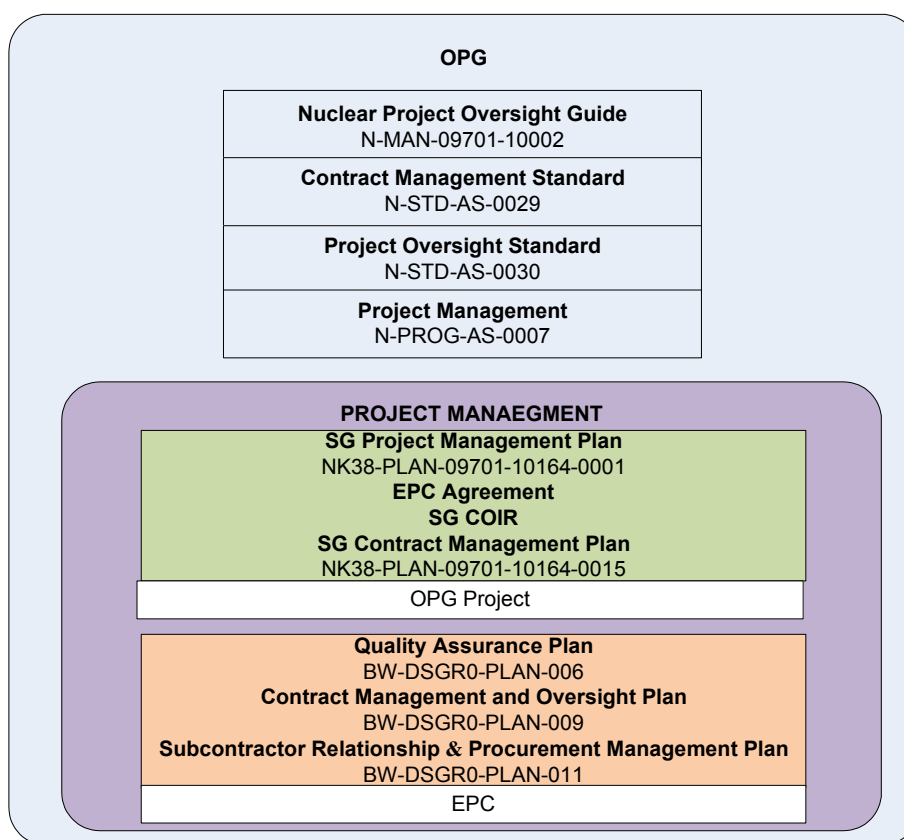


Figure 13 – SG Quality Management Integration

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**12.0 PERFORMANCE BASELINES, OBJECTIVES AND DELIVERABLES FOR  
DEFINITION PHASE**



G2-1 Performance Baselines, Objectives and Deliverables.pdf

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**13.0 PRELIMINARY POST IMPLEMENTATION REVIEW (PIR) OBJECTIVES, PLAN,  
AND ASSIGNMENT OWNER**



G2-15 PIR.pdf



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## 14.0 ACRONYMS AND DEFINITIONS

Acronym	Definition
ALIS	Acoustic Leakage Inspection System
BOE	Basis of Estimate
BTU	Building Trades Union
CBA	Cost Benefit Analysis
CAP	Corrective Action Plan
CCA	Component Condition Assessment
COIR	Contract Owner Interface Requirements
COMS	Construction, Operability, Maintainability, and Safety
DNGS	Darlington Nuclear Generating Station
DRAS	Decision Record and Analysis Summary
DSR	Darlington Scope Request
ECC	Engineering Change Control
EDMS	Electronic Data Management System
EOI	Expression of Interest
EPC	Engineering, Procurement and Construction
ET	Eddy Current Testing
HOS	Health of Scope
IT	Information Technology
LCMP	Life Cycle Management Plan
MOE	Ministry of the Environment
MOL	Ministry of Labour
OAR	Organizational Authority Register
OHSA	Occupational Health and Safety Act
OMS	Outage Management System
OPEX	Operating Experience
OPG	Ontario Power Generation
OSS	Owner Support Services
NR	Nuclear Refurbishment
NOP	Neutron Over Power
PCD	Project Change Directive
PHT	Primary Heat Transport
PIR	Post Implementation Review
PM	Project Manager
PMP	Project Management Plan
POP	Project Oversight Plan
PSC	Primary Side Clean
PSRB	Program Scope Review Board
QA	Quality Assurance
QMP	Quality Management Plan
RDM	Records and Document Management
RFI	Requests for Information
RFP	Request for Proposal
RIHT	Reactor Inlet Header Temperature
RQE	Release Quality Estimate
RMP	Risk Management Plan

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RTS	Return to Service
SG	Steam Generator
SOW	Scope of Work
SPOC	Single Point of Contact
UT	Ultrasonic Testing
VP	Vice President
WBS	Work Breakdown Structure
WP	Work Package

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## 15.0 REFERENCES

Engineering, Procurement, and Construction Agreement for Nuclear Refurbishment Steam Generator Project

D-GUID-09701-10018 Darlington Refurbishment Significant Issue Resolution

N-MAN-00120-10001-RDM Series

N-MAN-00120-10001-COM Project Communications

NK38-NR-PLAN-09701-10001 Darlington Refurbishment Staffing Program Management Plan

D-PCH-09701-10000 Darlington Refurbishment Project Charter

N-MAN-00120-10001-GRB Nuclear Projects - Gated Process.

NK38-PLAN-09701-10227 Nuclear Refurbishment – Pre-Gate Readiness Review Alignment Meeting - Terms Of Reference

N-GUID-09701-10011 Darlington Refurbishment - Safety Management Essentials

N-MAN-09701-10002, Nuclear Refurbishment Project Oversight

D-DAI-09701-10005 Steam Generator Project Contractor Owner Interface Requirement

Occupational Health and Safety Act

NK38-REP-33320-10009 - CCA 000156-system 0054 Primary Heat Transport Pressure And Inventory Control - Bleed Cooler

N-GUID-09701-10120 Guideline For Construction Oversight

NK38-PLAN-09701-10012 Management Plan: Management of Contractors for Darlington Refurbishment Project

NK38-INS-09701-10001 Darlington Refurbishment Project – Scope Control

N-MAN-00120-10001 Sht: RISK Nuclear Projects Risk Management Process

N-MAN-00120-10001 Sht: RISK-04 Nuclear Refurbishment Risk Management & Contingency Development Guide

N-MAN-00120-10001 Sht: RISK-06 Darlington Refurbishment Lessons Learned And OPEX Management

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N-MAN-00120-10001 Sht: RISK-07 Nuclear Refurbishment Actions Issues Decisions And Key Assumptions Management

NK38-PLAN-09701-10223, Darlington Refurbishment Construction Execution Functional Management Plan

BW-DSGR0-PLAN-002 Site Infrastructure and Layout Plan

BW-DSGR0-PLAN-003 Project Management Plan

BW-DSGR0-PLAN-005 Tool and Materials Management Plan

BW-DSGR0-PLAN-006 Quality Assurance Plan

BW-DSGR0-PLAN-009 Contract Management and Oversight Plan

BW-DSGR0-PLAN-011 Subcontractor Relationship & Procurement Management Plan

BW-DSGR0-PLAN-012 Health and Safety Plan

N-STD-AS-0029 Contract Management Standard

N-STD-AS-0028 Project Management Standard

N-PROG-AS-0007 Project Management

N-STD-AS-0030 Project Oversight Standard



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**Turbine Generator Project Management  
Plan**

**NK38-PLAN-41000-10001-0001-R003**


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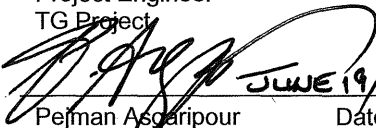
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R000	2013-05-28	Initial issue.
R00	2014-01-07	Revised for Gate 2b
R002	2015-03-31	Procurement Management
R003	2015-04-31	Revised for Gate 3

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## 1.0 INTRODUCTION

The *Darlington Refurbishment Project Charter*, D-PCH-09701-10000, documents the purpose of the Darlington Refurbishment Program.

Darlington NGS is aging and there is a need to assess and make recommendations with respect to the feasibility of continuing to operate beyond the current nominal end-of-service life dates. The goal of the refurbishment project is to extend the service life of the units by an additional 30 years of post-refurbishment operations.

Refurbishment will involve an outage for replacement of life-limiting components, as well as maintenance or replacement of other components which can be most effectively done during the refurbishment outage period.

The Nuclear Refurbishment (NR) organization has been established with the responsibility of assessing, making recommendations to OPG's Senior Management with respect to the feasibility of refurbishing the Darlington units, developing the scope, schedule and estimate for the Refurbishment Program, and providing overall program oversight on the execution of all activities associated with refurbishment. For Darlington, NR will undertake the Darlington Refurbishment Project, in phases per the approved Program Release strategy, to:

- Assess the technical feasibility of refurbishing Darlington and operating it for an additional 30 years of post-refurbishment operations
- Make recommendations as to the lead time required to be prepared to refurbish each unit,
- Fully define refurbishment scope,
- Execute front end planning including developing contract management strategies, cost estimates, schedules, a full risk assessment, and a release quality estimate for the project,
- Manage the refurbishment pre-outage planning and preparation activities,
- Provision of overall program oversight on all execution and commissioning activities, and
- Project Closeout.

The refurbishment is currently planned to begin in 2016. The first two unit refurbishment will be unlappped with the 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> units' shutdown in a partially overlapping sequence. Currently, the approved plan to refurbish the four units is shown in the following table:

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Unit	Start of Refurbishment Outage	Finish of Refurbishment Outage	Duration (Months)	Overlap on Previous Unit
D2	October 2016	October 2019	36	
D3	October 2019	October 2022	36	0
D1	March 2021	March 2024	36	19
D4	October 2022	October 2025	36	17

The current reference schedule is as follows:

- Initiation Phase – 2008 - 2009 COMPLETE
- Definition Phase - Preliminary Planning – 2009 - Dec 2011 COMPLETE
- Definition Phase - Engineering and Detailed Outage Planning – 2012 - 2016
- Field Execution and Closeout Phase (four units) – 2016 - 2025
- Operation Phase (Return to Service of Units) - Starting with the first unit in 2019

The Turbine Generator Project is one of the major projects within refurbishment. Timely, cost effective preparation and completion of this scope and project will be required to meet objectives for the refurbishment outage.

The goals of the Darlington Refurbishment project (ref: NK38-CORR-09701-0458306, *Common Outage Goals and Objectives for Darlington Refurbishment*), which are aligned with the high level goals of the Turbine Generator Project, are:

- Station and Refurbishment scope is completed safely, at the specified quality, on time and on budget;
- Transitions of units, work programs and staff between the Station and Refurbishment are planned and controlled to minimize disruption in Refurbishment and Plant Operations;
- Darlington operation post-Life Extension meets OPG documentation requirements and operating objectives, as defined by the Nuclear Performance Index and the Equipment Reliability Index.

## 2.0 PROJECT DESCRIPTION

The Turbine Generator Project (the "Project") is one of the major projects under the Darlington Nuclear Refurbishment Program. The Turbine Generator sets, auxiliaries, and controls are highly specialized equipment designed and supplied as an integrated system for the Darlington station. The Project is planned to be executed within the refurbishment window for each unit.

## Plan

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The Project scope of work has been generated using recommendations from a Component Condition Assessment (CCA) program undertaken by OPG in order to identify components of the Turbine Generators and their auxiliaries which exceed the lifetime or need replacement due to other reasons. These recommendations are a combination of the Condition Assessment Program (CAP) report developed by the OEM - Alstom Canada Inc. and OPG operational experience. One of the findings in the CCA process was that a variety of turbine generator components either mechanical, electrical or instrumentation have to be replaced due to aging or obsolescence related issues. Another finding was that a number of components require more detailed inspection or technical analysis.

To meet contracting objectives and project execution requirements, the targeted Turbine Generator work packages have been bundled as follows:

- (a) Turbine and Auxiliaries - inspections, overhauls, repairs, modifications and replacements of specific equipments and components.
- (b) Generator and Auxiliaries - inspections, overhauls, repairs, modifications and replacements of specific equipments and components.
- (c) Moisture Separator Reheater (MSR) - inspection, overhaul, repair, modification and replacement of specific equipments and components.
- (d) Steam Turbine Electronic Controls (STEC) - upgrades from an analog to a digital platform.
- (e) Generator and Excitation Controls - upgrades from an analog to a digital platform.

Life extension of the Turbine Generator equipment will extend the life of the station by 30 years to the 2050 station end date.

### 3.0 PROJECT MANAGEMENT APPROACH

There are five distinct phases considered during the life of the project:

- Project Definition
- Execution Planning
- Project Execution
- Commissioning
- Project Closeout

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The Definition Phase includes the scope identification, development of the contracting strategy and contract award, detailed engineering substantial completion, and other tasks required to prepare for the Execution Phase work.

The Execution Planning Phase includes completion of all engineering deliverables, procurement, and outage planning.

The Execution Phase work includes detailed engineering, inspection, overhaul, refurbishment, replacement of TG equipment and components, layup and preservation of the turbine generator and auxiliary systems.

The Commissioning Phase includes both static and dynamic commissioning of the refurbished / replaced equipment including controls and excitation systems.

The Project Closeout includes the administrative closure (archive project information, confirming all deliverables have been met, analyze project success, lessons learned, transfer the project products to Operations) and the contract closure.

The project management approach for the TG Project has two main components:

- **Engineering Services and Equipment Supply (ESES) model**

The Turbine Generator equipments and components are highly specialized with a significant level of integration. It has been determined that purchasing the most critical / specialized TG components, equipment and engineering services from the Original TG Equipment Manufacturer (OEM) is the most time / cost efficient alternative.

OPG has awarded an ESES contract for the Darlington Refurbishment Turbine Generator Project with the OEM - Alstom Power & Transport Canada.

During execution, the ESES will provide technical assistance and support to the EPC in disassembly and assembly of the turbine generator, assist in dispositioning any inspection findings and installation and commissioning of new equipment. The ESES will also execute certain specialized inspection (DIRIS,etc.)

The ESES project management plan is detailed under TS-PLAN-PMT-0002.

- **EPC (Engineering, Procurement and Construction) contracting model.**

The EPC contractor will provide the integration of the entire project scope, including the equipment supplied from the ESES (as described above). This will include the Engineering Change Control related work, limited procurement, as well as field execution.

OPG will be accountable for performing oversight for all Contractors involved in refurbishment and integrating all work packages throughout the project lifecycle.

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Current OPG strategy is to contract this portion of the contract to a qualified Engineering, Procurement and Construction (EPC) contractor. This portion is currently awarded to a Joint Venture (JV) SNC-Lavalin and AECON contractor.

The JV project management plans are detailed under, including sub-plans with the main PMP:

- DNGS TGR – Project Management Plan – Definition Phase 617391-0002-00000-30IM-0001
- DNGS TGR – Project Management Plan – Execution Phase 617391-0002-00000-30IM-0019

Other components include IMS, who will perform inspection on the turbine generators, assessment and recommendations based on inspection results. Third party source surveillance supplier to perform source surveillance on Alstom supplied parts and engineering equipment. This support can be contracted or terminated as required as per the project needs.

Appendix A contains the Contracting Strategy Summary for TG Project.

### **NK38-GUID-09701-10031 “Darlington Refurbishment Execution Strategy”**

provides construction execution information related primarily to Vendors and Construction Execution Field Support, and contains key program and process changes or developments. Information includes details, principals, comments and expectations related to key activities which are or will be planned, executed and verified.

## 3.1 Roles and Responsibilities

The key roles on the TG Project are as follows:

Project Sponsor - Vice President, Nuclear Refurbishment Execution

Contract Owner - TG Project Director and Project Manager

Design Authority - Director Refurbishment Engineering

Accepting Organization - DNGS Director of Operations and Maintenance (DOM)

The TG Project Director and TG Project Manager have the accountability for all aspects of the TG Project.

### 3.1.1 Limits of Authority

The authority to execute the TG Project resides with the Project Sponsor – Vice President of Refurbishment Execution. As sponsor, the VP of Refurbishment Execution delegates execution authority to the TG Project Director. This authority includes the following:



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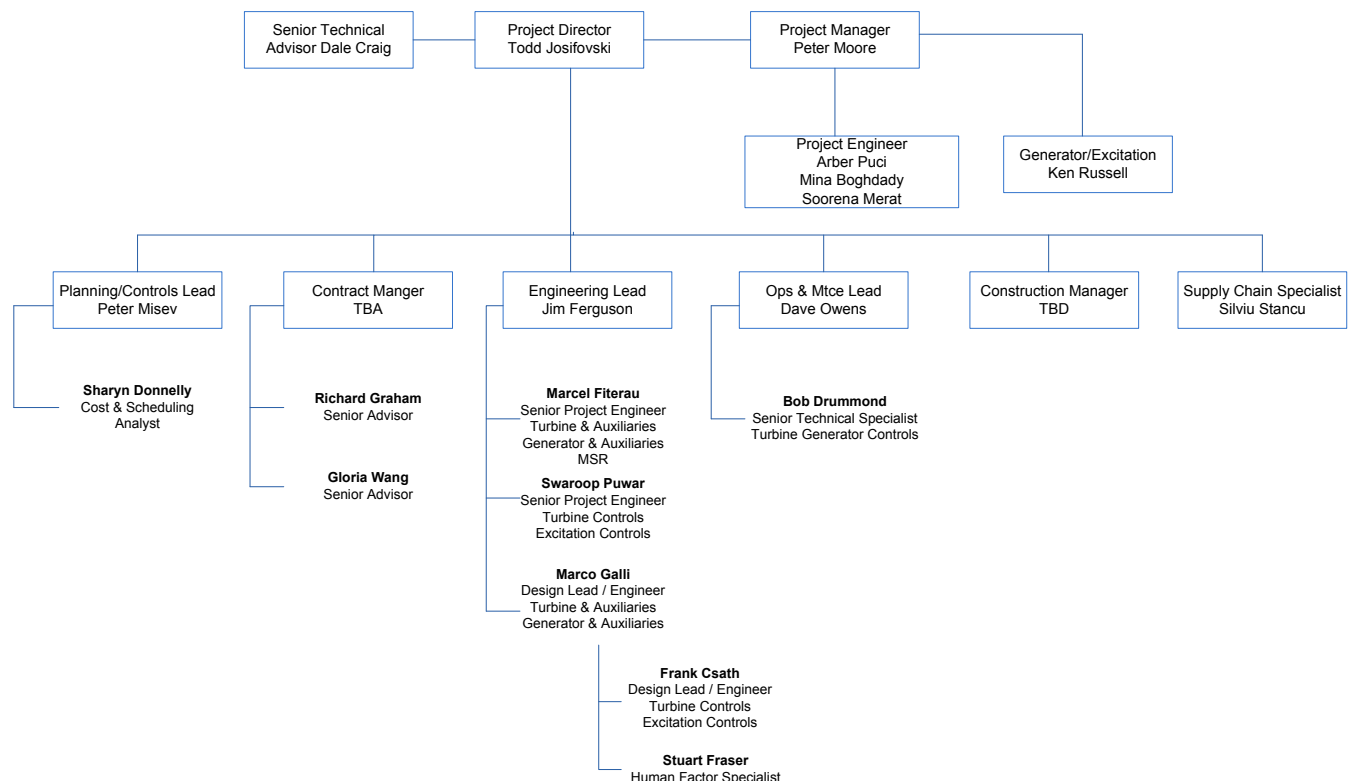
- Determine the structure, size and makeup of the organization required for project execution.
- OAR authority for TG Project costs as per OPG-STD-0017, *Organizational Authority Register*.

#### 3.1.2 Project Organization

The TG Project staffing structure has been organized to facilitate project execution in the EPC contracting model. The organization has been setup to align with the work packages.

It is TG Project's plan to staff the project team with OPG and Contract staff. OPG staff will either be embedded in the team or will perform functions "matrixed" from the NR functional support organization. Where NR functional support staff are currently unable to fulfill a specific need, due to unavailability or missing skill sets, the project will either utilize managed task contracts to maximize outside experience or attempt to find staff within other OPG business units.

The project organization is shown in the following chart:



This chart reflects the staffing structure as of end of May 2015. This structure is expected to change during the next stages based on project's demands.

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## **TURBINE GENERATOR PROJECT MANAGEMENT PLAN**

### **4.0 MANAGEMENT PROCESSES**

#### **4.1 Gated Process for Projects**

The Gated Process for the Project establishes the requirements and strategy for funding release to support the Turbine Generator Project. The Project will adhere to the requirements as specified in N-MAN-00120-10001-GRB *"Nuclear Projects – Gated Process"*.

The gate strategy plan has been developed to document the overall strategy to achieve and progress through each respective gate, the deliverables associated with each gate, and, the anticipated timing of each gate. These activities have been incorporated into the project schedule and will be tracked accordingly. It is anticipated this document and the strategy/timing will change as the project moves forward.

### **5.0 PROJECT MANAGEMENT PLAN COMPONENTS**

The project management plan integrates and consolidates all the subsidiary management components. The content of these subplans are subject to change as the project progresses or the contracting strategy changes.

#### **5.1 Communications Management Plan**

The purpose of the Communications Management Plan is to determine the information and communication needs of the project stakeholders (internal to OPG and external), Project Team and determine how information will be distributed. The Communications Management Plan defines the following:

- Communication requirements based on roles
- What information will be communicated
- How the information will be communicated
- When will information be distributed
- Who sends the communication
- Who receives the communication

The communication plan is consistent with the agreed communication plan between OPG and the EPC and ESES Vendors.

##### **5.1.1 Communications with the Canadian Nuclear Safety Commission and Other Regulatory Agencies**

All official communication with the CNSC and other Regulatory Agencies will be through the OPG Nuclear Regulatory Affairs Division.

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N-PROC-RA-0047 *“Communications with the CNSC”*, and N-PROC-RA-0026, *“Regulatory Action Management”* are used to manage all regulatory communications.

### 5.1.2 ESES and EPC Communication Management

#### 5.1.2.1 Roles and Accountabilities

All communication from the ESES and EPC Contractors to OPG, and from OPG to the ESES and EPC, will be through the OPG Representative or his Designated Delegate as follows (may change with needs of the project):

Role	Primary	Title	Alternate	Title	Scope
OPG Representative	Todd Josifovski	Project Director	Peter Moore	Project Manager	As per Agreement
Alstom Representative	Michael Winters	Project Director	David Kurz	Project Manager	As per Agreement
JV Representative	Mustafa Shousheh	Project Director	Kevin Folk	Construction Manager	As per Agreement
OPG Project Management	Peter Moore	Project Manager	Pejman Asgaripour	Project Manager	As per Agreement
OPG Designated Delegate	Jim Ferguson	Engineering Lead	Marco Galli	Design Team Lead	Engineering
OPG Designated Delegate	Marcel Fiterau	Senior Project Engineer	Dale Craig	Senior Advisor	Turbine/Generator & Auxiliaries, MSR
OPG Designated Delegate	Swaroop Puwar	Senior Project Engineer	Bob Drummond	Senior Tech Specialist	Turbine Controls
OPG Designated Delegate	Ken Russell	Senior Project Engineer	Swaroop Puwar	Senior Project Engineer	Excitation Controls

#### 5.1.2.2 Darlington Refurbishment Records and Document Control

Nuclear Refurbishment Records and Document Management (RDM) staff play a primary role in the receipt, routing and management of documentation deliverables submitted for information, review or acceptance. RDM staff manages all formal documentation deliverables from the point of submission, until final acceptance by OPG. Contact information for RDM staff is outlined in the table below:

Name	Role	Contact Info
David Glover	Senior Manager, Records and Document Management	<a href="mailto:david.glover@opg.com">david.glover@opg.com</a>
Lynn Adams	Section Manager, Records and Document Management	<a href="mailto:lynn.adams@opg.com">lynn.adams@opg.com</a>
Michael Hughes	Administrator, OPG Engineering	<a href="mailto:michael.hughes@opg.com">michael.hughes@opg.com</a>

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Name	Role	Contact Info
	Document Management System (VenDM)	
Angela Webster	First Line Manager, Records and Document Management	<a href="mailto:angela.webster@opg.com">angela.webster@opg.com</a>
	RDM Document Controllers	Email account NR DOC CONTROL

The Project Director or Manager for the EPC and ESES will identify the people within their organization, with whom OPG RDM staff will communicate on project documentation issues. This would include one or more persons who are authorized to identify staff needing access to the OPG Engineering Data Management System (VenDM). This will help ensure that OPG has timely and correct information about the number of users and their roles during the life of the project.

### 5.1.2.3 Communication Protocol

#### Correspondence

All formal correspondence (official memorandums) shall be issued to OPG via VenDM. Each memorandum must clearly indicate the intended recipient. OPG RDM staff will route the correspondence accordingly, and ensure a record copy is kept on file.

Informal correspondence issued via email, can be sent directly to the appropriate project team member, with a cc addressed to the standard Email Correspondence lists below.

OPG project team members will obtain an OPG Record Number for official correspondence sent to the EPC or ESES as appropriate, and will forward to DNGD:Refurb Doc Mgmt for filing.

#### Requests for Information

The following process for the flow of RFI has been established between OPG and the ESES and EPC vendors:

1. RFI is generated by JV and sent to Alstom Interface Spoc
2. Alstom Interface Spoc routes the RFI to Alstom's Resident Technical Advisors
3. A conversation happens between Alstom's Resident Technical Advisors and the OPG team to decide who should answer the RFI.
4. IF Alstom responsible, RFI is routed to Alstom department, and response coordinated by Alstom Interface Spoc.
5. IF OPG responsible, it's answered directly by OPG.

#### Email Correspondence

The following email cc: lists have been developed with the ESES Vendor.

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In addition to these lists, the HFE group mailbox: DN REFURB:HFENG -NUCLEAR shall be used for email correspondence concerning Human Factors Engineering or Human Machine Interface design.

**Note:** The following tables capture the communication protocol for e-mail correspondence. E-Mails shall be exchanged between Primary contacts with copies to Alternate contacts and "Copy" contacts. In the event that a Primary contact is unavailable, the Alternate contact shall take the lead.

		OPG	Alstom
<b>EHS</b>	Primary	Peter Moore	Mike Winters
	Alternate	Todd Josifovski	David Kurz
	Copy	Jim Ferguson, Marcel Fiterau, Swaroop Puwar, Dale Craig, Bobby Drummond, Ken Russell, Arber Puci, Mina Boghdady	Marty Albright Norbert Heinemann  PIRS
<b>Finance</b>	Primary	Peter Moore	Mike Winters
	Alternate	Todd Josifovski	David Kurz
	Copy	Terri Keggenhoff, Janice Ding	Johnny Zhang Norbert Heinemann PIRS
<b>Schedule</b>	Primary	Peter Moore	David Kurz
	Alternate	Todd Josifovski	Mike Winters
	Copy	Jim Ferguson, Peter Misev, Sharyn Donnelly	Dalal AZRA'I Norbert Heinemann Johnny Zhang, Marcel Kern PIRS
<b>Supply Chain</b>	Primary	Peter Moore	Mike Winters
	Alternate	Todd Josifovski	David Kurz
	Copy	Janice Ding, Richard Graham, Silviu Stancu	Jeff Curran Norbert Heinemann PIRS

		OPG	Alstom
<b>Quality, Document Management</b>	Primary	Peter Moore	Mike Anderson
	Alternate	Todd Josifovski	Mike Winters
	Copy	Jim Ferguson, Marcel Fiterau, Swaroop Puwar, Dale Craig, Bobby Drummond	David Kurz, Norbert Heinemann Marcel Kern PIRS
<b>General Project Management</b>	Primary	Peter Moore	Mike Winters
	Alternate	Todd Josifovski	David Kurz
	Copy	Jim Ferguson,	Norbert Heinemann

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		<b>OPG</b>	<b>Alstom</b>
		Marcel Fiterau, Swaroop Puwar, Dale Craig, Bobby Drummond Marco Galli, Peter Misev, Ken Russell, Arber Puci, Mina Boghdady	Marcel Kern PIRS
<b>Commercial</b>	Primary	Peter Moore	Mike Winters
	Alternate	Todd Josifovski	David Kurz
	Copy	Janice Ding, Richard Graham	Johnny Zhang Norbert Heinemann PIRS
<b>General Technical Issues</b>	Primary	Jim Ferguson	David Kurz
	Alternate	Marcel Fiterau	Mike Winters
	Copy	Todd Josifovski, Peter Moore, Swaroop Puwar, Dale Craig, Bobby Drummond Marco Galli, Mina Boghdady, Arber Puci	Norbert Heinemann Marcel Kern Mike Anderson Paul Harris PIRS
<b>Turbine and Auxiliaries</b>	Primary	Jim Ferguson	Irina Pfeil
	Alternate	Marcel Fiterau	David Kurz
	Copy	Todd Josifovski, Peter Moore, Swaroop Puwar, Dale Craig, Bobby Drummond Marco Galli, Mina Boghdady	Norbert Heinemann Mike Winters Mike Anderson Andreas Hoffman Paul Harris PIRS

		<b>OPG</b>	<b>Alstom</b>
<b>Generator – Stator and Rotor</b>	Primary	Jim Ferguson	Leopold Grimm
	Alternate	Marcel Fiterau	David Kurz
	Copy	Todd Josifovski, Peter Moore, Swaroop Puwar, Dale Craig, Bobby Drummond Marco Galli, Mina Boghdady, Ken Russell	Norbert Heinemann Mike Winters Mike Anderson Marcel Kern Paul Harris PIRS
<b>Generator Auxiliaries</b>	Primary	Jim Ferguson	Stefen Weis
	Alternate	Marcel Fiterau	David Kurz
	Copy	Todd Josifovski, Peter Moore, Swaroop Puwar, Dale Craig, Bobby Drummond Marco Galli, Mina	Norbert Heinemann Mike Winters Mike Anderson Marcel Kern Paul Harris PIRS

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		OPG	Alstom
		Boghdady	
<b>Turbine Controls Hydraulics</b>	Primary	Jim Ferguson	Thomas Sautter
	Alternate	Swaroop Puwar	David Kurz
	Copy	Todd Josifovski, Peter Moore, Marcel Fiterau, Dale Craig, Bobby Drummond Marco Galli, Mina Boghdady	Norbert Heinemann Mike Winters Mike Anderson Marcel Kern Paul Harris Salvador Atilano-Velazquez PIRS
<b>Turbine Controls</b>	Primary	Jim Ferguson	Dietmar Abraham
	Alternate	Swaroop Puwar	David Kurz
	Copy	Todd Josifovski, Peter Moore, Marcel Fiterau, Dale Craig, Bobby Drummond Marco Galli, Arber Puci, Mina Boghdady	Norbert Heinemann Mike Winters Mike Anderson Marcel Kern  Matthias Jaeckel Paul Harris Salvador Atilano-Velazquez PIRS
<b>Excitation Controls</b>	Primary	Jim Ferguson	Dietmar Abraham
	Alternate	Swaroop Puwar	David Kurz
	Copy	Todd Josifovski, Peter Moore, Marcel Fiterau, Dale Craig, Bobby Drummond Marco Galli, Ken Russell, Mina Boghdady	Norbert Heinemann Mike Winters Mike Anderson Andreas Hoffman Aissam Idouammou Mathias Jaeckel Paul Harris Salvador Atilano-Velazquez PIRS

**Document Submissions**

The communications management principles for Submittals are outlined below:

- All technical and/or formal documentation deliverables owed by the EPC or ESES has been submitted to OPG via the Vendor Document Management System (VenDM) and will continue to be in that manner for any future documents, except where other means have been agreed between OPG and vendors.
- Submission to OPG (or from OPG) of Submittals or other transmissions to/from the ESES or EPC Contractors has been done via existing FTP (before contracts award) or VenDM (after contracts award).
- VenDM has been subdivided into elements as per TG WBS. For example, separate folders for submittals related to Turbine & Aux, Generator & Aux, and Turbine Controls etc.

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- The ESES and EPC have developed a matrix of planned submittals (“Submittal Tracker”).
- Submittals have been workflowed to reviewers of a particular document by OPG sub-leads for comments. OPG reviewers will enter comments directly into VenDM, for transmission back to the Contractor.
  - For the ESES, as per contractual agreement and in compliance with their internal QA program, comments have been gathered in a single document on the ESES side of VenDM for dissemination and disposition of comments among their various international design groups. The ESES have been consolidating the comments/dispositions and entering them back into VenDM for transmittal to OPG.
  - For the EPC, the VenDM has been used in a manner which supports effective communication, timely review and acceptance of submittals, and value for money.
- TG project SPOCs are accountable for timely review consolidation of comments for Submittals. The turnaround time has been as per contractual durations outlined in the contract / agreement documents.
- Contractual review periods only begin once a document is uploaded into VenDM.
- Updated submittals which include incorporation of comments by OPG are stored in OPG’s shared TG drive or Internal SharePoint drive and will continue to be in the same manner for the remaining phases of the project.

## 5.2 Scope Management Plan

The Scope Management Plan identifies the method of defining, managing and controlling scope throughout the project. It includes the development of:

- Scope statements
- Work Breakdown Structure
- Scope of supply / scope of work documents
- Cost Benefit Analysis - CBA
- Decision Record and Analysis Summary - DRAS
- Process by which scope changes will be managed

The Turbine Generator Scope Management will be in accordance with NK38-INS-09701-10001, *Darlington Refurbishment Project – Scope Control* and NK38-NR-PLAN-09701-10000, *Refurbishment Program Management Program*.



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### 5.2.1 Scope Statements

The primary objective of the Refurbishment Program is to successfully refurbish the DNGS life-limiting components in order to allow the station to operate for 30 years (or the equivalent of 210,000 EFPs) beyond the current predicted end of service life. The Refurbishment Program must maintain and return the unit in the condition in which it is turned over, at a minimum. The goal of the TG Project is to deliver all core and approved non-core TG scope (through the DRAS process) within the allotted timeline and budget.

**Core scope** is work that must be done to achieve the Primary Objective of refurbishment as defined in NK38-INS-09701-10001, *Darlington Refurbishment Project – Scope Control*. Core scope will determine the critical path for the refurbishment outage and sets the lower boundary for the cost estimate. Core scope includes:

- **Regulatory scope** – scope that is not optional in order to support station license and regulatory requirements, as agreed with the regulator and documented in the Integrated Improvement Projects based on Environmental Assessment, Integrated Safety Review and other activities such as Global Assessment which do not require Economic Assessment.
- **Station Life Limiting Components** – modification, repair, or replacement of station life limiting components that must be replaced in order to allow the extension of station operations beyond its current end of life, including items which have an asset class tied to station life.
- **Component Upgrades** – work to upgrade components, which have a high station priority that can only be done during an extended refurbishment outage.
- **Programmatic work** – Programmatic work typically performed online or in a normal station outage that must be done in the refurbishment period in order to maintain station licence, including mandatory Preventive Maintenance, inspections, etc.
- **Prerequisite Scope** – scope that must be done in order to enable a successful refurbishment, including pre-refurbishment incremental inspections to determine refurbishment scope, and pre-refurbishment modifications such as islanding modifications or fuel machine upgrades to meet refurbishment production requirements during the refurbishment period.

**Non-Core Scope** – Will be performed in the refurbishment period if it has no impact on the projects Core Scope critical path, does not add risk to the successful completion of core scope, and where cost or resource efficiencies and station priority warrant the work to be executed in the refurbishment period. A Business Case Assessment or Decision Record Analysis Summary (DRAS) N-FORM-11390 demonstrating the economic advantage; including risk management and/or reliability improvement, and priority of completing this work during, pre-, during or post-refurbishment will be required to gain approval.

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### 5.2.2 Scope of Supply

The first component of the TG contract is for Engineering Services and Equipment Supply. The OPG has engaged to purchase directly some of the most specialized TG equipment / components and engineering services from an Engineering Services and Equipment Supply (ESES) Vendor, the scope being outlined in the following documents:

- (a) NK38-SOW-41000-10002 Scope of Supply - Turbines and Aux
- (b) NK38-SOW-42000-10002 Scope of Supply - Generators and Aux
- (c) NK38-SOW-41800-10002 Scope of Supply – Moisture Separator Reheater (not issued)
- (d) NK38-SOW-64100-10003 Scope of Supply - Turbine Controls Upgrade
- (e) NK38-SOW-64220-10002 Scope of Supply - Generation Excitation Control Upgrade

### 5.2.3 Scope of Work

The strategy for overall TG refurbishment, including the integration of services and equipments supplied by the ESES (as shown under Scope of Supply) has been developed separately, through a separate contract with the EPC contractor. As such, Scope of Work documents have been generated. They were broken down into each of the 5 subprojects plus Inspections:

- (a) NK38-SOW-41000-10003 Scope of Work - Turbines and Aux
- (b) NK38-SOW-42000-10003 Scope of Work - Generators and Aux
- (c) NK38-SOW-41800-10003 Scope of Work – Moisture Separator Reheater
- (d) NK38-SOW-64100-10004 Scope of Work - Turbine Controls Upgrade
- (e) NK38-SOW-64220-10003 Scope of Work - Generation Excitation Control Upgrade
- (f) NK38-SOW-40000-10001 Scope of Work – Inspections (Optional Scope)

### 5.2.4 Scope of Work (Other)

- (a) NK38-SOW-44000-10001 Scope of Work - Turbine Hall Crane
- (b) NK38-SOW-41000-10001 Scope of Work - Condenser Struts
- (c) NK38-SOW-09701-10041 Scope of Work - Turbine Generator And Auxiliaries Systems Layup

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## 5.2.5 Scope Review and Verification

Through definition phased on the project, scope has been removed from and/or added to the Darlington Scope Request (DSR) database. As described in the NK38-NR-PLAN-09701-10001, *Refurbishment Program Scope Management Plan* when the Definition Phase is complete, the Program scope has been finalized and currently reflects the scope baseline. Following the Definition Phase, it is expected that minimal scope changes will be initiated through the DSR process. For the most part, TG discovery work will be covered by project contingency on identified contingent work and via contingency analysis (Monte Carlo). Any additional discovery work (unknown unknowns) will be covered by management reserve. The majority of discovery work changes will be initiated through Project Change Directives (PCDs) which will streamline the process, facilitate swift OPG responses, and ensure that schedule milestones are achieved.

Scope verification will include quality checks, tracking PCDs, reviewing the Basis of Estimates (BOEs) and monitoring status against the Release Quality Estimate (RQE). As the Execution Phase progresses, the final cost of each deliverable will be compared to the RQE at a high level. For the TG Project, scope verification will involve continually validating scope against the original estimate and ensuring that the Contractor does not complete more work than that which is required to achieve success.

OPG, the ESES and EPC Contractors will transparently collaborate under a Cooperation Agreement, by co-developing risk registers and estimates, in order to complete the TG Project successfully. This is expected to prevent surprises, provide value for money, and ensure that OPG receives all agreed-upon deliverables.

## 5.2.6 Scope Change Control – ESES and EPC

The process for identifying the Project scope and the management of scope changes is described in the *Scope Review Instruction* (NK38-INS-09701-10001). The intent of the instruction is to ensure that proposed scope additions and/or deletions have undergone a thorough assessment based on the return on investment, impacts on plant safety, reliability, project schedule and cost, program resourcing, regulatory requirements and environmental impacts.

Currently, all work requested to be included in the scope of the Darlington Refurbishment Program is initiated via the DSR database. DSR form (D-FORM-10757) must be completed in order to add new scope to the DSR database. The DSR database provides a common format through which DSRs can be submitted and reviewed. Once requested in the database, the scope will be processed and eventually reviewed by the screening committee, the funding committee and the PSRB.

Once the TG execution phase begins, OPG will be required to provide responses to the Contractor requests within predefined time intervals; delayed responses could potentially affect the critical path schedule. In an effort to streamline the process and facilitate timely and accurate OPG responses to changes in the work, all TG discovery work will be initiated through PCDs.

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DSR entries will not necessarily be required for PCDs since discovery work items will likely correspond to an existing DSR database line item. For example, unanticipated work required to relocate materials that block access to a target system (i.e., a system associated with an approved DSR database line item). Costs associated with the PCDs will be assigned to the specific schedule tasks that require the additional work. Furthermore, when additional discovery work is identified and a PCD has been approved, a variance will be declared against the original DSR line item and the applicable schedule milestone. The details of the work changes or additional work discovered will be added to the description of the existing DSR line item and/or the existing milestone deliverable.

For PCDs that demand significant changes in the work and thus significant cost increases, approval must be obtained as per N-MAN-00120-10001-RISK-07, *Nuclear Refurbishment Assumptions and Decisions Management* (see the following table for reference):

IMPACT TYPES	<\$1M	\$1M-\$5M	\$5M-\$20M	\$20M-\$50M	>\$50M
SCOPE STRATEGIC REGULATORY TECHNICAL RESOURCE OTHER	<b>P</b> – Initiator (minimum Band H)  <b>A</b> – Band G in Initiating Organization	<b>P</b> – Initiator (minimum Band H)  <b>Re</b> – Band G in Initiating Organization  <b>A</b> – Band E/F in Initiating Organization	<b>P</b> – Initiator (minimum Band G)  <b>Re</b> – Band E/F in Initiating Organization  <b>Re</b> – Director, P&C  <b>A</b> – SVP	<b>P</b> – Initiator (minimum Band G)  <b>Re</b> – Band E/F in Initiating Organization  <b>Re</b> – Director, P&C  <b>A</b> – SVP	<b>P</b> – Initiator (minimum Band G)  <b>Re</b> – Band E/F in Initiating Organization  <b>Re</b> – Director, P&C  <b>Re</b> – SVP  <b>A</b> – EVP

### 5.2.7 Scope Change Control – ESES Specific

Scope Change has been carried out in accordance with section 5.2.5, the Agreement and ESES's Standard practices. ESES's Scope Change Procedure covers the following:

- To record, control and authorize all changes and variances to the As-Sold Scope of Supply and/or Services.
- To ensure that sell, cost, man-hour, and schedule impacts of the change are evaluated and identified through the Internal and External Control of Change (COC). The impact of the COC will be monitored through the project financial reporting system.

The incorporation of this system promotes the following benefits:

- Ensure the effect of the change on every discipline is evaluated.

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- Provide a formal approval process to ensure changes made to scope of work are reviewed.

ESES will apply the following technical change management process / Interim Inspection Report (IIR) process for parts and equipment:

- (a) Disassembly of component takes place.
- (b) Damage / Defect / Out of Tolerance / Out of Specification / found by on-site personnel.

An Interim Inspection Report (IIR) shall also be issued under the following circumstances:

OPG instructs ESES to install an out of tolerance / out of specification part due to the unavailability of spare parts.

ESES or ESES's Subcontractor follows an incorrect procedure during installation, test or any other site procedures, which are not in compliance with ESES's technical instructions.

A spare part supplied by ESES does not meet with the required standard / dimension / specification but site personnel have to install the part due to time limitations. This would include supplied parts that are within service tolerance or would require replacement within a period less than normal service life of the component.

The Interim Inspection Report (IIR) should also mention any limitation imposed on the performance / reliability of the Turbine Generator due to the installation of parts / components not meeting ESES's design criteria.

- (c) The next available IIR # is to be taken out (Format of IIR # --- Contract # - 1, 2, 3, etc.) and the applicable (turbine or generator) interim inspection report is to be written by the applicable on-site Technical Field Advisors. (The "Report", "Recommendation" and "Schedule Impact" Section are completed.)
- (d) The IIR is officially submitted to OPG either for disposition or information only.
- (e) At the same time the IIR is to be officially submitted to the ESES's Lead Centre Engineering Group for review / comment / disposition as applicable. (The "Engineering Department Recommendation" Section is to be completed.)
- (f) When a response is received from the ESES's Lead Centre Engineering Group, then OPG also must be informed regarding the official Engineering Disposition.
- (g) All IIR's are submitted to OPG for review in order to receive an acknowledgment that OPG has seen and reviewed the "as-found" condition.

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- (h) If the IIR is returned from an “information only” submission, it is to be ensured that either OPG (the “customer”) has signed the IIR or that a record is kept of who reviewed the IIR and when. (The “Customer’s Response” Section is to be completed.)
- (i) If the IIR is returned from an “OPG review” submission, it is to be ensured that OPG has signed off on the IIR and has provided their acceptance, rejection and/or their own recommendation that may require subsequent review by ESES’s Engineering. (The “Customer’s Response” Section is to be completed.)
- (j) ESES’s on-site personnel are to ensure that all other applicable areas of the IIR are completed prior to final submission to the applicable Canadian Project Manager. In addition, if the recommendation that is given to OPG by ESES requires a change to the original contract, then the IIR must be submitted to the applicable Canadian Project Manager immediately for creation of a Change Request Notice (CRN), which will then be submitted to the customer for their review and acceptance of the additional cost.
- (k) Check that recommendations have been implemented and recorded in IIR.
- (l) Reassembly of machine takes place.

### **5.3 Staffing & Resource Management**

#### **5.3.1 Project Organization / Staffing Plan for the ESES and EPC Contractors**

The roles and responsibilities shown below will be utilized for the Equipment Supply and Engineering Services and Engineering, Procurement, Construction portions of the TG refurbishment project and will be managed by the respective parties.

The ESES’s General Project Team which is led by the Project Director will be put in place as required for the various phases of the project (planning, supply, installation). Support personnel from Taxation, Commercial and Legal, Parts and Logistics, Human Resources and Finance will support the project on an as required basis. The project specific functions of Quality Assurance, Project Controls, Commercial, Supply Chain/Logistics and Planning/Scheduling will report directly to the Project Director. Also reporting to the Project Director, is the Project Manager who is responsible for the coordination of ESES’s internal project resources as well as acting as the Deputy Project Director. The Project Director (or delegate) will be the single point of contact (SPOC) with OPG for the Darlington Refurbishment Project.

The EPC’s project teams will be divided into two phases: Definition phase and Execution phase. A Definition Phase Resourcing Plan was fully defined by the EPC after contract award, coinciding with the Project Management Plan submittal.

The EPC has developed an Execution Phase Resourcing Plan during the Definition phase. The Project Management team assembled during the Definition phase will continue to operate through the Execution phase. Project organization charts were

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included in the EPC proposal, and was finalized and accepted by OPG coincident with submission of the EPC Project Management Plan.

## 5.3.2 OPG Roles and Responsibilities

### 5.3.2.1 Project Sponsor

The OPG Project Sponsor:

- “Owns” the project
- Provides the key link between the project team and the OPG senior leadership team
- Supports the project director.

### 5.3.2.2 Project Director

- Acts as Contract Owner
- Project Manager responsible for overall Cost, Schedule, Quality and Scope

### 5.3.2.3 Section Manager – Projects

- Acts as Project Manager responsible for overall Cost, Schedule, Quality and Scope
- Coordinates / facilitates matrixed team – project engineers, CSA, etc

### 5.3.2.4 Contract Manager

- Handles all contract related issues
- Provides contract analysis and support to Project Manager
- Liaises with counterpart within ESES and EPC vendors
- Monitors and preserves OPG’s rights and entitlements under the contracts
- Manages support by Legal (except for Amendments)

### 5.3.2.5 Section Manager – Engineering Lead

The TG Engineering Lead will be matrixed to the Project Director for all engineering related issues including:

- Schedule, Quality and Safety as pertains to Engineering deliverables

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- Align to the project Vendor Owner Interface Requirement for ESES Vendor, and N-STD-MP-0009, *Contract/Owner Engineering Interface and Oversight* for the EPC Contractor
- Act as technical liaison for the Contractor
- Provide technical leadership for matrixed engineering staff assigned to the project team
- Facilitate technical communication between project team and functional support organization
- Facilitate and expedite resolution of project technical issues
- Ensure solutions and approaches are technically correct, effective and consistent with OPG expectations
- To the extent possible, staff the project teams with the required number of appropriately qualified Project Engineers
- For specialized skills will approach the functional group as a shared service
- Maintain Qualified contingency resources via the Owner Support Service (OSS)

### 5.3.2.6 Project Engineers / Senior Advisors

- Review ESES / EPC technical submittals
- Review/respond to Requests for Information
- Act as Subject Matter Experts / liaise with ESES and EPC
- Review non-conformances
- Review as-found component conditions review disposition by ESES
- Provide oversight for ESES / EPC engineering and field activities
- Review commissioning/testing results

### 5.3.2.7 Project & Controls Lead

- Acts as interface between the Project and the functional Project Controls group
- Responsible for project reporting and metrics in the area of cost & schedule
- Analyses cost metrics and variances



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- Updates schedule monthly through the Cost & Scheduling Analyst
- Prepares gate submission packages for funding

### 5.3.3 ESES Roles and Responsibilities

#### 5.3.3.1 Project Director

The Project Director has the total responsibility for the performance of the project in accordance with the contract and to the satisfaction of the Customer, ESES's management and all other stakeholders including but not limited to:

##### Project Execution Strategy:

- Based on the contract, developing and implementing the strategy for the execution of the ESES's work scope in order to achieve the project's performance goals.

##### Performance Management:

- Constantly monitoring and, if requested, reporting the identified performance indicators.
- Immediately taking all necessary actions and decisions to guarantee financial, time, quality and safety performance to maximize the project goals achievements.

##### Project Content Management:

- Addressing change by deciding on actions and leading them in consideration of the defined strategy.
- Immediately informing OPG of any relevant impact on the overall performance of the project.

##### Risk and Opportunities Management:

- Constantly updating and reviewing the risk and opportunities of the project.
- Evaluating and deciding on actions that benefit the overall performance of the project, consulting with the management if appropriate.
- Following-up these actions, implementations and results.

##### Project Process:

- Assuming full responsibility for the delivery of the allocated project scope, from start until all obligations are complete.

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- Taking necessary actions to improve the project process. Also providing feedback to other Business Functions on the performance of the project and processes.
- Leading Monthly, Quarterly Review, Executive, Steering Committee , and QPR Presentation Meetings

### People Management:

- Providing direction to the Project Manager for building, leading and coaching the committed project team to guarantee the highest-level performance for the project.
- Defining project goals and objectives, reviews performance evaluations and provides performance evaluation and development plans to the functional management.

### Safety:

- Development and implementation of site EHS programs to ensure compliance with ESES and OPG standards.
- Have a good knowledge of ESES and OPG Safety Policies and Procedures.
- Participating in safety and environmental incident investigations.
- Participating in personal and peer job safety.
- Have completed all necessary training to carry out the assigned tasks.
- Use Human Performance tools Questioning Attitude, STAR (Stop-Think-Act-Review), job site review, etc.

### Work Control:

- Required to stop work in the event of any conflict with Health, Safety, Work Package, or OPG, or ESES's policy or procedure.
- Be able to manage integration with overall refurbishment schedule.

### Quality:

- Recording and reporting of projects lessons-learned and participating in closeout meetings with OPG Project Director.

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### Commercial:

- Ensure that the contractual commitments, obligations and requirements are commonly understood by all personnel.
- Provide guidance and direction on questions of interpretation of the contractual terms and conditions.

### 5.3.3.2 Project Administration

#### Responsibilities

- Follow up on open/outstanding/overdue actions from the Action Tracker in the ESES Team Site
- Provide back-up for the Submittal Tracker and OPG Submittal Process
- Responsible for all local logistics for the Project Team
- Coordinate the security clearance, immigration and training requirements of the ESES Project Team
- Coordinate the customer training requirements

### 5.3.3.3 Local Project Managers

The Project Manager is more inward focus toward the project's requirements, schedule, and budget.

The Local Project Manager will be specifically responsible for three distinct areas of the project.

- Product Supply Phase – The Project Manager will oversee and coordinate all supply activities from ESES's various Product Lines in conjunction with the Project Manager. Additional Project Managers/Project Management support will be engaged as required.
- Project Execution and Commissioning Phase – The Project Manager will oversee and coordinate all Site Execution and Commissioning Activities in conjunction with the Refurbishment Outage Coordinator Lead.
- Stator Rewind (Units 3&4) – The Rewind Workshop Project Manager will report directly to the Project Manager in all matters relating to the stator rewind activities that will be completed at an offsite workshop.+

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The responsibilities of the Project Managers include but are not limited to:

### Communication:

- Providing adequate reporting to all stakeholders such as OPG, business partners and management.
- Managing the internal and external communication loop.

### Project Organization

- Setting up and securing the necessary resources for the execution of their specific project.
- Organizing the Project Team and ensuring that the team members have clearly identified roles, responsibilities, defined interfaces and are empowered to execute their duties.

### Quality, Environmental and Health & Safety Management

- Ensuring best compliance with specification at lowest final cost.
- Launching the preparation and monitoring of inspection test programs.
- Consolidating and approving the documentation on the allocated scope.
- Ensuring Quality, Environmental and Health & Safety requirements are met.

### Risk and Opportunities Management

- Assisting the Project Director with reviewing the risk and opportunities of the project.
- Providing input to the Project Director on actions that benefit the overall performance of the project and following-up and/or implementing those actions and reporting results to the Project Director.

### People Management

- Building, leading and coaching the committed project team to guarantee the highest-level performance for the project.
- Directing the implementation of project goals and objectives, evaluating performance against them and providing performance evaluation and development plans to the Project Director.

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### Project Planning

- Developing and monitoring the Master Time Schedule, managing project float to ensure timely completion of the project.

### Safety

- Development and implementation of site programs to ensure compliance with OPG Contractor company's policies and standards.
- Have a good knowledge of OPG and ESES's Safety Policies and Procedures.
- Participating in safety and environmental incident investigations.
- Participating in personal and peer job safety
- Have completed all necessary training to carry out the assigned tasks.
- Immediately notify supervisor of all injuries, no matter how minor, and near misses.
- Use Human Performance tools Questioning Attitude, STAR, job site review, etc.

### Work Control

- Required to stop work in the event of any conflict with Health, Safety, Work Package, or OPG, or ESES's policy or procedure.

### Quality:

- Recording and reporting of projects lessons-learned and participating in closeout meetings with Project Director.

### Commercial:

- Assisting the Contract Manager with claim handling.
- Create and maintain Delay and COC register

### Reporting Structure:

- The Project Managers report in all project related items directly to the Project Director for installation items.

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#### 5.3.3.4 Project Planner/Scheduler

The responsibilities of the Project Planner/Scheduler include but are not limited to:

##### Safety:

- Participating in safety and environmental incident investigations.
- Participating in personal and peer job safety
- Have completed all necessary training to carry out the assigned tasks.
- Immediately notify supervisor of all injuries, no matter how minor, and near misses.
- Use Human Performance tools Questioning Attitude, STAR, job site review, etc.

##### Work Control:

- Assisting the Project Director in the development of a clear, accurate and consistent outage installation schedule. The schedule shall reflect the correct scope, costs, resources, constraints, logic and task durations in line with the Contractor's Time Schedule and have effective interfaces with the OPG's Program Milestones (PIMS).
- Preparing regular progress reports to OPG.
- Prepare and issuing daily 'look ahead' reports, forecasts and schedule briefings.
- Liaise with OPG site installation planning dept. to update station schedules as required.
- Updating and maintaining the schedule.
- Attending the Shift Turnover meetings.
- Required to stop work in the event of any conflict with Health, Safety, Work Package, or OPG, or ESES's policy or procedure.
- Lead Update meetings and look ahead discussions.
- Ensuring full compliance of all Installation scheduling activities with ESES's internal requirements.
- Supervising the work control documents (work packages).
- Supervising the interface between ESES's work groups and the OPG's Work Control System.

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- Analyzing and maintaining the consolidated schedule and project plan
- Assisting the Contract Manager with contract change handling.
- Prepare the project schedule in line with the Work Breakdown Structure provided by the customer, to ensure that ESES's schedule may be aligned with the overall Darlington Refurbishment Schedule. Internal ESES requirements for data collection, controlling, etc. capabilities to be maintained.
- Data collection/updates/analysis
- Earned Value – "S" Curves and Engineering Hours
- Monthly Reporting

### Quality:

- Recording and reporting of projects lessons-learned and participating in closeout meetings with Project Director.

### Reporting Structure:

- The Scheduler reports in all project related matters directly to the Project Director.

### 5.3.3.5 Quality Assurance Manager

The responsibilities of the Quality Manager include but are not limited to:

### Safety:

- Participating in safety and environmental incident investigations.
- Participating in personal and peer job safety
- Have completed all necessary training to carry out the assigned tasks.
- Immediately notify Project Director of all injuries, no matter how minor, and near misses.
- Use Human Performance tools Questioning Attitude, STAR, job site review, etc.

### Work Control:

- Attending the Shift Turnover meetings.
- Required to stop work in the event of any conflict with Health, Safety, Work Package, or OPG, or ESES's policy or procedure.

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### Quality:

- Ensure the mechanical integrity, quality of the turbine & generator refurbishment
- Ensure that all work is carried out in accordance with ESES and OPG policies, procedures and expectations.
- Regular audits of work packages and test certificate completion (twice per week).
- Manage installation documentation handover.
- Create and maintain a site register of NCRs (non-conformances).
- Monitor NCR resolution and report on completion.
- Audit and witness FME close out inspections as required.
- Recording and reporting of projects lessons-learned and participating in closeout meetings with Project Director,

### Authority:

- The Quality Manager is authorized to act on behalf of the Project Director and Project Manager in all matters regarding Quality issues, but in no case agree to any modification of or amendment to the contract documents. He is authorized to stop the work, if required, to ensure the quality of the product is maintained.

### Reporting Structure:

- The Quality Manager reports all project related matters directly to the Project Director and Project Manager

### 5.3.3.6 Supply Chain / Logistics Manager

The Supply Chain / Logistics Manager is responsible for movement of equipment and materials on site. The responsibilities of the Supply Chain / Logistics Manager include but are not limited to:

### Safety:

- Participating in safety and environmental incident investigations.
- Participating in personal and peer job safety
- Have completed all necessary training to carry out the assigned tasks.
- Immediately notify supervisor of all injuries, no matter how minor, and near misses.



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- Use Human Performance tools Questioning Attitude, STAR, job site review, etc.

#### Work Control:

- Attending the Shift Turnover meetings.
- Required to stop work in the event of any conflict with Health, Safety, Work Package, or OPG, ESES or EPC's policy or procedure.

#### Quality:

- Recording and reporting of projects lessons-learned and participating in closeout meetings with Project Director

#### Material Control:

- Coordinating material deliveries with OPG.
- Coordinating with OPG Security regarding incoming equipment and material deliveries.
- Managing the safe delivery of equipment and materials to the correct working areas as scheduled and required.
- Inventory of contract material and spares.
- Document and report equipment/material deficiencies and shortages.
- Identification and quarantine of damaged equipment

#### Authority:

- The Supply Chain / Logistics Manager is authorized to act on behalf of the Project Director regarding logistic/material issues, but in no case agree to any modification of or amendment to the contract documents.

#### Reporting Structure:

- The Supply Chain / Logistics Manager reports in all project related matters directly to the Project Director

### **5.3.3.7 Contracts Manager**

The responsibilities of the Contract Manager include but are not limited to:

- Handling of all contract related issues raised by the site installation or project teams or external parties until all relevant commercial obligations are complete and all relevant commercial issues are resolved/settled.

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- Ensuring that contractual commitments, obligations and requirements are commonly understood and respected by the site installation team and providing assistance in ensuring commitments, obligations and requirements are properly addressed.
- Providing requested contractual analysis and support to the Project Team.
- Establishing, implementing and managing project specific commercial procedures, particularly those impacting subcontracting, clarifications, variation requests/orders, insurance, notifications, correspondence and claims management strategy.
- Liaising with site installation planning to ensure appropriate schedules and supporting documentation are produced, monitored, and maintained to support Project Claim strategy.
- Supporting the development of the project risk and opportunity identification and analysis via implementation of appropriate commercial action plans.
- Preserving and monitoring ESES's rights and entitlements as provided in the contract, including proper notices to all relevant parties.
- Controlling back charges from site and ensuring appropriate recovery from relevant 3<sup>rd</sup> parties.
- Managing Project Insurances, including submission, monitoring and settlement of insurance claims in accordance with the Policies.
- Providing guidance and direction on questions of interpretation of the contractual terms and conditions, as well as general contractual issues relative to any aspect of the installation.
- Handling and managing of support by Legal Department and external experts wherever needed.
- Providing support to Legal Department as required in the event of a Dispute.
- Undertaking such necessary commercial tasks, as instructed/requested by Project Director, to facilitate Project Director's effectiveness in Project Management.
- Working with JV
- Creating and maintaining contract change register.

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### Authority:

- The Contract Manager is authorized to take positions, gather factual statements, advance position statements and act upon notices, directions, and instructions on behalf of the Project Director, but in no event to agree to any modification of or amendment to the contract documents.

### Reporting:

- The Contract Manager reports in all project related items directly to the Project Director.

## 5.3.3.8 Resident Technical Advisor (RTA)

### Responsibilities

The Resident Technical Advisor is responsible for the oversight of the planning, coordinating and execution of the site work for the Darlington Refurbishment project. The role's responsibilities include supporting all aspects of installation planning, budget and resources estimating, and the coordination of interfaces between Alstom's project organization, including internal and external installation subcontractors, and OPG's site organizations. Responsibilities include, but are not limited to:

- Integrated outage planning with contractors and OPG; schedule, procedures, budgetary estimates, risk management, EHS, etc. covering all resources; manpower, tools and equipment. The development of an overall integrated outage plan including risk review, mitigation plan and follow-up.
- The technical and organizational interface to ESES's Refurbishment Engineering and Project Management, OPG's site organization and ESES's contractors.
- Maintaining and developing generic and project specific procurement specifications.
- Directing the execution of the retrofit outage scope.
- Full responsibility for managing the installation schedule, EHS, and the reporting to and interfacing with OPG on site.
- Project specific reporting to the Project Director.
- Ensuring that Alstom and its contractor conform to all applicable local, plant, province and country legislation and ESES procedures in respect of EHS issues for own protection and for protection of reporting staff.
- Recording and reporting of projects lessons-learned and participating in closeout meetings with Project Director, OPG's representatives and contractors.

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- Integrated outage planning for all resources (man-power, tools and equipment) with contractors and customers including schedule, procedures, budgets, risk management, EHS, etc.
- Supporting and leading incident investigations.
- Training and instruction of ESES's Refurbishment Organization and OPG Operations and Maintenance staff.
- Supporting Experience feedback initiatives with input, evaluation and leading of improvement actions.
- Defining site management organization and structure for Installation.
- Managing installation related documentation exchanges and requirements.
- Providing input for the claims register to Contract Manager and Scheduler.
- Notifying the OPG Project Director if the job will be delayed.
- Resident Technical Advisors will be involved in outages (pre-refurbishment) wherever feasible, for training purposes and to provide outage support.

### Safety

- Obtain ESES Internal EHS Management System Qualification
- Development and implementation of site EHS programs to ensure compliance with Alstom and OPG standards.
- Have a good knowledge of ESES and OPG Safety Policies and Procedures.
- Participating in safety and environmental incident investigations.
- Participating in personal and peer job safety
- Have completed all necessary training to carry out the assigned tasks.
- Use Human Performance tools Questioning Attitude, STAR (Stop-Think-Act-Review), job site review, etc.

### Authority

- The Resident Technical Advisor is authorized to act on behalf of ESES and the Project Managers on all aspects of installation, planning, coordination and execution but in no case to agree to any modification of, or amendment to, the contract documents. He/ She is authorized to direct, instruct ESES's site management and installation organizations.

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### Reporting

- The Resident Technical Advisor reports all project related matters directly to the Project Manager & Project Director.

### 5.3.3.9 Technical Field Advisor (TFA)

#### Responsibilities

The Technical Field Advisor provides technical advice and guidance for the disassembly and modification of the existing plant and the installation of the new refurbishment components. Responsibilities include but are not limited to:

- Ensuring the mechanical integrity, quality of the turbine & generator refurbishment and operation.
- Providing technical assistance and advice on the disassembly and reassembly of all turbine components.
- Directly monitoring the disassembly and assembly of the turbine and associated equipment, providing guidance to the craft labor as required to ensure the mechanical integrity and quality of the turbine.
- Ensuring that the pre-determined work scope is completed following procedures, instructions and inspection and test plans.
- Ensuring that check sheets and work packages are completed and signed off correctly and in a timely manner consistent with the requirements of the contract.
- Maintaining an individual work record and notebook.
- Supervising the use of precision measuring hand tools, hydraulic bolt stretchers, and other industrial tooling and equipment.
- Prepare detailed reports based upon findings and actions taken as and when required.
- Supervised the work to be performed to the applicable quality standard to ensure safe and reliable operation of equipment.
- Notifying the Refurbishment Outage Coordinator if job will be delayed.

#### Authority

- The Technical Field Advisor is authorized to act on behalf of ESES in aspects of execution of the contract work.

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### Reporting

- The Technical Field Advisor reports in all project related matters directly to the Refurbishment Outage Coordinator.

**Note:** These responsibilities will be expanded upon once the team is specifically defined.

#### 5.3.3.10 Assessment Engineer

The responsibilities of the Assessment Engineer will be determined upon once the team is specifically defined.

#### 5.3.3.11 Project Manager - ESES's Design and Manufacturing Headquarters

The Project Manager will coordinate the design, manufacture and supply activities for the various project packages (Turbine & Auxiliaries, Generator & Auxiliaries, Turbine Controls, and Excitation Controls). The project specific functions of Finance, Commercial, Scheduling, Quality Assurance, Project Engineering and Supply Chain will report directly to the Project Manager. Additionally, the individual Project Managers/Director for the specific project packages will coordinate their tasks and responsibilities with the Project Manager.

The Project Manager has the responsibility to coordinate all matters related to the performance of the TS Product Line scope of supply of the project. The Project Manager clearly communicates the essential tasks and requirements of the TS Product Line scope of supply of the project to the Design project team.

The responsibilities of the Project Manager include but are not limited to:

- Constantly monitoring and, if requested, reporting identified performance indicators as provided by Project Director. Immediately taking all necessary actions and decisions to guarantee financial, time, quality and safety performance for the TS Product Line scope of supply
- Providing adequate reporting to all stakeholders and managing the communication loop between Project Director and TS Product Line project team.
- Assists the Project Director with reviewing the risk and opportunities of the project. Providing input to the Project Director on actions that benefit the overall performance of the TS Product Line scope of supply and following-up and/or implementing those actions and reporting results to the Project Director.
- Ensuring best compliance with specification at lowest final cost. Ensuring Quality, Environmental and Health & Safety requirements are met.
- Building, coordinating and coaching the project team.

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- Developing and monitoring the Time schedule for TS Product Line scope of supply, managing the respective project float to ensure timely completion of the project

### Authority:

- The Project Manager is duly authorized to act on behalf of the Project Director in all matters related to the specific Project Manager scope of supply (Turbine and Generator) and coordinates with PAC, but in no event to agree to any modification of or amendment to the contract documents

### Reporting Structure

- The Project Manager reports to the Project Director

### **5.3.3.12 Quality Assurance Manager - ESES's Design and Manufacturing Headquarters**

The Quality Assurance Manager has the responsibility to coordinate all matters related to OPGs and ESES's quality standards for the contract for the TS Product Line scope of supply of the project with the design project team

The responsibilities of the Quality Assurance Manager include but are not limited to:

- Knowledge of ESES and OPG Quality policies and procedures
- Ensuring manufacturing processes in accordance with ESES and OPG policies and procedures
- Ensuring using of qualified sub suppliers
- Managing and communicating QA related changes and variances to the Project Manager
- Developing and managing creation and execution of test plans
- Identifying, managing and communicating risks defined by QA to the Project Manager
- Guaranteeing QA relate project documentation

### Authority:

- The Quality Assurance Manager is duly authorized to act on behalf of the Project Manager to stop work or initiate corrective actions if any conflict with Quality based OPG, or ESES's policy or procedure related to the specific TS Product Line scope of supply

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Reporting Structure:

- The Quality Assurance Manager reports to the Project Manager

**5.3.3.13 Project Engineers - ESES's Design and Manufacturing Headquarters**

The Project Engineer has the responsibility to coordinate all matters related to OPGs Engineering Change Control process for the contract for the TS Product Line scope of supply of the project with the Design project team. The responsibilities of the Project Engineer ECC include but are not limited to:

- Knowledge of OPG Engineering Change Control process and procedures
- Ensuring compliance with the OPG Engineering Change Control process and procedures
- Providing engineering support to Project Management

Authority:

- The Project Engineer is authorized to act on behalf of the Project Manager ESES's Design and Manufacturing Headquarters concerning all aspects of the OPG Engineering Change Control process related to the specific scope of supply

Reporting Structure

- The Project Engineer ECC reports to the Project Manager

**5.3.3.14 Project Planner - ESES's Design and Manufacturing Headquarters**

The Project Planner has the responsibility to coordinate all matters related to the time schedule of contract for the TS Product Line scope of supply of the project with the Design project team. The responsibilities of the Project Planner include but are not limited to:

- Producing comprehensive schedules covering TS Product Line scope of supply
- Monitoring actual progress of the individual work packages, comparing to baseline and reporting progress against schedule
- Forecasting the impacts on schedule of proposed changes
- Providing recommendations to improve schedule

Authority:

The Project Planner is authorized to act on behalf of the Project Manager concerning all aspects of scheduling for the specific M TS Product Line scope of supply



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### Reporting Structure:

- The Project Planner reports to the Project Manager

### **5.3.3.15 Document Controller - ESES's Design and Manufacturing Headquarters**

The Document Controller has the responsibility to coordinate all matters related to the technical and quality documents to be provided to OPG for the TS Product Line scope of supply of the project with the Design project team. The responsibilities of the Document Controller include but are not limited to:

- Managing and maintaining document flow between TS Product Line and the General Darlington Project Team for the TS Product Line scope of supply
- Maintaining updated records of all documents required for the respective review points
- Managing the list of deliverables for the TS Product Line scope of supply

### Authority:

- The Document Controller is authorized to act on behalf of the Project Manager concerning all aspects of technical and quality documents for the specific TS Product Line scope of supply

### Reporting Structure:

- The Document Controller reports to the Project Manager

### **5.3.3.16 Supply Manager - ESES's Design and Manufacturing Headquarters**

The Supply Manager has the responsibility to coordinate all matters related to sourcing and procurement to be provided to OPG for the TS Product Line scope of supply of the project with the Design project team. The responsibilities of the Supply Manager include but are not limited to:

- Ensuring all required ESES and OPG standards, guidelines and specifications are considered related to procurement
- Maintaining the list of OPG qualified supplier
- Coordinating the qualification of new supplier, if required
- Requesting extension of OPG qualified supplier list

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#### Authority:

- The Supply Manager is authorized to act on behalf of the Project Manager concerning all aspects sourcing and procurement related to the specific TS Product Line scope of supply

#### Reporting Structure:

- The Supply Manager reports to the Project Manager.

### **5.3.4 EPC Roles and Responsibilities**

For a full list of EPC Roles and Responsibilities, refer to the EPC Execution Phase Project Management Plan. However, few of the key roles are:

Construction Manager

Scope Lead

Project Director

#### **5.3.4.1 Joint Venture Executive Committee**

- Comprised of Aecon and SNC-Lavalin executive management representatives
- Responsible for ensuring the project is properly staffed with qualified and experienced personnel and overall project and contract oversight
- Supervises the Project Director

#### **5.3.4.2 Project Director**

- Responsible for overall contract execution, project management, engineering, field execution, commissioning, labor relations and client relations
- Responsible for ensuring project is executed in compliance with contract provisions; all applicable corporate standards, policies and procedures; applicable regulations, codes and standards; applicable client policies and programs

#### **5.3.4.3 Construction Manager**

The construction Manager reports to the Project Director, and is responsible for the following:

- For the overall execution of assigned scopes of work;
- To interface with the engineering manager and customer;

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- For work planning and control for construction and installation activities;
- To ensure that personnel assigned to perform activities are trained, qualified and competent to perform their assigned tasks effectively;
- For the performance of all constructions and construction planning activities;
- For maintaining construction schedule;
- For trade supervision;
- For supervision of any on-site subcontractors;
- To ensure that construction equipment, tooling, materials and resources are consistent with the requirements of, and the capabilities offered in the contract;
- To ensure that work is performed efficiently and in accordance with project plans and customer specifications;
- For review of safety plan;
- For involvement in union discussions;
- For site infrastructure management

### 5.3.4.4 Engineering Project Manager

- Responsible for overall engineering work program deliverables and effective integration with all phases of the project
- Responsible for ensuring that engineering is performed in compliance with contract provisions; all applicable corporate standards, policies and procedures; applicable regulations, codes and standards; applicable client policies and programs

### 5.3.4.5 Deputy Project Director / Definition Phase Construction Manager

- Responsible for overall technical definition of the Execution Phase work program per contractual requirements
- Supervises Project Scope leads, and Project Director's direct reports as required

### 5.3.4.6 Project Controls Manager

- Responsible for overall project support functions for scheduling, accounting, procurement and administration
- Responsible for preparation of project schedules, cost reports, and invoices

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- Supervises Project Schedulers, Project Accountants, Project Controls Coordinators

### 5.3.4.7 Project Estimating Manager

- Responsible for overall development and issuance of Definition Phase cost estimates, risk register and contract changes
- Supervises Contract and Risks Manager, Project Estimators, Project Estimating Coordinators.
- Responsible for definition and development of execution estimate of Unit 2 and all the subsequent units. The class estimate will integrate all working groups such as OPG, IMS, JV and Alstom.

### 5.3.4.8 Project Scope Leads

- Responsible for production of Definition phase technical deliverables, and overall project management of assigned technical work scope, including safety, quality, budget and schedule
- Supervises Superintendents, Technical Advisors, and Project Coordinators.

### 5.3.4.9 Project Quality Manager

- Responsible for generating the overall Project Quality Plan ensuring compliance of project operations/deliverables with relevant codes and standards
- Responsible for ensuring training records related to Project Quality Plan are maintained
- Responsible for ensuring Project Quality Procedures training is delivered to project personnel
- Responsible for regularly reporting performance metrics for project quality

### 5.3.5 Project Coordinator / Assessors

- Prepares Field Work Packages
- Prepares Asset Suite work orders and task assessments
- Interfaces with Refurbishment Work Control to schedule Asset Suite work orders
- Monitors technical issues in the field and assists Field Engineers with preparation of Change Notices

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- Prepares As-Found Reports and As-Left Reports with input from Construction Coordinator

### 5.3.6 ESES Resource Planning for Non-Trades

ESES's professional (non-union) personnel will support the project with both on and off site activity to support the scope of work. ESES resourcing for the core technical team will accommodate timing of vacations, training and holiday requirements within their resource planning. ESES will also consider suitable number and timing of returns of out-of-town specialists to their dispatch location so to minimize impact on the project.

### 5.3.7 ESES Succession Planning

A succession plan, simply put, is a component of good HR planning and management. Succession planning acknowledges that staff will not be with an organization indefinitely and it provides a plan and process for addressing the changes that will occur when they leave. Most succession planning focuses on the most senior manager/director, however, all key positions will be included in the plan. Key positions can be defined as those positions that are crucial for the operations of the organization and, because of skill, seniority and/or experience, will be hard to replace.

The succession plan involves nurturing and developing employees from within the ESES organization. Employees who are perceived to have the skills, knowledge, qualities, experience and the desire can be groomed to move up to fill specific, key positions. The ESES Organization will:

- Assess its current and future needs based on its strategic plan, goals and objectives, or priority programs and projects. This will include the Darlington Refurbishment Project Team.
- Match these to the capabilities of the existing workforce
- Develop a plan to manage the gaps that will arise when individuals in key positions leave or are promoted, as will likely be the case with certain members of the Darlington Refurbishment Team due to the length of time of the entire project span.

### 5.3.8 ESES Knowledge Transfer to and from the Project Team

All ESES Project Managers (PM) have the responsibility of recording, tracking and completing Lesson Learned records in the Service Account Management (SAM) database. A "Lesson Learned" is any issue or activity that occurs during any project phase that would result in either a negative or positive impact on the Current Control Budget (CCB) of the project, or any other non-financial impact.

Normally a Lesson Learned is inputted into the SAM database upon completion of the entire project. For the Darlington Refurbishment Project, the lessons learned will be inputted into SAM database and presented to OPG before the start of the next unit outage.

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Contract managers log Lessons Learned in the Service Account Management database. Lessons Learned are reviewed by a Contract Manager. The purpose of reviewing the collection of Lessons Learned in the SAM is to provide the PMs with past histories from other projects and also to share the difficulties that other PMs have encountered on their projects.

It is the role of the Project Manager to facilitate and promote the Lessons Learned process during the agenda of all project meetings; therefore, the Project Manager is responsible for compiling and logging all Lessons Learned into the SAM and for distributing the outcome to other Project Managers at the end of their project.

## 5.4 Documentation and Closure Management

Records, documents and data collectively form the memory of the TG Project. Together they constitute the business and intellectual assets of critical importance, and therefore must be managed to meet both regulatory and business requirements.

The purpose of the Documentation and Closure Management Plan is to manage the process of organizing, storing, protecting, and sharing documents. This section describes how documents will be managed throughout their life cycle during the planning, execution and project closure.

### 5.4.1 Project Document Description

The management of documentation is described in relation to three principal activities: Document Creation, Document Control, and Records Management.

The TG Project Plan for Records and Documents Management (RDM) adheres to OPG-PROG-0001, *Records and Document Control* and OPG-PROC-0019, *Record and Document Management*.

### 5.4.2 Roles and Responsibilities

Records and document management is a shared responsibility amongst all Nuclear Refurbishment employees in referencing and filing information according to governance and non-governance process documents.

- **Project Managers (PMs)** – are responsible to prepare and issue a formal Communication Protocol document to the successful supplier immediately after contract award. The Communication Protocol document will provide direction on how all project correspondence and documentation deliverables are managed. All suppliers will comply with the standards and requirements of this plan. PMs will adhere to and share with suppliers N-MAN-00120-10001-RDM-03, *Nuclear Projects Supplier Document Submission*.
- **NR Records and Document Management (NR RDM)** – will manage the Darlington Refurbishment records and data provided by OPG and suppliers, perform quality checks, route to the appropriate stakeholders and track the status and performance through the review/acceptance cycle. RDM also retain

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and publish all “Change Papers” and related Engineering Change Control documentation, are responsible for registering and managing controlled documents, management of the VenDM database, and population of the Records and Controlled Documents modules in Asset Suite 7. RDM will adhere to N-MAN-00120-10001-RDM, *Nuclear Projects Records and Document Management*.

- **Refurbishment Employees** – have the responsibilities to identify, protect, and present their records as intellectual assets, this is done by completion of training, use of training aides, and through adherence to communications issued to guide staff on information management rules or practices.

#### 5.4.3 Document Creation

Document creation is the first stage in the records management cycle. The TG Project follows the existing OPG program requirements for creation and approval to ensure compliance with standards.

During the development and review of project documentation, industry best practice is to employ information technology that provides access controls and minimizes document editing requirements during collaboration and review of in-process documents. This helps avoid re-work and confusion. To address this need, document creation and update is to be performed within the document libraries established within the appropriate SharePoint team site.

#### 5.4.4 Document Control

Document Control is a managed process of information and documentation exchange between OPG and its suppliers. All document submissions from suppliers to the Darlington Refurbishment program are conducted through a central electronic portal (a secure website) known as Vendor Document Management System (VenDM).

The processes for document reviews and acceptance have been defined and recorded in a series of process support documents. Within the document control process, the Project Manager ensures all documentation deliverables from suppliers are defined with established due dates. RDM track and record processing dates so that OPG can monitor compliance to contractual commitments and provide the necessary reporting. NR Contract Managers support the process by participating in Supplier/OPG process discussions to ensure actions/agreements align with the contract. Document Control staff manage the process for receipt/review/issuing of supplier submittals.

#### 5.4.5 Records Management

A record provides evidence of the performance of business activities and/or the achievement of results, to demonstrate conformance to standards or compliance with laws, or to retain knowledge and information of business importance when needed. A record is that version of a document designated to be maintained in an Approved Information Management System (for electronic records) or a Records Centre (for hard copy record).

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All records are stored as required by OPG-PROG-0001, *Records and Document Control*. Official QA records are indexed and stored in OPG Nuclear approved information management system (Asset Suite 7). Additionally, NR employs SharePoint libraries for the storage of in-process project documentation and non QA records.

All Refurbishment project records are managed in accordance with OPG-PROC-0019, *Record and Document Management*, and adhere to OPG-STD-0030, *Classification, Protection and Release of Information*, and OPG-MAN-8133-0002, *Records Management Authority Register*. Each record is managed according to a predetermined plan which is documented in the Records Table resident in the process document which governs the activity resulting in the creation of the record. The Records Table will identify the database in which the item will be indexed, the retention requirements for the document, and may detail the relationships or links to other objects or data that must be maintained.

Any electronic information to be issued as a record is to be sent to file via a workflow task request or by submitting to the appropriate RDM e-mail account, where it will be reviewed, categorized and indexed in the appropriate information management system. This will allow for easy search and retrieval based on unique identifiers, specific supplier and/or project codes, and types of correspondence.

Project records delivered as a hard copy will be scanned, indexed and retained as necessary based on their classification.

All supplier deliverables not identified as an ECC deliverable or controlled document will be addressed as a project record and be managed as described in the appropriate Records Table.

Confidential or commercially sensitive information should be addressed in detail in the Communication Protocol.

### 5.4.6 Miscellaneous Project Data Management

There are several areas where miscellaneous data will be accumulated by the supplier or OPG staff during the life of the project which normally would not have significant relevance when the work is performed internally. This data needs to be collected and delivered to RDM, then organized for potential future retrieval. These may include, for example, Vault Entry Logs or MSDS/WHMIS data for materials brought on site by suppliers.

### 5.4.7 Document Nomenclature System

Document numbering schemas have been developed for project documentation in cases where the existing OPG numbering convention is not suitable or the need to establish unique numbering systems existed, in order to enhance management or retrieval.



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## 5.5 Schedule Management

### 5.5.1 Overall Planning and Scheduling Process

The overall planning and scheduling process can be represented in two major stages:

- (a) Project Planning and Schedule Development, resulting in the formation of a Baseline Schedule
- (b) Schedule Management, Monitoring, Analysis, Reporting, and Mitigation, resulting in regular periodic schedule updates

The three levels of schedule hierarchy are outlined below; overviews of how the schedules interact with each other refer to NK38-NR-PLAN-09701-10001 SHEET: 0002 *Program Schedule Management Plan*.

The scheduling development and process shall follow, as applicable to the specific contractor, N-MAN-00120-10001-SCH-09 *Scheduling Requirements from EPC Contractors*, N-MAN-00120-10001-SCH-02 *Standard Project Milestones*, and N-MAN-00120-10001-SCH-06 *Milestone Framework*.

The Joint Venture progressive planning and schedule development will follow the process listed above. JV is responsible to integrate all the working groups such as OPG, IMS, Alstom and JV into the schedule.

#### Level 1 - Management Summary Level

The level 1 schedule provides a high-level management summary of the project. It will represent all Units, Phases, Bundles, Program and key project milestones.

The level 1 schedule is a roll up from the Level 2 Co-ordination and Control Schedule.

The schedule is prepared by OPG as part of the initial planning phase of the project and updated to reflect the progression of planning, i.e. as projects are better defined, the Level 2 Control and Co-ordination Schedule is updated.

#### Level 2 – Co-ordination and Control Schedule (C&C Schedule)

The level 2 schedule covers the full scope of work by Phase, Unit, and Type of work and contains full Critical Path Method (CPM) logic. It is referred to as the C&C schedule, or, Control and Co-ordination schedule, as this is the schedule which will be used, at the Phase and Unit level, to track the overall schedule status of the Program.

It will be updated and controlled by OPG and based on the Contractors detailed Level 3 Schedules.

#### Level 3 – Detailed Schedules

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The level 3 detailed schedules will be prepared by the groups executing the work: the ESES and EPC Contractors.

The schedule must be prepared in accordance with the Program's Work Breakdown Structure ("WBS") and coding guideline. This schedule contains the lowest level of detail required to manage and execute the work. It is structured in a way to allow summarizing of the activities in order to update the Level 2 C&C Schedule.

The Level 3 will include the full scope of each vendor / contractor showing all interfaces with other contractors / OPG.

The Schedule will be resource loaded to the lowest level of the defined Work Breakdown Structure as applicable to the contract type.

The Schedule will define all long lead procurements.

After being captured as a baseline, the schedule will be regularly updated, providing the basis for status reporting, progress physical percent complete at the activity / Work Package Level, forecasting, and change management.

All vendor / contractor baseline schedules need to be approved by OPG to ensure program milestones, WBS and scheduling guidelines and coding are followed.

Schedule variances and mitigation plans will be analyzed from the Level 3 schedule.

Daily, Weekly and Monthly look-ahead reports will be generated from Level 3 schedule.

### 5.5.2 Schedule Integration

All Contractors' Level 3 Schedules or OPG Functional detailed schedule will be fully aligned, utilizing a common Work Breakdown Structure and coding guideline as per N-MAN-00120-10001-SCH-01 *Work Breakdown Structure Direction* and N-MAN-00120-10001-SCH05 *Nuclear Refurbishment Project WBS and Control Account And Work Packages*, and integrated in the overall C&C Schedule.

The C&C Schedule will be the program's basis for measuring schedule progress. Additionally, the C&C schedule, as described in NK38-NR-PLAN-09701-10001 sheet 2 *Program Cost Management Plan*, will be integrated with the Cost Management software ("Proliance") for the purposes of reporting Earned Value and determining cash flows / forecasting.

### 5.5.3 Work Breakdown Structure (WBS)

The WBS is subdivided to work packages (WP) as related to Scope and aligned with contracting strategy. Every WP is represented with one activity in the C&C Schedule that integrates into Proliance for Earned Value calculations. The WP can be represented in Level 1, C&C and in the Detailed Level 3 schedule, as needed.

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The WBS is controlled by the Program Management Office (PMO) Scheduling Group and is available from within Primavera Planner (P6).

For a detailed look at the standard Refurbishment program Work Breakdown Structure refer to N-MAN-00120-10001-SCH-05 *Nuclear Refurbishment Project WBS and Control Account And Work Packages*.

### 5.5.4 Work Breakdown Structure Dictionary

The TG Work Breakdown Structure Dictionary (WBSD) is a companion document to the WBS and provides a description of each of the work elements to be accomplished during the Project. The WBS and thus the WBSD will evolve and must be revisited and potentially revised as the Project develops.

The WBSD contains information related to certain high level WBS. Depending on the nature of a given WBS element, the WBSD may capture some of the following information:

- Coding for each WBS element.
- Responsible and accountable individuals or organizations.
- A description.
- A list of quality requirements.
- A list of resource requirements.
- The contracting model.

The WBSD will be updated to different levels of detail as the scope develops. Once the scope baseline for the TG Project is accepted, changes to the WBS and the WBSD are expected to be minimal.

### 5.5.5 Milestone Management

Milestones within the Program will be managed at various levels per the following:

All phases will be controlled by Program Milestones. Adherence to milestone timelines and definitions is essential to ensure a successful Refurbishment. Refer to N-MAN-00120-10001 *Nuclear Refurbishment – Milestone Definition Framework* for the following:

- Milestone Tier Structure
- Milestone Numbering Nomenclature
- Common Milestone Definition Template

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- Milestone Completion Progress Monitoring
- Quality Requirements for Milestone Deliverables
- Milestone Closeout and Document Retention Requirements

### 5.5.6 Schedule Change Management

Changes to the baseline scope will be managed through a formal Change Control process as per N-MAN-00120-10001-PC, *Project Control* and implemented at all levels of schedule.

### 5.5.7 Schedule Monitoring and Control

The contractor's / OPG Level 3 Schedule will be updated regularly using OPG guidelines (see N-MAN-00120-10001-SCH09 *Nuclear Project Scheduling Requirements from EPC Contractors*). During the planning phase, schedules will be updated at least once per month; during execution, that will increase to as frequently as needed to manage the schedule, i.e. critical path activities may be updated daily, near critical path activities weekly, and others monthly.

Variance / critical path analysis, and percent complete at the work package level will be prepared for every schedule on a monthly basis. The Project & Controls Lead and Cost & Scheduling Analyst will review the contractor's schedule and prepare highlights of issues / corrective actions required and take appropriate steps working through the project team and the contractor to resolve.

The Level 3 will be summarized in order to update the Coordination and Control schedule.

Overall program variance / critical path analysis will be prepared by OPG's Program Management Office (Project Planning and Controls).

Forecast dates at the work package level and percent complete will be integrated with the Earned Value Software ("Proliance").

### 5.5.8 Schedule Management and Controls Governance

Additional information, based on the *Project Management Standard* (N-STD-AS-0028), on the schedule management processes utilized by the Refurbishment Program can be found within N-MAN-00120-10001-SCH, *Nuclear Refurbishment Schedule Management*.

### 5.5.9 Schedule Approach for Equipment Supply and Engineering Services Vendor

The Schedule and associated resources are developed by the ESES through close collaboration among project team members and stakeholders with input from functional managers and research from past projects. Where appropriate, the ESES's

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global schedules were used, applying adjustment for Canadian workforce. The schedule has been developed using Primavera P6 format.

The schedule will be maintained as a Primavera P6 by the Darlington Cost & Scheduling Analyst. Any proposed changes to the schedule will follow ESES Vendor's change control process and the Changes to Contract Schedule section contained in the Agreement. The Vendor will be applying the appropriate tools and reporting structure to monitor the ongoing health of the project.

### Schedule Approach:

- (a) Reflective of the nature of the ESES Agreement (fixed price, delivery-based milestone payments), the ESES schedule will not be resource loaded.
- (b) The Vendor Owner Interface Requirements (VOIR) document details the specific Engineering change requirements for each component/work package and the number of face to face meetings that will be required between OPG and ESES Vendor. The VOIR forms a part of the ESES Agreement and the most up to date copy is kept in the project files.
- (c) The ESES Vendor developed a Submittal Tracker document covering all component/work packages based upon the requirements of the VOIR. This Submittal Tracker identifies the kind and number of documents that are required as a result of the requirements of the VOIR and which documents are required to be submitted to OPG.
- (d) The Submittal Tracker was used to identify the resourcing and effort required in order to complete the applicable tasks relevant to the Engineering change control process.
- (e) Finally, the ESES Vendor's baseline schedule has been developed on the basis of the VOIR, the Submittal Tracker and the resourcing and efforts required to Engineer and Supply the major components in ESES's scope of supply.

**Note:** The VOIR hold points will be treated as milestones, whereas the Submittal Tracker deliverables will be shown as individual activities in the schedule that are logically required to satisfy their respective milestone.

Alstom is not an EPC vendor but is an engineered equipment supplier as per ESES Agreement signed in March 2013. It is considered appropriate and best value for money to have the EPC vendor manage reporting on Alstom's activities and inputs, in the context of the overall EPC execution schedule, and based on Alstom's status reporting. Alstom is responsible, as an engineered parts supplier, to deliver and maintain a separate shop schedule for the offsite work (LP blade carriers).

The ESES activities will be captured, managed and progressed as follows for different types of work activities:

1. Activities in Alstom Workshop

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Alstom is to deliver, maintain, and status a separate shop schedule for the offsite work (LP blade carrier shipping and machining/modification in Chattanooga, TN). The JV's schedule incorporates windows, established with information from Alstom, for this shipping and offsite work. The activities in the JV Execution schedule are a summary of the Alstom shipping and shop schedule. They will be reported/progressed in the JV schedule based on periodic (daily, weekly etc) updates based on Alstom's shipping/shop schedule.

### 2. Alstom Field Labour for Specialized Inspections and Technical Field Advisor Support

Alstom is providing TFA support of JV execution activities, and also certain specialised inspections (eg. DIRIS inspection on generator rotor). These activities are captured in the JV's execution schedule, based on both Work Order tasks for TFA support, and Alstom OPEX/ information regarding specialized inspection duration. They will be reported/progressed in the JV schedule based on periodic (daily, weekly etc) Alstom updates.

Alstom has a contractual milestone in July/2015 to finalize TFA Reimbursable Work Targets. Alstom TFA labour hours can be resource loaded in the JV schedule or, and/or Alstom can provide histograms.

The Project will be confirming this strategy with the JV, but there is very low risk to ability to implement.

### 3. Cost Collection (Project Management, Core Resident Field Advisors etc)

Given that the core work (#1 and #2) is covered in the JV schedule, it is not cost effectively or value for money for Alstom to produce a schedule for the purpose of level of effort activities (PM, Core RTA's, etc). Nor is it appropriate for OPG to create/report on a schedule on behalf of a vendor. It is proposed that PM, Core RTA, etc costs are captured via Oncore to Proliance on the basis of a Proliance PIF (cash flow) and related to Work Packages. There will be a direct relation to the Alstom payment schedule for these activities.

## 5.6 Procurement Management

Darlington Refurbishment Turbine Generator Project approved SOW's documents provide detailed information regarding TG and Auxiliaries refurbishment and components / equipment replacements. Some of the components need to be replaced with like-for-like components; some components are obsolete and will be replaced with new technology. Some component replacement is identified as contingency based on future inspections and test results. However, none of which has been identified as long lead item. (16 months lead time as defined in ESES Agreement)

*Darlington Refurbishment Turbine Generator Project Negotiation Plan* NK38-PLAN-09701-10096 provides guidelines related to the procurement of the TG components / parts.

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Due to difference in units' condition and existing TG sets' degradation mechanisms there are some differences between the units components / parts lists. One of the significant differences is the Generator Stators' conditions in Darlington units 3 and 4 when compared with Units 1 and 2, which will require rewinding / replacement. The project team identified these components up front to allow proper procurement and manufacturing (if required) planning to meet project objectives.

Based on existing NK38-09701-10030, *Darlington Refurbishment Turbine Generator Project's Contracting Strategy Summary for Turbine Generators* and the subsequent - *Turbine Generator Refurbishment Project Alternate Contracting Plan* NK38-09701-10112, a contract was negotiated and awarded to the TG sets OEM – Alstom to engineer, manufacture and deliver the Scope of Supply (SOS) components / parts.

The recommended path and TG project Objective is to have all components required for one DNGS unit Refurbishment manufactured and delivered not less than 90 days before breaker open for each of the Darlington unit refurbishment.

Due to contingency items identified in the TG Project SOS the project team is expecting to have more components / parts manufactured or procured and delivered for the DNGS Refurbishment Outage Unit 2. Based on the inspection results and the condition assessments of the Unit 2 TG set, the need for more or less contingency components/parts for future refurbishment units will be assessed by the Project team and the procurement plan will be updated accordingly.

Beside the TG sets components/parts identified in the SOS, a contract was awarded to an EPC Contractor for Engineering (ECC) and Project Execution Phase (e.g. installation) and procurement through that contract limited materials for logistics and installation.

These materials are common materials that will be procured and managed during Project execution phase by the EPC Contractor. These kinds of materials will be procured by the EPC Contractor under the second contract T&C and these materials are but not limited to:

- PPE
- Welding
- Rigging materials
- Fencing
- Containers
- Rentals( trucks, waste containers, diesel generators etc)
- Other consumables that are not supplied by the ESES

Due to the nature of these materials, the project team will ensure through the contract T&C that these materials will be available and operational 2 months ahead each unit breaker open and also that they are properly maintained along the projects (e.g. scaffolding will be reused and will be inspected for safety before each subsequent unit Refurbishment outage).

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### 5.6.1 ESES and EPC Procurement Management

A Purchase Order for parts and engineered products has been issued to the ESES (Alstom) in connection with the Engineering and Equipment Supply Agreement dated 27<sup>th</sup> of March 2013.

The Agreement scope of supply includes two sections; Spare parts delivery for Steam turbine and auxiliaries and Generator and auxiliaries. For Unit 2, there are 8 spare parts packages with 1416 line items:

1. MS75301001 TSSM SOW Spares
2. MS75301002 TSSM Recomm. Spares
3. ME75300502 TSEM SOW Spares
4. ME75300503 TSEM Recomm. Spares
5. ME75300504 TSEM HV Bushings
6. ME75300505 TSEM Terminal Box
7. ME75300506 TSEM Aux. SOW
8. ME75300500 TSEM Aux. Recomm.

As per Agreement requirements, Alstom reports schedule progress on Procurement, Manufacturing, Shipment, and Delivery in the Contract Schedule (P6) based on the project Work Breakdown Structure (WBS). Alstom control transactions, to internally monitor progress of RFQs such as deliveries, expediting logistics, setup and other related project deliverables as per WBS, is in the Alstom SAP/pmX system.

Parts delivery from the ESES is required contractually not less than 90 days in advance of Unit Breaker Open, and nominally 10 months prior to the Turbine Generator Unit work window. Therefore EPC and ESES vendor activities with respect to delivery and receipt of parts ensure that actual need dates for parts are accommodated.

In order to provide tracking at a deeper level than the ESES schedule and mitigate risk of any potential late parts delivery, a method to track procurement, manufacturing, shipping, and delivery has been implemented such that Alstom will report monthly on status in the supply /manufacturing chain of the individual parts.

The EPC shall evaluate, audit (as appropriate) any supplier as per the PQAP. As described in the Quality Plan, 617391-0002-00000-38QP-0001 - Quality Assurance Plan, it is the intent that the EPC shall use suppliers on the OPG ASL for the purposes for which they have been approved. For the suppliers not on OPG's ASL, a copy of the audit report, checklist shall be provided to OPG. Evaluation results shall be submitted to OPG and input into Asset Suite as per Appendix D of the COIR.

The EPC procurement activities will predominantly deal with bulk materials (e.g. cables, fittings) and will be performed from the Cambridge office as detailed in the PQAP. ESES vendor engineered materials and some tooling will be free-issued to the EPC.



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### 5.6.2 Procurement, Manufacturing and Shipment Earning Rules

Earning rules are established and implemented for non-deferred scope for parts. The rules for spare parts material procurement, manufacturing and shipment will be based on quantities. The reported progress earned in the schedule, at activity level, will be tracked and calculated at the part level using the progress reporting from Alstom's SAP/pmX system.

Earning rules are established and material tracking will also be implemented for engineered products (deferred scope); subject to timing of procurement/manufacturing activities for these engineered items.

Table below demonstrates the earned progress rules per schedule activities. These rules are applied to procurement of non-deferred parts:

Schedule Activities Example for T & A (MS75301001)-(SOW Spares) Package	Earned Progress based on quantities
Request for Quotation Process (SOW Spares)	Total % earned calculated at the item level in SAP
Issue of Purchase Order (MS75301001)-(SOW Spares)	Total % earned calculated at the item level in SAP
Receipt of order acknowledgement (SOW Spares)	Total % earned calculated at the item level in SAP
Procurement of Goods (SOW Spares)	Total % earned calculated at the item level in SAP
Manufacturing (SOW Spares)	Total % earned calculated at the item level in SAP

### 5.7 Cost Management

The purpose of the Project Cost Management Plan is to outline how the T/G project manages budgets and costs over the life cycle of the project.

The governing document defining NR's approach to cost management is N-STD-AS-0028, *Project Management Standard*. Cost management and control practices are further detailed in N-MAN-00120-10001-PC, *Project Controls*.

#### 5.7.1 Cost Model

Project funding will be allocated from the program via the Gated Process and the Gate Review Board in accordance with N-MAN-00120-10001-GRB. Estimated funding requirements for the program life cycle beyond the current release will be documented as unreleased funds at the project and functional levels.

Changes to project funding levels within a release will be managed via a formal change control process in accordance with N-MAN-00120-10001-PC, *Project Controls*.

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Funding required in the current release period will be categorized and tracked as follows in Nuclear Refurbishments Project Cost Management system ("Proliance"):

- *Original Budget* is the approved funding established by the release or Gated Process. Original Budgets cannot be altered for the period in which they apply.
- *Control Budget* consists of the Original Budget plus the sum of all approved Directed Changes (i.e. baseline changes).
- *Approved Funding* consists of the Control Budget plus all approved funding requests not impacting the baseline.
- *Projected Budget* represents the accountable manager's forecast of cost at completion of the current release, and includes all pending (i.e. unapproved) funding change requests plus the impact of undocumented funding impacts based on managerial judgment.

The TG project is using the Earned Value Management principle for forecasting, as per N-MAN-00120-10001-SCH07 *Earned Value Management*. It should be noted that the ESES Vendor's earned value reporting will be developed in a manner that is reflective of its particular scope and combined reimbursable target price/fixed price nature of the contract (deliverable based milestone payments and non-resource loaded schedule for the fixed price work).

Project level Contingency funding may be allocated within the Definition and Execution phases via the Gated Process. Contingency funding is based on known risks. There is also Management Reserve funding which is set based on "unknown-unknowns" that could impact the viability of the project. The strategies for managing Contingency and Management Reserve are defined in NK38-PLAN-09701-10067 Sheet 0006, *Darlington Refurbishment Risk Management Plan*. Release of Contingency and Management Reserve funding will be controlled via the change control process in accordance with N-MAN-00120-10001-PC, *Project Controls*.

## 5.7.2 Cost Breakdown Structure

There will be a systematic and hierarchical Cost Breakdown Structure (CBS) that identifies all the Control Accounts used by the Project. Within each Control Account will be specific Work Packages. Budgets for all TG work will be established at the Work Package level and associated actual costs will be collected at the Work Package level to support cost performance monitoring including earned value measurement.

## 5.7.3 Project Cash Flows

As the costs and schedules for projects are developed, resource loaded schedules (as applicable) will be derived to form the basis of the function and project cash flows to support business planning and cost performance monitoring processes. The schedules will establish Planned Value (PV) at the Work Package level, which will then be translated into budget cash flows in the cost management system.

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#### 5.7.4 Measuring and Reporting Project Costs

Costs will be managed at project, function, vendor, and Work Package levels using source data from OPG financial systems. Vendor costs will be managed in accordance with contract terms and conditions to meet OPG requirements.

Cost performance will be measured using standard industry metrics, including Earned Value (EV), Schedule Performance Index (SPI), and Cost Performance Index (CPI).

Earned Value (EV) is the value of work performed and will be calculated within the NR cost management system using Work Package budget information from the cost management system work progress information derived from schedules.

Schedule Performance Index (SPI) is a measure of progress achieved compared to planned progress. SPI will be calculated within the OPG cost management system based on the equation:

$$SPI = EV/PV$$

Cost Performance Index (CPI) is a measure of the value of work completed compared to actual cost (AC) and will be calculated within the OPG cost management system based on the equation:

$$CPI = EV/AC$$

Cost variances at project level will be regularly monitored to ensure that actual and forecasted costs are within Life-to-Date (LTD) approved funding levels.

Forecasting will include mitigation and recovery plans as required.

Cost reports will be published on determined frequency in accordance with the Project Reporting Management Plan.

#### 5.8 Quality Management

The ESES and EPC Contractors shall perform the entire scope of work under an OPG-approved quality assurance program. Compliance with applicable quality assurance requirements will not relieve the respective Contractors from any of their obligations or liabilities under the established agreement between OPG and the Contractors. The Contractors will be responsible for ensuring that their Sub-Contractors are working under the Contractor's quality assurance program or have implemented an appropriate quality assurance program acceptable to the Contractor and OPG.

##### 5.8.1 General

##### 5.8.1.1 Quality Records

The Contractor will provide OPG with signed and dated legible copies or originals of all quality documentation pertaining to any goods and services. The Contractor will

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identify, index, and file quality records for prompt retrieval for seven years after the completion of the goods and services or for any other period required by the applicable quality assurance standard.

The Contractor and OPG will each have a single point of contact (SPOC) to facilitate information exchange to enable update of Passport documentation (EPC only).

The Contractor will provide an electronic copy of all deliverable documents in a format approved by OPG's Business Services, Nuclear Programs, as outlined in OPG-STD-0057 "*Electronic Document Management*" and N-PROC-AS-0042 "*Records and Document Management*".

The Contractor will be required to provide a detailed listing of all quality documents that are required for turnover and will be expected to submit the preliminary list for OPG's review, which will be used as a baseline during the turnovers.

#### 5.8.1.2 Audit and Surveillance Rights

The Contractor is subject to audits, inspections, and witnessing by OPG to ensure compliance with the requirements of the Specification, Codes and Standards, drawings, and Contractor's approved submittals.

OPG shall have the right to witness any inspection called for in the Contractor's quality plan and submitted Inspection & Test Plan (ITP). The Contractor shall co-operate with OPG in establishing when the various inspections and hold points will be performed during design, manufacture, testing, and preparation for shipment. Goods shall not be shipped prior to OPG inspection release. This shall be incorporated in the submitted ITP as a hold point.

The Contractor shall notify Sub-Vendors of OPG's inspection and testing requirements.

The Contractor shall make provision for access by OPG or OPG's inspection representative to the plant/ manufacturing facility or the plant/manufacturing facilities of their Sub-Vendors at any reasonable time during the course of the Project.

OPG may advise the Contractor in writing of any non conformance identified during a visit.

#### 5.8.2 ESES Vendor Quality Management

The ESES Vendor must implement, maintain and comply with an OPG-approved quality assurance program that:

- (a) Will ensure the workmanship used to produce and perform the goods and services will meet all OPG requirements as per the agreement
- (b) Engineering Services consisting of upgrades, optimization and modifications to existing steam turbine generator sets including the control of design activities

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related to field services in compliance to CSA Z299.1 and applicable elements of N286-05

- (c) Supplier's manufacturing facility where each item is manufactured shall be on OPG Approved Supplier List for the required quality level specified by OPG.
- (d) When acting as a distributor or agent for an item, the original manufacturer shall be on OPG's Approved Supplier List.
- (e) Items used for Pressure retaining system that requires CSA B51 or CSA N285 Class 6, shall be procured from a supplier who is registered with the Technical Standards and Safety Authority(TSSA).
- (f) Meets EPRI Guideline with respect to the prevention and detection of counterfeit and fraudulent items.

The ESES Vendor can submit to OPG for review and approval a suitable quality assurance program that satisfies the applicable requirements given in CSA Standard N286-05. OPG may impose additional applicable requirements on the Vendor to ensure that the requirements of CSA N286-05 are met.

The Vendor will be mandated to be qualified and remain qualified during the course of the project to the following requirements:

- Design engineering services which include the software /firmware will be developed to meet the requirements of CSA Z299.1 and the applicable elements of CSA N286-05 for Design.
- Meets applicable elements for Design software (use, modification or development) of CSA N286.7, Quality assurance of Analytical, Scientific and Design Computer Programs for Nuclear Plants.

The Engineer, Procure and Construct (EPC) contractor will be mandated to be qualified and remain qualified during the course of the project to the following requirements:

- Applicable elements for engineering, procurement and construction services of CSA N286-05, Managed System Requirements for Nuclear Power Plants as amended, restated or replaced from time to time.
- CSA Quality Standards Z299.1 or such equivalent quality standard agreed by OPG that may replace said standard.
- Applicable elements for Design software (use, modification or development) of CSA N286.7, Quality assurance of Analytical, Scientific and Design Computer Programs for Nuclear Plants.

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- CSA N285.0 General Requirements for Pressure Retaining Systems and Components in CANDU Nuclear Power Plants, as amended, restated or replaced from time to time.
- Electric Power Research Institute (EPRI) guidelines with respect to the prevention and detection of Counterfeit, Fraudulent and Suspect Items (CFSI)
- Ensure Subcontractors' evaluation and selection is performed in compliance with the requirements of the applicable elements of CSA N286-05 and CSA Z299 series of quality standards or such equivalent quality standard agreed to by OPG.

During the different phases of Project work, the Project Team jointly with the Functional Team will ensure the quality of design, quality of materials and services provided and the quality of installation and commissioning work performed at station:

- (a) Comply with OPG standards
- (b) Meet Purchase Order requirements
- (c) Comply with applicable codes and standards

### 5.8.2.1 ESES Inspection and Test Plan

ESES shall submit Inspection and Test Plans (ITP) and reference acceptance criteria.

OPG reserves the right to insert inspection requirements and hold points as required to verify quality objectives. An Inspection Test Plan (ITP) is to be submitted to OPG for review /approval prior to manufacturing. The ESES Vendor shall maintain a Customer Shop Inspection Schedule of OPG hold and witness points, and notify OPG in advance of such points. A third party Source Surveillance inspection agency will be utilized to conduct hold and witness points on behalf of OPG, at ESES sites in Europe and potentially the U.S. Source surveillance for ESES off-site activities in Ontario (i.e. generator auxiliaries skids) will be executed by OPG Supply Chain Quality Services.

The ITP shall describe the inspections, tests and verifications for all products and services specified in the contract. The test plan shall be approved by the manager primarily responsible for Quality Assurance and accepted by OPG. Test plans shall clearly state the test method, test equipment and accuracy, acceptance criteria and basis.

OPG shall be provided access to review procedures referenced on inspection and test plans; during the life of the contract, the plan and procedures are to be updated to reflect revisions.

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OPG shall have the right to establish witness and hold points for which the Vendor shall give ten (10) business days prior notification. In addition, OPG may establish witness points to ensure resolution of quality issues.

### Inspection and Test Strategy for QL-4 OEM Parts

Many of the ESES (OEM) parts have historically been QL-4 and will continue to be QL-4. As an additional level of oversight, OPG is receiving ITPs from Alstom, inserting witness points, and conducting reviews on selected parts at Alstom's site in Europe using a third party source surveillance vendor. In general the rationale for this level of oversight which exceeds the normal requirement for QL-4 parts is:

- Volume of parts required for Refurbishment (i.e. OPG is not simply purchasing single parts for ongoing operational replacement, but 1000+ parts for a major refurbishment campaign – “construction project”).
- Mitigation of risk around timely parts receipt with expected quality; OPEX from other Nuclear Refurbishments.
- The Project Team is following a risk based methodology, to perform oversight / ITP witnessing on selected parts only, which have higher potential to impact Refurbishment or the Station.
- This is consistent with the level of oversight / documentation Ontario Hydro utilized for turbine generator initial erection. At that time, Merz & McLellan was engaged as OPG's source inspection agent.

### 5.8.2.2 ESES Inspection Test Plan Content

The ITP shall contain as a minimum:

- The products or services that are to be subcontracted and specify the Quality Assurance Program to be applied.
- How the Vendor will verify the sub-supplier's conformance to specified requirements by one of the following methods:
  - (1) Inspection & Test by the sub-supplier as defined in the sub-supplier's Inspection and Test Plan.
  - (2) Inspection & Test by the Vendor at the sub-supplier facility.
  - (3) Surveillance by the Vendor.
  - (4) Incoming Inspection.
  - (5) Where each inspection and test point is located in the production cycle.

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- (6) What characteristics are to be inspected at each point and specify acceptance
- (7) Criteria and any sampling plan to be used.
- (8) Where OPG has established WITNESS / HOLD or verification points.

### 5.8.2.3 ESES Deviations and Non-Conformance

Any departure from any requirement of approved specifications is considered a deviation or non-conformance. Examples include physical defects in equipment, test failures, equipment out-of-tolerance, or deviations from specification, inspection or test procedures.

The ESES shall be responsible for the disposition of all non conforming items, during engineering, manufacture, procurement and execution, including those of its Sub-Vendors. Non conformance reporting shall be classified and dispositioned at three levels:

Level 1 – Non conformance which does not affect the function, safety of operation and interchangeability of components in any way. Level 1 non conformance will be recorded and retained to be available for OPG to review if requested

Level 2- Non conformances which may impact spares, delivery schedule, standard design/drawings, or require calculation or analysis to disposition. Level 2 non conformance reports will require submission to OPG for information.

Level 3 – Non conformances which impact contract document, incomplete or missing inspections, and deviations impacting maintenance, interchangeability, life cycle, or spares. Level 3 non conformance reports require submission to OPG in accordance with section 2.7 of the Agreement. Further engineering or fabrication prior to final resolution shall be at the Vendor's risk.

The ESES shall establish and maintain measures for controlling and disposition of all non conforming items which is to include:

- (a) Defining the responsibility and authority of those who disposition the non conforming item
- (b) Detect and record the non conformance
- (c) Identify and hold non conforming items for evaluation
- (d) Develop a disposition, obtain concurrence of responsible parties, and submit to OPG for acceptance where required
- (e) Implement and accept disposition



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- (f) Specify requirements for re inspection and testing of the repaired or reworked components
- (g) Provide quarantine of the item to prevent unauthorized use
- (h) Maintain records identifying non conformances, the nature and extent of the issue, disposition, and records of repair and re inspection.

#### 5.8.2.4 ESES Software Quality Assurance Project Requirements

The ESES is required to comply with the software QA requirements as specified in the following design requirements and associated technical specifications prepared for both Turbine controls upgrade (NK38-SOW-64100-10003) and Excitation controls upgrade (NK38-SOW-64220-10002).

- NK38-MDR-64100-10001 Turbine Generator Controls
- NK38-MDR-64160-10001 Turbine Generator Supervisory System
- NK38-TS-64100-10001 Turbine Generator Control System Procurement
- NK38-MDR-64220-10001 Generator Excitation and AVR Controls
- NK38-TS-64220-10001 Generator Excitation and AVR Digital Control System Procurement

There are no software requirements associated with the Turbine and Auxiliaries and Generator and Auxiliaries scope of work.

#### 5.8.2.5 ESES Software Maintenance/Software Tools

The ESES is required to comply with the software maintenance / tools requirements as specified in the following design requirements and associated technical specifications prepared for both Turbine controls upgrade (NK38-SOW-64100-10003) and Excitation controls upgrade (NK38-SOW-64220-10002).

- NK38-MDR-64100-10001 Turbine Generator Controls
- NK38-MDR-64160-10001 Turbine Generator Supervisory System
- NK38-TS-64100-10001 Turbine Generator Control System Procurement
- NK38-MDR-64220-10001 Generator Excitation and AVR Controls
- NK38-TS-64220-10001 Generator Excitation and AVR Digital Control System Procurement

There are no software maintenance / tools requirements associated with the Turbine and Auxiliaries and Generator and Auxiliaries scope of work.

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#### 5.8.2.6 ESES Quality Control Oversight

The oversight activities will be based on the documented oversight plan in accordance with N-STD-AS-0030, *Project Oversight Standard* and N-MAN-09701-10002, *Nuclear Projects Oversight Guide*. The basis of oversight will be:

- (a) Risk
- (b) Criticality
- (c) OPEX (internal and external)

To ensure compliance with the OPG requirements:

- The ESES Vendor interface will be controlled by the Vendor Owner Interface Requirement (VOIR) document forming part of the agreement and all other deviations, additions, exceptions, revisions accepted by both OPG and the Vendor.
- The EPC Vendor interface will be controlled by the Contractor Owner Interface Requirement (COIR) document forming part of the agreement and all other deviations, additions, exceptions, revisions accepted by both OPG and the Contractor.
- Assessments, witnessing activities, document review etc will be performed as required to ensure that Quality is never compromised.
- The Vendor's QA program will be audited in intervals as required, but not greater than three years to ensure that the Contractor is continue to implement the Quality program as required by OPG.

Adverse conditions such as Quality System failure or breakthrough events for which Contractor is accountable, will be documented as per N-PROC-RA-0022, *Processing Station Condition Records*. Contractor will be asked to initiate a Corrective Action as per their program for any identified quality issues. When there is a systemic failure of Quality System implemented, a formal Non Conformance and Corrective Action Request process will be initiated by Supply Chain Quality services as per N-PROC-MM-0010, *Establishing and Maintaining Ontario Power Generation Nuclear Approved Suppliers List* and N-GUID-01935-10004, *Desktop Guide for Supplier Non-conformance Correction Requests (NCAR)*.

#### 5.8.3 EPC Quality Management

The EPC Contractor shall submit a Construction Quality Assurance Plan (QAP) to OPG within the time frame stipulated in the Contract Agreement. The QAP shall include items such as:

- Project Quality Assurance requirements

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- Training & Qualification
- Organizational structure and roles
- Design process (control, planning, use of analysis software, documentation, design verification, etc)
- Procurement requirements and documents
- Inspection and test
- Control of measuring and test equipment
- Handling, storage and shipping
- Non-conformances and corrective action
- Quality Assurance records

This Project Management Plan will be fully updated upon acceptance of the QAP.

## 5.9 Risk Management

### 5.9.1 Risk Management Overview

Risk management provides projects with forward-looking actions and metrics to reduce the likelihood and minimize the impact of undesirable events during the project life cycle. The goal of risk management is to remove obstacles to project success before they occur in order to minimize their consequential effect on project costs, schedule, quality, and safety targets.

Proactive risk management is used to understand the characteristics of the risk, how to manage them, and plan for *contingency* based on the *residual risks*. As such, risk management can have a significant impact on the financial health of the project.

Risk management should be performed with a graded approach. The intent of this approach is to match the level of effort with the impact to safety, cost, schedule and success of the project.

### 5.9.2 Risk Identification

Risk identification is the process of determining and documenting the risks and their characteristics that can affect the project. It is an iterative process as new risks may be identified throughout the project lifecycle and previously identified risks may not have realized and are closed. The risks must be defined in relation to project objectives and it is important to distinguish a risk from its causes and *consequences*.

Currently the risks for the TG project are recorded into a Risk Registry (contract pre-award phase); after the contract award they were transferred into the Project /

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Departmental SharePoint risk database. In late March, 2015, all risks were transferred to a new Risk Management Oversight (RMO) tool.

- (a) Risks are identified through:
  - (1) Facilitated brainstorming sessions or risk workshops
  - (2) Individual project team member or stakeholder input
  - (3) A review of experience (OPEX) and lessons learned from other internal and external projects
  - (4) Any other relevant techniques or sources (e.g. Delphi technique, checklists, Project Definition Rating Index (PDRI)).
- (b) Identified risks are clearly and unambiguously described, so that they can be understood by those responsible for risk assessment and risk planning. Elements of the risk statement should include a description of the risk event, the *consequences* of such event occurring, the project objectives impacted, the potential causes of risk realization and expected time period of the risk occurring.
- (c) The project risks are grouped into logical risk categories. This aids in the identification of project risks and the assignment of ownership and serves as a method of grouping of risks for assessment, analysis, monitoring and reporting. This also allows the project to consider related risks that have the potential to produce a greater *consequence* than the individual risks.
- (d) The projects documents and updates risks in the risk register. A risk register is the document containing the results of risk analysis, and risk response planning. The risk register details all identified risks, including description, category, cause, *probability* of occurring, impact(s) on objectives, proposed responses, owners, and current status. The risk register is updated quarterly (the frequency may increase when closer to the Refurbishment Outage).
- (e) A *Risk Owner* is identified for each risk, which is accountable to ensure that an appropriate response strategy is selected and implemented.
- (f) Each risk has:
  - Risk identification number
  - A concise risk title
  - Risk category

### 5.9.3 Risk Monitoring and Control

Risk monitoring is essential as projects are dynamic and project risks will evolve over time. Risk monitoring and control involves the tracking of identified risk, monitoring of

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*residual risks*, identification of new risks, monitoring the execution of risk response plans and evaluation of risk response effectiveness. *Contingency* reserves should also be periodically monitored.

Projects should review the project risks and update the risk register to document any changes and new risks as per the RMP. It is recommended that risks are not deleted from the risk register. If a risk is deemed to be irrelevant, the risk should be statused as "Closed". Risks can be closed (and the rationale documented) for any of the following reasons:

- (1) Risk matured, the expected time for risk realization has passed.
- (2) The *risk trigger* does not exist anymore and there is no other risks related to this condition
- (3) The risk has been mitigated to the point that it is considered a Business As Usual (BAU) risk.

Projects should prioritize the project risks, and communicate any changes to project stakeholders, including risks that have been triggered or a risk that has increased significantly in *probability*.

## 5.10 Engineering Management

OPG has adopted a combined EPC/ESES Vendor contractual model to be applied to the TG Project. For the engineering portion of the work, the *Modification Process*, N-PROC-MP-0090, will require OPG interfaces with the EPC to accept, review, support, approve and/or authorize deliverables required as part of N-PROC-MP-0090.

In order to provide the ESES with the flexibility to work under their QA Program and identify/utilize key acceptance and oversight points, a TG contract specific Vendor Owner Interface Requirements (VOIR) has been developed.

Similarly, for the part of the TG scope assigned to the EPC contractor, in order to provide its flexibility to work under their QA Program but within the bounds of N-PROC-MP-0090, a TG contract specific Contractor Owner Interface Requirements (COIR) has been developed.

### 5.10.1 Design Reviews

The design deliverables requiring OPG to Review, Accept, Approve, and/or Authorize shall be routed through the Engineering Lead Section Manager or DTL, to the assigned Project Engineer that will coordinate the necessary acceptance, approval and/or authorization per appropriate governance (e.g. N-PROC-MP-0010, *Engineered Tooling Change Control*, N-STD-MP-0009, *Contractor\Owner Engineering Interface and Oversight*, N-PROC-MP-0105, *Quality Design Plan*, N-PROC-MP-0078, *Specification Review Acceptance and Use Of Vendor Technical Documents* and N-PROC-MP-0009, *Design Management*).

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The ESES shall participate in an initial design review meeting with OPG during preliminary engineering. This meeting will involve all project stakeholders and the purpose of this meeting will be to discuss the specification, design, manufacture, testing, and inspection requirements for preliminary engineering solutions and equipment to be supplied. This will also provide an opportunity for plant equipment walkdown and inspection to ensure compatibility of the proposed replacements.

Design drawings shall be submitted by the ESES for review to OPG at 50%, 70%, 90% completion as outlined in VOIR.

### 5.10.2 Engineering Closeout

Engineering Closeout shall be conducted in accordance with N-PROG-MP-0001, *Engineering Change Control* and N-PROG-MP-0010, *Engineered Tooling Change Control*.

### 5.10.3 Engineering Oversight

The oversight will be:

- Performed in accordance with N-STD-AS-0030, Project Oversight Standard, N-MAN-09701-10002, Nuclear Projects Oversight Guide, and N-STD-MP-0009 Contract/Owner Engineering Interface and Oversight.
- Engineers will follow approved procedures as well as direction from Design Authority on how to perform Oversight, in line with the Project Oversight Plan
- Focus on ensuring Contractor meets their own quality program and meeting specified requirements and contractual terms
- With support and approval of Project Managers, conduct targeted review of Contractor's Engineering deliverables and verify Contractor's internal Engineering oversight activities
- The Project Engineers may require support from Engineering Functional Groups such as Design Engineering, Engineering Projects. An Owners Support Services Contractor will be available to provide additional resources or support of the Project Engineers and Engineering Functional Groups when need.

## 5.11 Construction Management

The TG Construction Management will be in accordance with NK38-PLAN-09701-10012, *Management Plan: Management of Contractors for Darlington Refurbishment Project*, and NK38-PLAN-09701-10067 Sheet 14 *Program Site Implementation And Construction Management Plan*.

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The Construction Management objective is to ensure alignment between all the project stakeholders including the Contractors and groups executing the construction phase of the project, and to provide oversight such that the project is completed safely, meets the quality requirements while achieving cost and schedule targets. OPG staff will act as “Enablers” that support the executing groups, work with them to achieve world class safety, meet quality requirements and achieve the project schedule milestones.

General Construction Management principles related to TG project:

- (a) The ability to influence a positive outcome increases when the construction details are clarified and well planned prior to field implementation.
- (b) A relationship based on trust and openness between OPG and execution contractor is crucial for meeting all the project objectives
- (c) The level of oversight applied will be risk based and be specific to each of the five TG sub-projects” as detailed in the Project Description section of this document.
- (d) Oversight will be performed in accordance with N-STD-AS-0030 *"Project Oversight Standard"* and N-MAN-09701-10002 *"Nuclear Projects Oversight Guide"*.

It is assumed that the TG EPC contractor would be self sufficient and adopt industry best practices for performing installation and construction type of work for turbine generator refurbishment. However, based on nuclear industry OPEX regarding execution of EPC contracts, the level of oversight in the Project Oversight Plan will be commensurate with the EPC Contractor’s experience and past performance.

Prior to execution of the scope of work OPG will provide a fully serviced office for the Contractor’s single point of contact (SPOC) in a location with the Project team.

During site execution OPG will provide the following:

- Identified work “islands” to perform the scope of work on the refurbishment unit separated and isolated from the operating units. The area provided would include laydown for the major components of the turbine generator equipment and control / operation of the crane for the duration of the execution window for the work.
- Two fully serviced re-locatable office structures on the turbine floor. Computer and telephone services will be the responsibility of the Contractor.
- A reasonable number of 600V 3 phase 60Hz welding receptacles to be used for bolt heating and inspection equipment. Any distribution boards or extension cables shall be supplied by the Contractor.
- A reasonable number of 120V 60Hz power supplies.

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- A reasonable number of service compressed air supplies, however distribution headers and hoses will be supplied by the Contractor.
- Reasonable amounts of service water from the low pressure service water system. Distribution headers or hoses will be supplied by the Contractor.
- Washrooms in the powerhouse. External washrooms will not be provided.
- An area to use for breaks and lunch, and an area for coats and storage of personal items.
- Parking for the Contractor staff and trades.

In the event on-site laydown is insufficient, it will be the Contractor's responsibility to arrange site storage and warehousing including transportation to and from site and material handling. (This is to include a staging plan and inventory control process). Movement of major equipment / items within the work area, in and out of the work area / site, and to any off site areas shall be integrated with OPG's and project requirements (i.e. Lifting Plan, SATM Plan, Transportation Plan, etc). See NK38-CORR-09701-0537091 Refurb Vendor Storage Protocol.

OPG shall provide two turbine hall cranes during execution of the refurbishment work on each turbine generator. The turbine hall crane operators shall not be provided and are the responsibility of the Contractor. OPG shall perform any inspections and maintenance on the turbine hall cranes prior to the commencement of work on each unit and will arrange and perform any call-ups on the cranes at a mutually agreeable time while they are under the operation of the Contractor (see NK38-CORR-22000-0500070).

OPG and the contractor will make arrangements to ensure the ingress and egress from the area would be streamlined to maximize working time for installation and construction.

The Contractor will remove only non-asbestos insulation, and re-apply new insulation as required within the Contractor's scope of work. The determination of the non-asbestos replacement insulation material selection will be mutually agreed to by OPG and the contractor, and should be as per original installation wherever possible. If asbestos insulation is found, OPG is to be solely responsible for its removal and disposal including any resultant delays.

Asbestos containing gaskets will be removed and replaced by the Contractor in accordance with the applicable health and safety standards, with the work being carried out by a qualified contractor, or sub contractor having insurance coverage acceptable to OPG. OPG will be advised of the Contractors' qualifications and insurance coverage prior to the work being executed, and OPG will be responsible for the safe disposal of any asbestos containing gasket material.

The Contractor shall use the special tools supplied during the initial installation of the turbine generator sets. This is to include any lifting beams, rotor stands, spreader



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beams, bolt heating, stub shafts, etc. The existing special tools shall be provided by OPG to the Contractor in a state ready for their use including completion of any calibrations, call-ups, or maintenance. These tools shall be returned on the completion of the Project and the Contractor shall replace any tool that is damaged or lost while in its possession at the Contractor's cost. This tooling shall be inspected and inventoried at the beginning and end of the Project. Any additional special tooling which is required to complete the Project will be the responsibility of the Contractor (i.e. spreader beams, rotor stands, and OPG qualified slings for applicable large lifts).

The Contractor shall supply all standard rigging required to complete the scope of work with the exception of special rigging which is included with the special tooling ( slings etc for rotor and inner cylinder removal, turbine generator jib cranes ). Any special rigging supplied by OPG will be supplied and returned under the conditions identified in the previous paragraph.

The Contractor shall supply all hand tools as necessary for completion of the Contractor's scope of work. OPG will be responsible for providing decontamination / transfer permits to allow the tools to be removed from the site.

The Contractor will comply with all OPG radiation requirements for transportation of material and personnel on and off site.

All Contractors' personnel involved in the construction and installation activities will require appropriate training. There are several types of training requirements:

All Contractor training must meet the requirements of OPG procedure N-TQD-510-00001, "*Supplemental BTU, Direct Hire and Contract Management Training and Qualification Description*".

- The Contractor will develop a training plan for each trade, professional and supervisory staff group.
- The Contractor will provide its own training facilities for any training conducted under their accountability.
- OPG will provide oversight of any specialized training that the Contractor is conducting through routine observation and audits of material.
- All training records must be maintained as QA records in the OPG TIMS II ("*Training Information management System*") database or an equivalent Contractor's training database to demonstrate qualifications.
- Contractor and / or Project specific training and qualifications are the responsibility of the Contractor.
- General training requirements is the responsibility of the Contractor, with support from OPG:

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- (1) Nuclear general employee training (NGET) computer based training (CBT) mandatory for issuance of site access card.
- (2) Additional CBTs / computer assisted trainings (CALs) / administrative requirements (ARQs) mandatory for all Boiler Trade Union (BTU) direct hire, Contractor supervisors of BTU and Contractor personnel (e.g. Intro to Corporate Safety Rules, procedural usage and adherence). Mandatory training requirements for Contractor supervisors of BTU-general foreman (e.g. health and safety law, pre-job brief). Supervisory personnel, prior to assuming supervisory oversight activities independently, shall complete all OPG training requirements applicable to that position or equivalence approved by OPG. OPG will assess BTU foremen qualification via an oral review board to ensure their qualification in conformance with OPG standards.
- (3) Islanding & interface training, provided or arranged by OPG, which includes: access restrictions and controls, shared areas, barriers & controls, incident / emergency response, staging of materials.
- (4) Training qualifications required to perform task specific work - examples: radiation protection training (e.g. orange 1 badge, half mask air purifying respirator), work protection (e.g. work protection applicant level 4), Class III to VIII industrial lift truck, confined space and conventional safety training.

The current plan, as per NK38-CORR-09701-0513497, is for a single service scaffolding provider to purchase and maintain Refurbishment scaffolding material stock. Scaffolding erection shall comply with OPG requirements for construction, inspections etc.

The Contractor shall provide its own garbage and debris removal from site and disposal off site. The Contractor will ensure that all work areas will be cleaned and left in a state as good as original, including removal of all equipment, tooling, and temporary barriers, and meeting OPG Material Condition, Housekeeping and Inspection Standards.

The Contractor shall have and administer its own confined space program during execution of the scope of work. This program shall be approved by OPG to ensure compliance with OPG standards and shall comply with OSHA requirements. This shall include identification of confined spaces, set up, testing and monitoring etc.

### **5.11.1 Cooperation Agreement**

The effective use of a Cooperation Agreement is essential to obtain tripartite (OPG/JV/Alstom) agreement to cooperate, work together, not interfere with each other, resolve issues, and act transparently. The Cooperation Agreement will help to minimize any impact with constant monitoring and address any issue.

The Cooperation Agreement reflects the following principles:

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#### ***Success Criteria***

- All parties shall strive to achieve a common goal to ensure the project is executed safely, with quality in accordance with their respective contracts and within the allotted budget and schedule.
- The parties will acknowledge that the success of the project depends upon the success of each of the parties.

#### ***Integration***

- All parties will develop and work to an integrated schedule for the project.

#### ***Transparency***

- All parties shall act in good faith and disclose information that the receiving party requests and reasonably needs to perform their work under their respective contracts, subject to and in accordance with the respective parties' confidentiality agreements.

#### ***Effective Communication***

- All parties shall agree to a communication protocol for timely and effective exchange of information.

#### ***Issue Resolution***

- All parties must adhere to the pre-established resolution protocol contained in their respective contracts, or as may be otherwise agreed to by the parties
- The parties will endeavour to work to resolve issues in a timely manner, and communicate the unresolved issues through the proper channels.

#### ***Contract Terms and Conditions***

- The rights, remedies and obligations of all parties will remain within their respective contracts.

### **5.12 Safety Management**

It has been recognized that a unique approach to the management of the Nuclear Refurbishment (NR) Project is required due to the large scope and duration of the project, and the multi-employer configuration. The operations and construction safety integrity is required so that all refurbishment work is completed in a safe, high quality, and economic manner. This will require an integrated approach between OPG, ESES, EPC, and other contractors/work groups where Safety is the **CORE VALUE** of the NR project as well for the individual Turbine and Generators project.

Together, OPG and all contractors on the project are committed to this **CORE VALUE**. OPG and all the contractors will protect every employee's right to work in a safe and healthy refurbishment work environment. This will be achieved by preventing work-caused injury and ill health and by complying with all relevant safety legislation, written safety procedures, and using safe work practices established for NR work.

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The ultimate purpose of project safety management processes is to ensure that projects are planned and executed in a manner that ensures a safe work environment is established in order to prevent incidents. These plans will provide NR Project Teams and support staff with a clear understanding of the Health & Safety management requirements for the project. The Guide for Refurbishment Work Stoppage / Reporting and Recovery is NK38-GUID-09701-539564.

The Turbine Generator (TG) Project will adhere to all applicable obligations as defined in the Occupational Health and Safety Act (OHSA), the OPG expectations (N-POL-0001, *Nuclear Safety Policy*, OPG-POL-0001, *Employee Health And Safety Policy* and N-GUID-09701-10011, *Darlington Refurbishment - Safety Management Essentials*), and the TG ESES and EPC Agreement Terms and Conditions.

The over-arching health and safety performance requirements have been set out in N-GUID-09701-10011 "*Safety Management Essentials*" and have been issued by OPG to the contractors performing work under the NR Program. Based on this Guide, the Contractor will develop a Project Site Specific Safety Plan for their work scope that will meet or exceed the requirement of OPG as described in the Guide and as referred to in Safety Exhibit 2.4 of the contract.

Together, the NR Safety Governance framework (including N-GUID-09701-10011) and the TG ESES and EPC Contractors' Safety Program and specific safety plans will form the bases of the Safety Management Plan for the TG Project.

### 5.13 Environment Management

The Environmental Management Plan (EMP) describes how OPG and TG Contractors will manage environmental issues for Turbine Generator Refurbishment Program.

It establishes a framework for environmental management for the TG Project, and Vendors/Contractors in accordance to defined goals, objectives and expectations for the Nuclear Refurbishment Program.

During all phases of the TG project, the ESES and EPC Contractors shall comply with the program level requirements of the *Nuclear Refurbishment Environmental Management Plan* (NK38-PLAN-09701-10067 Sheet 12) as summarized below:

#### 5.13.1 Goals and Objectives

##### Objectives:

- Maintain Environmental Management System Certification during the project
- Event-free operations during the project.
- Minimize impacts on the operating units.
- Minimize delays in return to service.

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#### Goals:

- Operate As Low As Reasonably Achievable for radiation exposure of the Public and the Environment (PE-ALARA)
- Zero Reportable Spills and Environmental Infractions
- Maximize landfill diversion of conventional waste in alignment with regional objectives.
- Maintain top quartile performance for the generation of Low and Intermediate Level Radioactive Waste (LILRW) during Refurbishment and sustain top decile performance following the project.

### 5.13.2 Contracting Requirements for Environmental Management

With respect to the Project, there are certain elements that must be considered: the standard requires that any person performing work or services on a site, which has the potential to cause a significant environmental impact, should be aware of the requirements and importance of the Environment Management System (EMS) and are competent to perform the job assigned. Also, for Contractors performing an operation or activity that has the potential where environmental impacts are significant, these controls should take the form of documented procedures. Regardless of who performs the work (i.e. sub-Contractors) the Contractor is accountable for ensuring compliance.

Whether or not OPG is the Constructor of a project or the project is an Owner Only project, OPG can be found liable for environmental regulatory infractions. The Project Manager is responsible for ensuring environmental requirement specifications are prepared, approved and followed. This must be done with full knowledge of the degree of environmental risk inherent to the construction or maintenance activities involved in the project (including environmental impact risks, stakeholder risks and legal risks).

The TG Project Manager will prepare an assessment of the *Environmental Aspects* and potential *Environmental Impacts*, unique to the project. This assessment will be integrated into the Contractor's Environmental Management Program (CEMP). The assessment provides assurance to the workplace parties that the environmental risks unique to the project have been identified and that adequate controls to eliminate or mitigate the risks are in place before work commences.

This plan provides the TG Project Manager with an understanding of the environmental risks of the project and in conjunction with the N-GUID-09701-10013: *Nuclear Refurbishment – Environmental Requirements Guideline* which provides expectations and specific requirements for the CEMP.

### 5.13.3 Contractor Environmental Management Expectations

The ESES and EPC Contractors are required by OPG to identify hazards, evaluate risks and develop appropriate plans to mitigate risks. OPG expects Contractors to

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manage their operations to protect the environment the welfare of site staff and the environment. Their process, procedures shall be subject to competent scrutiny through the supply chain. Environmental programs and/or operations that do not meet these expectations, and in particular where there are opportunities that have not been utilized to improve the use of good environmental practice and/or eliminate/reduce significant risks, shall not be deemed acceptable (subject to assessments of reasonable practicability).

Where design is part of the works, the Contractor shall comply with the requirements in this guideline:

- (a) The Principal Contractor shall ensure that: all environmental requirements are fully Incorporated into the Engineering, Procurement and Construction (EPC) process;
- (b) There is clear allocation of responsibility and authority for environmental management matters;
- (c) There is an effective interface with regulators, including obtaining relevant licences, consents and permits;
- (d) This Guideline and other requirements are clearly communicated through their supply chain, and reflected in the Contractor Environmental Management Program (CEMP);
- (e) Ensure that sub-Contractors are competent and resourced to work to the required standards;
- (f) Ensure compliance with site as well as their own requirements by their personnel, sub-Contractors personnel and visitors;
- (g) There is cooperation with the TG Project Manager and OPG Environment Advisor;
- (h) There is cooperation and participation in environmental programs for Contractors;
- (i) There are mechanisms in place to ensure cooperation and exchange of information on neighbouring/shared risks and logistics;
- (j) Ensure that relevant information on work in the area designated as under their control is provided to OPG to facilitate coordination, so that the activity of any party does not result in undue risk;
- (k) Members of the team have access to appropriate, competent environmental management advice and support; and
- (l) Monitoring and reporting including: completion of the monthly Environment Scorecard and reporting of incidents and accidents is undertaken.

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#### 5.13.4 Environmental Performance Metrics and Targets

A single, consistent set of Environmental Metrics (measures and targets) for Nuclear Refurbishment and Contractors at the Program and Project levels are under review and will be approved for use (NK38-REP-09701-10145, *Proposal for Refurbishment Chemistry & Environment Metrics*).

NR Senior Line Management, NR Project Teams and Contractors will use the metrics to identify unsatisfactory performance against prescribed targets and identify methods to eliminate causes for unsatisfactory safety performance.

Program and Project Environment metrics will be tracked on a prescribed frequency and reported graphically, or otherwise, through the Refurbishment Program Monthly Status Report and TG Project Manager Status Reports.

#### 5.13.5 Environmental Oversight and Monitoring

Environmental oversight and monitoring requirements for Nuclear Projects will be established under direction of N-STD-AS-0030: *Project Oversight Standard*. Environmental oversight criteria are identified in N-GUID-09701-10013: *Nuclear Refurbishment – Environmental Requirements Guideline*. Environmental oversight criteria will be included in Project Oversight Plans (POPs).

A Darlington Environmental Review Team (DERT) has been established and will be a key environmental compliance oversight mechanism for the Program.

### 6.0 PROJECT REPORT MATRIX

The NR Planning and Controls Project Management Office (PMO), in accordance with N-PROG-AS-0007, *Project Management* and N-MAN-00120-10001-CST, *Nuclear Refurbishment Cost Management and Project Reporting*, will be providing the TG Project with reports in the following areas:

- Schedule performance, SPI
- Cost performance, CPI
- Earned Value, EV
- Forecast to complete based on EV, by cost element
- Metrics, including variance analysis, response times to requests for reviews of submittals, requests for information

The TG Project will provide the following to the NR PMO to be incorporated in the project reporting:

- Project Manager's status

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- Project milestone adherence
- Scope, cost, schedule changes anticipated and pending
- Financial forecast
- Risk urgency and realization

## 7.0 PROJECT MANAGEMENT PLAN APPROVAL AND REVISIONS

The TG Project Management Plan shall be approved by the VP - Refurbishment Execution

The TG Project Management Plan shall be reviewed at each Gate and revised accordingly.

## 8.0 REFERENCES

Document number	Title
617391-0002-00000-30IM-0001	DNGS TGR – Project Management Plan – Definition Phase
617391-0002-00000-30IM-0019	DNGS TGR – Project Management Plan – Execution Phase
D-PCH-09701-10000	Darlington Refurbishment Project Charter
N-CHAR-AS-0002	Nuclear Management System
N-GUID-00700-10000	Guide to Modification Process
N-GUID-01935-10004	Desktop Guide for Supplier Non-conformance Correction Requests (NCAR).
N-GUID-09701-10011	Darlington Refurbishment - Safety Management Essentials
N-GUID-09701-10013	Nuclear Refurbishment – Environmental Requirements Guideline
NK38-GUID-09701-10031	Darlington Refurbishment Construction Strategy
NK38-GUID-09701-539564	Nuclear Refurbishment Work Stoppage / Reporting and Recovery
NK38-CORR-09701-0513497	Scaffolding Protocol
NK38-CORR-22000-0500070	Crane turnover methodology
NK38-CORR-09701-0537091	Refurb Vendor Storage Protocol
NK38-REP-09701-10030	Darlington Refurbishment Turbine Generator Project's Contracting Strategy Summary for Turbine Generators
NK38-PLAN-09701-10112	Turbine Generator Refurbishment Project Alternate Contracting Plan
NK38-INS-09701-10001	Darlington Refurbishment Project – Scope Control
NK38-PLAN-09701-10010	Supply Chain Management
NK38-PLAN-09701-10012	Management Plan: Management of Contractors for Darlington Refurbishment Project.
NK38-PLAN-09701-10067	Refurbishment Program Management Plan



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Document number	Title
NK38-NR-PLAN-09701-10001 sht.0001	Program Structure and Summary
NK38-NR-PLAN-09701-10001 sht.0002	Program Scope Management Plan
NK38-NR-PLAN-09701-10001 sht.0002	Program Cost Management Plan
NK38-NR-PLAN-09701-10001 sht.0002	Program Schedule Management Plan
NK38-NR-PLAN-09701-10001 sht.0002	Refurbishment Program Reporting Management Plan
NK38-NR-PLAN-09701-10001 sht.0002	Program Risk Management Plan
NK38-NR-PLAN-09701-10001 sht.0014	Refurbishment Program Communication Management Plan
NK38-NR-PLAN-09701-10001 sht.0016	Refurbishment Program Staffing and Resource Management
NK38-NR-PLAN-09701-10001 sht.0002	Program Documentation and Project Closure Management Plan
NK38-NR-PLAN-09701-10001 sht.0008	DNGS Refurbishment Management Plan Darlington Engineering
NK38-NR-PLAN-09701-10001 sht.0011	Program Quality Assurance Plan for Darlington Nuclear Refurbishment
NK38-NR-PLAN-09701-10001 sht.0004	Program Environmental Management
NK38-NR-PLAN-09701-10001 sht.0010	Program Management System Oversight Management Plan
NK38-NR-PLAN-09701-10001 sht.0012	Site Implementation and Construction Management Plan
NK38-NR-PLAN-09701-10001 sht.0007	Program Licensing Management Plan
NK38-NR-PLAN-09701-10001 sht.0005	Health and Safety Management Plan
NK38-NR-PLAN-09701-10001 sht.0013	Contract Management Plan
NK38-NR-PLAN-09701-10001 sht.0003	Return To Service Management
NK38-PLAN-09701-10096	Darlington Refurbishment Turbine Generator Project Negotiation Plan
NK38-REP-00150-10001	Darlington Refurbishment Program Commercial Strategy
NK38-REP-09701-10145	Proposal for Refurbishment Chemistry & Environment Metrics
NK38-SOW-41000-10002	Scope of Supply - Turbines and Aux
NK38-SOW-41800-10002	Scope of Supply - MSR
NK38-SOW-42000-10002	Scope of Supply - Generators and Aux
NK38-SOW-64100-10003	Scope of Supply - Turbine Controls Upgrade
NK38-SOW-64220-10002	Scope of Supply - Generation Excitation Control Upgrade
N-MAN-00120-10001	Nuclear Refurbishment – Milestone Definition Framework

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Document number	Title
N-MAN-00120-10001-CST	Nuclear Refurbishment Cost Management and Project Reporting
N-MAN-00120-10001-GRB	Nuclear Projects – Gated Process
N-MAN-00120-10001-PC	Project Control
N-MAN-00120-10001-RDM	Nuclear Projects Records and Document Management
N-MAN-00120-10001-RDM-03	Nuclear Projects Supplier Document Submission.
N-MAN-00120-10001-RISK-07	Nuclear Refurbishment Assumptions and Decisions Management
N-MAN-00120-10001-SCH	Nuclear Refurbishment Schedule Management.
N-MAN-00120-10001-SCH-02	Standard Project Milestones
N-MAN-00120-10001-SCH-05	NR Project WBS and Control Account.
N-MAN-00120-10001-SCH-06	Milestone Framework
N-MAN-00120-10001-SCH-07	Earned Value Management
N-MAN-00120-10001-SCH-09	Scheduling Requirements from EPC Contractors
N-MAN-09701-10002	Nuclear Project Oversight Guide
N-MAN-09701-10003	Nuclear Contract Management Manual
N-POL-0001	Nuclear Safety Policy
N-PROC-AS-0042	Records and Document Management
N-PROC-LE-0012	Nuclear Refurbishment - Cost Management and Project Reporting
N-PROC-MM-0010	Establishing and Maintaining Ontario Power Generation Nuclear Approved Suppliers List
N-PROC-MP-0078	Specification Review Acceptance and Use Of Vendor Technical Documents,
N-PROC-MP-0090	Modification Process
N-PROC-MP-0105	Quality Design Plan
N-PROC-RA-0022	Processing Station Condition Records
N-PROC-RA-0026	Regulatory Action Management
N-PROC-RA-0047	Communications with the CNSC
N-PROG-AS-0001	Managed Systems
N-PROG-AS-0007	Project Management
N-PROG-LE-0003	Nuclear Refurbishment Project Controls
N-PROG-MP-0001	Engineering Change Control
N-PROG-MP-0009	Design Management
N-PROG-MP-0010	Engineered Tooling Change Control
N-STD-AS-0028	Project Management Standard
N-STD-AS-0029	Contract Management Standard
N-STD-AS-0030	Project Oversight Standard
N-STD-AS-0031	Field Engineering Standards
N-STD-MP-0009	Contractor\Owner Engineering Interface and Oversight

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Document number	Title
N-TQD-510-00001	Supplemental BTU, Direct Hire and Contract Management Training and Qualification Description
OPG-MAN-8133-0002	Records Management Authority Register.
OPG-POL-0001	Employee Health And Safety Policy
OPG-PROC-0019	Record and Document Management.
OPG-PROG-0001	Records and Document Control
OPG-STD-0017	Organizational Authority Register
OPG-STD-0030	Classification, Protection and Release of Information
OPG-STD-0057	Electronic Document Management
TS-PLAN-PMT-0002	Project Management Plan (ESES)

**9.0 APPENDICES**

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## Appendix A: Contracting Strategy Summary for TG Project

This Turbine Generator Refurbishment Project Contracting Strategy Summary provides the currently recommended alternative contracting strategy for the Turbine Generator Project (the “**Project**”) under the Darlington Refurbishment (“**DR**”) program (the “**Program**”) as the project objectives and negotiations goals could not be met through the original contracting approach (full EPC).

The Project Team recommends allowing inclusion of the original equipment manufacturer (“**OEM**”) in the alternate contracting plan. Participation of the OEM will help OPG minimize redesigned components and reverse engineering which will ultimately help to minimize risk.

The EPC contracting model is recommended because it helps ensure the achievement of OPG’s business objectives, DR Program and Project objectives and is the least risk option. This model includes:

- (a) EPC with OEM as prime subcontractor or Joint Venture (“**JV**”);
- (b) EPC without the OEM (i.e. reverse engineering or full replacement);
- (c) EPC where OPG manages the interface between OEM and EPC contractor where:

Work is done under 2 separate agreements (i.e., an agreement with the EPC contractor concluded as a result of a competitive process and an agreement with the OEM concluded as a result of selective single sourcing);

OPG contracts with OEM for engineering, technical support and OEM supplied equipment or components and then free issues materials to the EPC Contractor selected through the alternate process; or OPG assigns the agreement with the OEM to the EPC contractor.

The TG project using a risk based approach preceded with option c) (see above) as per alternative procurement plan NK38-PLAN-41000-10001 and this option includes the following 2 separate contracts:

- An agreement with an ESES Contractor, specifically the Turbine Generator OEM – Alstom (concluded as a result of selective single sourcing);
- An agreement with the EPC contractor concluded as a result of a competitive process considered as EPC wrap-up that will perform the EPC role using the components/parts provided and using the technical support services from in the first agreement with the OEM

All other options specified in the alternative procurement plan were considered higher risk due to reverse engineering and integration.

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**Appendix B: ESES Work Breakdown Structure (WBS)**

WBS Code	WBS Name
NR.TG.TG.01.U2.73262	73262 - U2 - Turbine Generator Project - ESES Contract
NR.TG.TG.01.U2.73262.1	Project Management - U2
NR.TG.TG.01.U2.73262.1.02	Project Mgmt - U2
NR.TG.TG.01.U2.73262.1.03	QA/Health, Safety and Environment - U2
NR.TG.TG.01.U2.73262.1.04	Org, Staffing and Training - U2
NR.TG.TG.01.U2.73262.1.06	Procedures and Work Plans Development
NR.TG.TG.01.U2.73262.1.99	Other Deliverables - U2
NR.TG.TG.01.U2.73262.3	Engineering - U2
NR.TG.TG.01.U2.73262.3.03	Preliminary Engineering - U2
NR.TG.TG.01.U2.73262.3.03.01	Turbine & Auxiliaries Preliminary Engineering - U2
NR.TG.TG.01.U2.73262.3.03.02	Generator & Auxiliaries Preliminary Engineering - U2
NR.TG.TG.01.U2.73262.3.03.04	Turbine Controls Preliminary Engineering TSSM/PAC - U2
NR.TG.TG.01.U2.73262.3.03.05	Excitation Controls Preliminary Engineering - U2
NR.TG.TG.01.U2.73262.3.04	Detailed Engineering - U2
NR.TG.TG.01.U2.73262.3.04.01	Turbine & Auxiliaries Detailed Engineering - U2
NR.TG.TG.01.U2.73262.3.04.02	Generator & Auxiliaries Detailed Engineering - U2
NR.TG.TG.01.U2.73262.3.04.04	Turbine Controls Detailed Engineering TSSM/PAC - U2
NR.TG.TG.01.U2.73262.3.04.05	Excitation Controls Detailed Engineering - U2
NR.TG.TG.01.U2.73262.3.05	Engineering Support/ Updating-U2
NR.TG.TG.01.U2.73262.3.05.01	Turbine & Auxiliaries - U2
NR.TG.TG.01.U2.73262.3.05.02	Generator & Auxiliaries - U2
NR.TG.TG.01.U2.73262.3.05.04	Turbine Controls TSSM/PAC - U2
NR.TG.TG.01.U2.73262.3.05.05	Excitation Control - U2
NR.TG.TG.01.U2.73262.3.06	SIL/HIL
NR.TG.TG.01.U2.73262.3.06.01	Turbine Controls- HIL- Engineering
NR.TG.TG.01.U2.73262.3.06.02	Turbine Controls- SIL- Engineering
NR.TG.TG.01.U2.73262.3.06.04	Excitation SIL - Engineering
NR.TG.TG.01.U2.73262.3.06.03	Excitation HIL - Engineering
NR.TG.TG.01.U2.73262.3.06.05	Turbine Controls- HIL- Procurement
NR.TG.TG.01.U2.73262.3.06.07	Excitation HIL - Procurement
NR.TG.TG.01.U2.73262.3.06.06	Turbine Controls- SIL - Procurement
NR.TG.TG.01.U2.73262.3.06.08	Excitation SIL - Procurement
NR.TG.TG.01.U2.73262.4.05	Procurement - U2
NR.TG.TG.01.U2.73262.5.00	Construction
NR.TG.TG.01.U2. 73262.5.01	TG ESES U2 Erosion Protection Rings Machining
NR.TG.TG.01.U2. 73262.5.14	TG ESES U2 TG & Condenser Work Phase (JV Schedule)

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NR.TG.TG.01.U2.73262.5.20	TG ESES U2 Turbine Inspections
NR.TG.TG.01.U2. 73262.5.50	TG ESES U2 Generator Inspections
NR.TG.TG.01.U2.73262.5.07	TG ESES U2 Test and Commissioning
NR.TG.TG.01.U2.73262.5.09	TG ESES U2 Closeout

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**Appendix C: EPC Work Breakdown Structure (WBS)**

WBS Code	WBS Name
NR.TG.TG.02.U2.73272	73272 - U2 - TG Definition Phase Baseline Schedule
NR.TG.TG.02.U2.73272.1	Definition Phase-Project Management
NR.TG.TG.02.U2.73272.1.01	Project Management
NR.TG.TG.02.U2.73272.1.04	Definition Phase-Org Staffing and Training
NR.TG.TG.02.U2.73272.1.04.1	Training
NR.TG.TG.02.U2.73272.1.09	Definition Phase - Project Management - Other (Test & Commissioning)
NR.TG.TG.02.U2.73272.3	Engineering-Definition Phase
NR.TG.TG.02.U2.73272.3.03	Preliminary Engineering - Definition Phase
NR.TG.TG.02.U2.73272.3.04	Detailed Engineering - Definition Phase
NR.TG.TG.02.U2.73272.3.07	Definition Phase-Procedures, Work Plans, and WO Development
NR.TG.TG.04.U2.73277.5	Construction
NR.TG.TG.04.U2.73277.5.02	Support Trades
NR.TG.TG.04.U2.73277.5.04	Breaker Open Pre Req's
NR.TG.TG.04.U2.73277.5.08	Pre MTCE Crane Inspection
NR.TG.TG.04.U2.73277.5.10	Post MTCE Crane Inspection
NR.TG.TG.04.U2.73277.5.12	TG and Condenser Work Pre Req's
NR.TG.TG.04.U2.73277.5.14	TG and Condenser Work Phase
NR.TG.TG.04.U2.73277.5.18	Turbine & Generator Major Overhaul Pre Req's
NR.TG.TG.04.U2.73277.5.24	Turbine Disassembly
NR.TG.TG.04.U2.73277.5.20	Turbine Inspection
NR.TG.TG.04.U2.73277.5.22	Turbine Reassembly
NR.TG.TG.04.U2.73277.5.21	Condenser Close
NR.TG.TG.04.U2.73277.5.23	Final Turbine Coupling Activities
NR.TG.TG.04.U2.73277.5.26	Turbine Auxiliaries
NR.TG.TG.04.U2.73277.5.28	Bearing Maintenance
NR.TG.TG.04.U2.73277.5.30	Turning Gear MTCE
NR.TG.TG.04.U2.73277.5.32	MSCV's
NR.TG.TG.04.U2.73277.5.34	Intercept Valves
NR.TG.TG.04.U2.73277.5.36	Lube Oil MTCE
NR.TG.TG.04.U2.73277.5.38	FRF MTCE
NR.TG.TG.04.U2.73277.5.40	Gland Steam MTCE
NR.TG.TG.04.U2.73277.5.42	Extraction Steam MTCE
NR.TG.TG.04.U2.73277.5.46	Moisture Separator Reheater
NR.TG.TG.04.U2.73277.5.48	Generator - Disassembly

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NR.TG.TG.04.U2.73277.5.50	Generator - Inspection
NR.TG.TG.04.U2.73277.5.51	Connect Current Transformers
NR.TG.TG.04.U2.73277.5.52	Generator - Reassembly
NR.TG.TG.04.U2.73277.5.56	Generator Aux. - H2 Cooling, SCW, Seal Oil
NR.TG.TG.04.U2.73277.5.58	Generator Auxiliaries - Excitation, HV Terminal & CT Refurb
NR.TG.TG.04.U2.73277.5.06	Turbine & Generator Major Overhaul Post Req's
NR.TG.TG.04.U2.73277.5.68	Simulator Installation
NR.TG.TG.04.U2.73277.5.00	Contingencies/ Spare Activities
NR.TG.TG.04.U2.73277.5.0A	NR/Closeout Activities for D1621
NR.TG.TG.04.U2.73277.6	Testing & Commissioning
NR.TG.TG.04.U2.73277.6.01	RTS Checks
NR.TG.TG.04.U2.73277.6.03	Breaker Close Post Req's
NR.TG.TG.04.U2.73277.9	Closeout
NR.TG.TG.04.U2.73277.9.01	AFS
NR.TG.TG.04.U2.73277.9.02	Post-AFS Activities
NR.TG.TG.04.U2.73277.9.03	OPG: Contract Closeout
NR.TG.TG.04.U2.73277.9.04	OPG: Project Closeout





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**DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL**

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**Darlington Nuclear Refurbishment  
Program-Scope Control**

**NK38-INS-09701-10001-R006**  
2014-10-22

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### Revision Summary

Revision Number	Date	Comments
R006	2014-10-22	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to incorporate the processes for Darlington Station owned non-IIP DSRs, and PSRB transition.</p> <ul style="list-style-type: none"> <li>• Addition of Section 2.1, 2.2, 2.3 for PSRB transition</li> <li>• Addition of HoS N/A.1, N/A.2, N/A.3, N/A.4</li> <li>• Removed HoS 4</li> <li>• Clarification of HoS 05 and 10</li> <li>• Rewording of HoS 4.1, 4.2 4.3, 4.4, 3 and 90</li> <li>• Rewording of 4.17.4: Requirement to Progress HoS</li> <li>• Updated diagram in section 4.1</li> <li>• Section 4.3 : DSR (Not Refurb) and Non-IIP</li> </ul>
R005	2013-12-10	<p>Revised and issued by Nuclear Refurbishment, Work Control to reflect current practices and incorporate DCR 0120354. This is an intent revision. Due to extensive changes, revision bars are not used.</p> <p>ISR flag in 3.2 – scope categorization paragraph and any other mentions in the body of this document have been removed.</p> <p>Section 4.6 PSRB, clarified role of PSRB secretary from “whom will ensure that all decisions are recorded within a scope database.” to “whom will ensure that all decisions are implemented in a timely manner.”</p> <p>The following has been added:</p> <ul style="list-style-type: none"> <li>• HoS 03, 04.1, 04.2, 04.3 and 04.4</li> <li>• Appendix B, questions concerning parts</li> <li>• Appendix K, attached a copy of the mentioned memo</li> <li>• GAR/IIP tracking</li> <li>• Migration of a draft DSR to the live database</li> <li>• Intent vs. non-intent changes</li> <li>• DSR status</li> <li>• DSR type</li> <li>• Initiating work requests from DSR line items</li> </ul>
R004	2012-12-12	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to Incorporate the requirement for Cost Benefit Analysis to accompany any new proposed scope post May 11, 2011 Major Scope Freeze Milestone, add the Life Cycle of a DSR, Screening and Funding committee quorum clarification. Scope Change Section added. Document numbers updated to align with Business Transformation initiative 2012.</p>
R003	2012-04-30	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to Incorporate revised Appendix A, Appendix B, added Appendix C (Scope Decision Matrix), added Appendix H (Scope Hierarchy) Added Appendix J (Scope Decision Matrix Summary Table), and references to the Integrated Safety Review (ISR) and DRAS processes. Incorporated NK38-GUIDE-09701-10012 Guide to Scope Health Definition Planning into this instruction section 7.</p>
R002	2010-12-23	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to Incorporate Screening and Funding Committees additions and governance alignment changes.</p>
R001	2010-06-30	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls</p>
R000	2009-04-29	<p>Initial Issue.</p>

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## 1.0 BACKGROUND

The Program Scope Review Board (PSRB) reviews and approves proposed additions or deletions of major program level scope for refurbishment of the Darlington Nuclear Generating Station (DNGS) as described in the Darlington Refurbishment Program – Program Scope Review Board - Terms of Reference (NK38-PLAN-09701-10003), DNGS Refurbishment Project Reference Plan – Scope Definition (NK38-PLAN-01060-10003) and in accordance with the Darlington Refurbishment Program Charter (D-PCH-09701-10000).

The process of identification of Program scope and the management of scope changes is described in this instruction and applies to all phases of the Darlington Refurbishment Program. This will ensure that the proposed additions and/or deletions have undergone a thorough assessment based on the return on investment, impacts on plant safety, reliability, project schedule and cost, program resourcing, regulatory requirements and environmental impacts. Refurbishment scope is maintained in the Darlington Scope Request (DSR) database.

Scope in the Darlington Refurbishment Program will support the Darlington Refurbishment Principle Program Objectives:

- (a) Confirm feasibility of refurbishing DNGS reactors
- (b) Plan and execute all work required to refurbish the Darlington units
- (c) Ensure the scope of the refurbishment outages will enable economic operations of each unit for an additional 30 years post-refurbishment.

Refer to Program Structure and Summary Management Plan, NK38-PLAN-09701-10067 Sht: 0001, for an overview of the Program and NK38-PLAN-09701-10067 Sht: 0002, Refurbishment Program Scope Management Plan, identifies how the program scope will be defined, managed and controlled throughout the Darlington Refurbishment program.

## 2.0 DIRECTION

This instruction applies to all staff performing or supporting the identification and definition of scope related to the Darlington Refurbishment Program. This instruction describes the process for submission and approval of scope additions by the Darlington Refurbishment Program Scope Review Board (NK38-PLAN-09701-10003). Scope changes and deletions will also follow the process outlined in this instruction.

Rigorous identification and control of the Darlington Refurbishment Outage Program scope and execution is essential to successful completion of the refurbishment on budget and on schedule and shall be based on the following principles:

- Project safety and defense-in-depth is maintained

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- Established Dose Targets are not exceeded
- Appropriate Program and Project work is completed
- Project schedule is not extended unnecessarily and recovery plans are developed as required
- The Program costs do not unnecessarily exceed budget
- Planning and integration with key work management areas of the company (outage and online Darlington schedules)
- Reasonable contingencies are in place for unforeseen circumstances that may arise, i.e. discovery work, during the Darlington Refurbishment Program
- Identify, prioritize, track and mitigate risks associated with the project.

For the purpose of supporting this scope control instruction, the Refurbishment Program scope will include core scope and non-core scope. Scope categories are chosen by the scope initiator and confirmed by the technical screening and funding committees and approved by the PSRB. Scope categories are used to ensure the correct work is accepted into scope with clear justification to support the Program Objectives. Once scope is accepted into the Program, the scope must still follow the Gate Review Board approval process for funding and scope management, in accordance with Nuclear Projects – Gated Process (N-MAN-00120-10001-GRB). Refer to Appendix G of this document for a flowchart of Refurbishment Scope Review Process.

### 2.1 Transition to Ad-Hoc PSRB Meetings

As of May 2014, the quarterly PSRB and Funding Committee Review will be replaced with Ad-Hoc meetings. The NR Project Planning and Controls will have the responsibility in scheduling the need-based PSRB and setting up the agenda.

## 3.0 SCOPING PRINCIPLES

### 3.1 Darlington Refurbishment Objectives

The goal of the refurbishment project is to extend the service life of the units by an additional 30 years of post-refurbishment operations. Refurbishment will involve an outage for replacement of life-limiting components, as well as maintenance or replacement of other components which can be most effectively done during the refurbishment outage period.

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### 3.1.1 Primary Objectives

- Successful refurbishment of Darlington Station Life Limiting Components in order to allow Darlington to operate for 30 years beyond the current predicted end of service life.
- The Refurbishment Project will return the unit in better condition than which it was received.
- A successful refurbishment project requires delivery of all core and approved non-core scope within the timeline and budget established in the Release Quality Estimate and as documented in the project Business Case Summary (BCS).
- Project cost and schedule as well as post-refurbishment performance goals are met with quality, because they will come under extreme scrutiny due to the high profile nature of this project and its impact on OPG's reputation.
- Where scope is approved by PSRB, NR (Nuclear Refurbishment) may recommend inclusion of scope to pre-refurbishment station outage.
- The Refurbishment Program must ensure that all scope is known and is executable.

### 3.1.2 Secondary Objectives

- Refurbishment will assess the scope and overall economics of the program, with consideration of the following:
  - Hardened Backlog
  - 10 Year Investment Program
  - Minor Modification Program
  - Margin Management Plan
  - System Health and Lifecycle management plans
  - System Available for Service (SAFS)/Ready for Service (RFS) process with respect to plant status and operational burdens.
  - Outage Improvement Initiatives
- Support the station vision by delivering value enhancing station improvements (non-core scope).

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- The amount of non-core scope executed during the refurbishment outage will be based on priority of work, and cost benefit assessment. This scope will be optimized to minimize the risk to the refurbishment critical path schedule, and overall project costs.
- All non-core scope must meet strict financial hurdle rules prior to consideration i.e. 9.5% discount rate and 6 year payback (per memo from Chief Financial Officer). Refer to Appendix K for a copy of the memo.

## 3.2 Scope Categorization

All scope is categorized as core scope (CS) or non-core scope (NCS). All core scope will be linked back to the program objectives and non-core scope will be categorized to control and monitor types of scope added and deleted from the Program. Refer to Appendix D of this document for a chart of all scope categories and their description.

### 3.2.1 Core Scope

Consists of work that must be done to achieve the Primary Objective. Core scope will determine the critical path for the refurbishment outage and sets the lower boundary for the cost estimate. Refer to Appendix E of this document for a brief summary of the current document major components of core scope. Core scope includes:

- **Regulatory scope** – Scope that supports station license and regulatory requirements (not optional), as agreed with the regulator and documented in the Integrated Improvement Projects based on Environmental Assessment, Integrated Safety Review and other activities such as Global Assessment which do not require Economic Assessment.
- **Station Life Limiting Components** – modification, repair, or replacement of station life limiting components that must be replaced in order to support the primary objective to allow DNGS to operate for 30 years beyond the current predicted end of service life. This includes items which have an asset class tied to station life and can only be done in a drained and defuelled state. Examples include: Calandria Tubes, Pressure Tubes and Feeders.
- **Component Upgrades** – work to upgrade components, which have a high station priority that can only be done during an extended refurbishment outage with units in a drained/defueled state. Examples include LISS (Liquid Injection Shutdown System) nozzle inspections & repairs, Shutoff Rod guide tubes, and Calandria vessel inspections and repairs.
- **Programmatic work** – Typically performed online or in a normal station outage that must be done in the refurbishment period in order to maintain station licence, including mandatory preventive maintenance, inspections, etc.
- **Prerequisite Scope** – Inspections to determine refurbishment scope and Modifications/upgrades that must be done before refurbishment starts to meet



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production requirements to enable a successful refurbishment. This includes islanding modifications and fueling machine upgrades.

- **Facilities & Infrastructure Plan** – construction of facilities and improvements to the infrastructure to support the refurbishment. See Scope Exclusions (3.2.4) below for exceptions.

### 3.2.2 Non-Core Scope

Consists of work that will be performed in the refurbishment period if it has no impact on the projects Core Scope critical path, does not add risk to the successful completion of core scope, and where cost or resource efficiencies and station priority warrant the work to be executed in the refurbishment period. A Business Case Assessment Summary (BCS) or Decision Record Analysis Summary (DRAS; N-FORM-11390) demonstrating the economic advantage; including risk management and/or reliability improvement, and priority of completing this work during, pre-, during or post-refurbishment will be required to gain approval.

Non-Core scope may include:

- **Safety Improvement Opportunities** – Safety or Environmental improvements beyond standard that provide benefits to the station in terms of increased reliability and/or lower operating costs some of which is documented in the Integrated Safety Review and Safety Factors Reports.
- **Station Improvement Opportunities** – Station improvements that provide benefits to the station in terms of increased reliability and/or lower operating costs, and where it is economically beneficial to OPG to perform the work in the refurbishment period.

### 3.2.3 Facilities & Infrastructure

Facilities & Infrastructure and Campus Plan projects, to support post-refurbishment operations will be funded by the Darlington Refurbishment program. The Darlington Site Infrastructure Co-ordination Committee will prioritize projects to be executed within this funding envelope.

### 3.2.4 Scope Exclusions

The following items are specifically excluded from the scope of Darlington Refurbishment Project:

- Operations and Maintenance work required to be performed to maintain the plant outside of the refurbishment outage window.
- Tritium removal facility improvements, upgrades, or replacements.
- Spare components, either capital or inventory (Other than per ECC (Engineering Change Control) )

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- New Maintenance Facility

## 4.0 PROCESS

Management of the Refurbishment Outage and the complexity over a long period of time will be a key factor in the success of the overall Program. The PSRB will approve the selection of only the correct scope to achieve success of the Program on schedule and within budget.

The Scope Management Process for the Darlington Refurbishment Program is graphically represented in Appendix A. This diagram represents (primarily) the Program Scope Review Board process and the Major Scope decision process. Approval of the further evolution of Major Scope is approved by the Gate Review Board (As per the Gated Process, N-MAN-00120-10001-GRB).

All work requested to be included in the scope of the Darlington Refurbishment Program must be initiated in the Darlington Scope Request database. Scope will originate from several areas of the Program, including the Environmental Assessment and Integrated Safety Review actions, Plant Condition Assessment, including Aging Management recommendations (through Component Condition Assessment's), infrastructure projects, Station Work Management requirements and Station Improvement Initiatives. Considering each scope origin, the scope request information originates in different forms and must be requested in a common format for the Program to control the scope. The Darlington Scope Request database for the Refurbishment Program will be the format in which DSR Line Items are submitted.

Once requested in the database, the scope will be processed accordingly through the database for consideration in the technical screening and funding committees and at one of the PSRB meetings.

Post Major Scope Milestone completion (May 2011) all proposed non-core scope will require a cost benefit analysis (i.e. BCS or DRAS) and project schedule impact review accompanying the DSR. Refer to Developing and Documenting Business Cases (OPG-STD-0076) for BCS process and Nuclear Refurbishment Actions, Issues, Decisions, and Key Assumptions Management (N-MAN-00120-10001-RISK-07) for DRAS process.

### 4.1 DSR life cycle

The DSR will go through a number of transitions from creation to reconciliation against a Work Order at 24 months before each unit's outage, and to close out as illustrated in the diagram below. A DSR starts as a high level thought and progresses from identification stage to the definition stage; depending on how well the scope is known and understood.

There will be five closeout reports, one per unit, as well as a final close out at the end of the project. The DSR managed in the DSR database is the currency of scope control until 24 months prior to the Refurbishment Outage (RO-24) at which time the

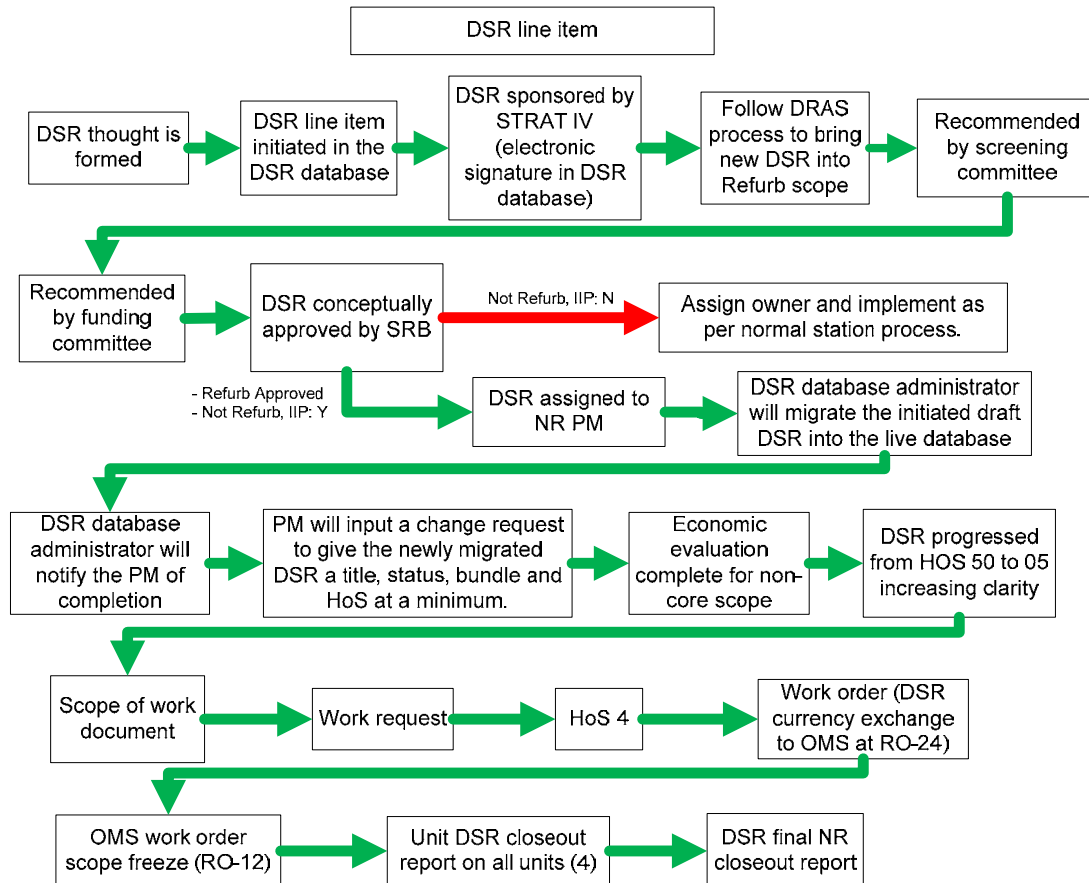
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currency will change to Work Orders managed in the Outage Management System (OMS). The reconciliation report will be complete by the RO-12 (Unit OMS Work Order Scope Freeze Milestone).



## 4.2 DSR database

The term DSR refers to a Darlington Scope Request line item. The DSR database is the source of scope control for the Darlington Nuclear Refurbishment Project. It is available on the project management section of the Darlington Refurbishment web page.

Refurbishment scope is maintained in the DSR data base. Scope management will be integrated into the Refurbishment program information management system through various processes; examples include schedules, contracts, scope of work documents, budgets and business plans. Scope information management shall follow approved OPG, Nuclear and Refurbishment governance, including, but not limited to, N-PROG-AS-0006, Records and Document Control.

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### 4.2.1 DSR initiation

It is intended for anyone to be able to initiate a DSR. To initiate a DSR, open DSR database and follow on screen instructions; if unsure, STOP and ask the DSR database administrator for help. During the DSR creation, the scope initiator will be required to categorize the scope (outlined in Appendix D) and select a DSR type (outlined in Appendix J).

All scope requested in the Darlington Scope Request database must be supported by a Stratum Level 4 sponsor. The sponsor's electronic signature will be required at the time of scope request prior to review at any of the scope review boards. Post Major Scope Milestone completion (May 2011) all new proposed scope will require a cost benefit analysis (i.e. BCS or DRAS) and project schedule impact review accompanying the DSR. After PSRB approval, the DSR database administrator will migrate the initiated draft DSR into the live database and send out an email notification to the PMs (Project Managers) of completion.

If a new DSR is created through an administrative DRAS (does not change scope; i.e. part of an approved DSR is moved to a new DSR with an approved status) and does not require PSRB approval, the signed and issued DRAS can be brought to the DSR database administrator to have the new DSR migrated to the live database.

The PM will need to input a change request to give the newly migrated DSR (at minimum) a title, status, bundle and health. The PM must also review and update any effected work orders.

### 4.3 Scope hierarchy

The scope hierarchy is a method of ranking the DSR line items in the DSR database to establish priority using Scope Type, Risk Rank, Prerequisite Indicator and Economic Valuation. The Scope Hierarchy is further detailed in Appendix H.

### 4.4 Technical Screening Committee

After major scope has been requested and sponsored in the DSR database, a Technical Screening Committee will review the requests. The committee will review a specific list of requirements including Core and None Core designations to ensure the scope request is adequately prepared for the PSRB. The technical screening committee will be led by the Vice President (VP), Nuclear Refurbishment Engineering.

The committee will make technical acceptance recommendations on specific scope items to the Refurbishment Funding Committee and the PSRB.

The Screening Committee Chair and Quorum is as follows:

**Chair:** Vice President, Nuclear Refurbishment Engineering

**Quorum Required (Voting Members):**  
Vice President, Nuclear Refurbishment Engineering

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Director, Operations and Maintenance, Darlington  
Director, Operations and Maintenance, Nuclear Refurbishment  
Director, Engineering, Darlington

Technical Screening Committee meetings require all quorum members or empowered delegates present.

See Appendix C for decision matrix to be used as a guideline by the Technical Screening Committee to make technical acceptance recommendations.

### 4.5 Funding Committee

After Major Scope has been requested and sponsored in the DSR database, and the Technical Screening Committee has recommended the proposed scope addition the Funding Committee will make funding stream recommendations. The Funding Committee will be led by the Director, Nuclear Refurbishment Planning and Controls.

The Funding committee will make funding recommendations on specific scope items to the PSRB.

The Funding Committee Chair and Quorum is as follows:

**Chair:** Director, Nuclear Refurbishment Planning and Controls

**Quorum Required** (*Voting Members*):

Director, Nuclear Refurbishment Planning and Controls  
Director, Business Support, Darlington  
Director, Asset Planning and Integration  
Controller, Nuclear Refurbishment

The Funding Committee meetings require all quorum members or empowered delegates present.

See Appendix F for funding matrix to be used as a guideline by the Funding Committee to make decisions.

### 4.6 Program Scope Review Board

The PSRB shall be a senior cross-functional board with representation from the site and supporting business units. The review board shall consist of voting members and nonvoting members. Non-voting members are scope sponsors or advisors in the Board. All scope presented at the PSRB should be supported by at least one sponsor among the Board membership. This is to ensure that there is support for the scope that is requested and knowledge of the scope that is requested at each meeting. The PSRB voting members will strive to arrive at a consensus for all scope requests. The Director of Planning and Control, Nuclear Refurbishment shall be the Chairperson of the PSRB and will designate a secretary to the PSRB whom will ensure that all

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decisions are implemented in a timely manner. Required quorum for PSRB meetings shall be all of the voting members. In the event of the unavailability of the individual specified below, the Board member may delegate the meeting attendance to an empowered delegate.

The Program Scope Review Board Chair, Quorum and non-voting members are as follows:

**Chair:** Director, Planning and Controls, Nuclear Refurbishment

**Quorum Required** (*Voting Members*):

SVP or Deputy VP, Darlington Nuclear  
SVP, Nuclear Refurbishment  
SVP, Nuclear Engineering and Chief Nuclear Engineer

**Non-Voting Members of the PSRB** (*Sponsors & Advisors*):

VP, Engineering, Nuclear Refurbishment  
VP, Execution, Nuclear Refurbishment  
VP, Corporate Business and Investment Planning  
VP, Science & Tech, or Director, Eng Services  
Director, Operations & Maintenance, Darlington Nuclear  
Director, Operations & Maintenance, Nuclear Refurbishment  
Director, Engineering, Darlington Nuclear  
Director, Engineering, Nuclear Refurbishment  
Director, Work Management, Darlington Nuclear  
Director, Planning and Control, Nuclear Refurbishment  
Director, Investment Management, Nuclear Finance  
Director, Commercial Projects and Facilities  
Director, Business Support Director, Darlington Nuclear

**Note:** The VP, Science and Technology and Director, Engineering Services shall be responsible for scope recommendations within their respective areas of responsibility and attend as appropriate.

In order to record a decision at the PSRB, consensus must be reached between the three (3) Voting Members. This applies to scope approvals and rejections. The PSRB Voting Members will strive to meet the meeting objective of reaching consensus on all scope items during the meeting or by requesting additional information to be provided by the scope sponsors and initiators, in order to support a decision.

## 4.7 Scope Challenge

The scope is challenged a number of times throughout the scoping process. It is challenged at the Technical Screening Committee meeting, financially at the Funding Committee meeting and finally as part of the PSRB, requested scope will be scrutinized to determine whether it must be completed in the Refurbishment Outage and whether it adversely affects the refurbishment outage(s) cost and schedule.

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For each scope request, the PSRB will utilize a list of questions that will challenge the scope initiator to support justification. These questions will address necessity, business need, risk and impact on cost and schedule (Appendix B). Appendix C shows a Scope Flow Decision Matrix which also will be used to validate and challenge the scope. Following approval of Major Scope by the PSRB for inclusion in refurbishment (Refurb) scope, the scope is formally added to the DSR database as Approved. If scope has not been approved, rejection justification will be formally recorded and the scope will be set to "Not Refurb" in the database indicating that it is not part of the refurbishment project and will follow Darlington's normal processes for evaluation.

### **Scope Challenge Meeting** (Prior to Gate 1 and 3 of the Gated Process N-MAN-00120-10001-GRB)

As per N-MAN-00120-10001-GRB, Nuclear Projects Gated Process there is a requirement for a Review of Scope to reassess and confirm need. This is accomplished through a Scope Challenge Meeting. The meeting is chaired and led by the Project Manager who owns the work being proposed to progress the project through the next decision Gate. For each DSR, the PM will utilize the Scope Decision Matrix (Appendix C) to justify / challenge the scope. The PM will complete the summary table in Appendix I and present to the Scope Challenge meeting Quorum for challenge of content and methodology. The completed table confirming recommendations will be submitted with the documents for the Gate Review Board Meeting (N-MAN-00120-10001-GRB). A DRAS will be completed as required and presented at next PSRB.

The Scope Challenge Meeting members are as follows:

**Presenter / Chair:** Project Manager, Nuclear Refurbishment Execution

**Quorum:** Vice President, Nuclear Refurbishment Engineering  
Director, Operations and Maintenance, Nuclear Refurbishment  
Director, Project & Controls, Nuclear Refurbishment

**Advisors:** Director, Nuclear Safety, Nuclear Refurbishment  
Director, Engineering, Nuclear Refurbishment

## 4.8 DSR Changes

If the DSR has not been through Gate 1 of the Gated Process (N-MAN-00120-10001-GRB), i.e. funding not yet allocated for this project, changes are requested through the change control form (change request) within the DSR database. Contact DSR Database Administrator for assistance.

If one of the PM's has been to Gate 1 for the DSR requesting funding, then a Change Control Form (N-FORM-11252) must be completed and approved prior to any DSR database changes.

DSR Change process:

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- For scope changes, DRAS completed by Project Manager and approved by PSRB
- If at or past (funding) gate 1, complete N-FORM-11252 prior to any DSR database changes
- Change control form Initiated in DSR database by an individual
- Change control form concurred (electronically signed) by Project Manager and appropriate stakeholders.
- For intent changes, the change control form also needs to be approved by System Engineering Manager, Nuclear Refurbishment.
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.
- Review and update any affected work orders in Asset Suite.

**Note:** At this time, the DSR Database Administrator is a WCTL (Work Control Team Leader) working for the NR Outage Manager.

### 4.9 Decision Record and Analysis Summary (DRAS)

Decision records are critical in maintaining an auditable trail of the NR Program changes, including changes in strategy, regulatory interactions, technology, resource, scope, etc. These important decisions should be validated by the appropriate authority to ensure alignment across all NR organizations. Refer to N-MAN-00120-10001-RISK-07, Nuclear Refurbishment Actions, Issues, Decisions, and Key Assumptions Management for full DRAS process. If a DRAS affects DSRs, then the follow the steps in section 4.8, DSR change process.

### 4.10 DSR Database change request

Changes to an approved DSR (before gate 1) are requested using the change control form in the DSR database with supporting document (i.e. DRAS), for auditable trail. DSR change control form is an electronic form found in the DSR database in the DSR menu, called "Request change to DSR info". When the form opens up, select the correct DSR and enter your proposed changes in the blue fields on the right of the original DSR. The specific approval is dependent on what is being changed, i.e. intent or non-intent.

This electronic method of change control which allows an individual to propose a change which will then be approved by the Project Manager. The time, date, and LAN ID associated with the change are all recorded in the DSR database.

#### 4.10.1 Intent Change process

Changes in Scope, context or title of a DSR are considered intent changes.



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- For scope changes, DRAS completed by Project Manager and approved by PSRB
- Change control form completed (quoting DRAS number) in DSR database by the Project Manager, Nuclear Refurbishment
- Change control form concurred (electronically signed) by Engineering Project Manager, Nuclear Refurbishment
- For intent changes, the change control form also needs to be approved by System Engineering Manager, Nuclear Refurbishment.
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.
- Review and update any affected work orders in Asset Suite.

### 4.10.2 Non-Intent Change process

Fixing spelling errors or splitting one DSR into multiple DSRs (which doesn't change scope or context) are considered a non-intent change and does not require engineering approval.

- Change control form completed in DSR database by the Project Manager, Nuclear Refurbishment
- Change control form concurred (electronically signed) by appropriate stakeholders.
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.

**Note:** If unsure, default to intent change or contact DSR database administrator.

### 4.11 DSR Ownership Change

- Change control form completed in DSR database by Sending Project Manager, Nuclear Refurbishment
- Change control form concurred (electronically signed) by Receiving Project Manager, Nuclear Refurbishment
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.

**Note:** If one of the PM's has been to Gate 1 for the DSR requesting funding, then a Change Control Form (N-FORM-11252) must be completed and approved prior to any DSR database changes.

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### **4.12 DSR GAR (Global Assessment Report) and IIP (Integrated Implementation Plan) Tracking**

NR Engineering is responsible to identify DSRs committed in the GAR/IIP. NR Engineering will input change requests and the DSR database administrator will ensure the changes reflect approved documentation. All work orders generated from IIP identified DSR line items will require regulatory tracking in AssetSuite.

### **4.13 DSR (Not Refurb) and Non-IIP**

Darlington Generation Station is responsible to use the current station processes to monitor, track and close the work per the following governances and processes.

- N-PROC-MP-0060: Aging Management Process
- N-PROC-MA-0024: System Performance Monitoring
- N-GUID-01510-10001: Site Component Health and Engineering Program Health Reporting Process
- N-PROC-MA-0097: Equipment Reliability Implementation

### **4.14 DSR status**

DSR Status	Description
Approved	PSRB approved scope for the Darlington Refurbishment Project.
Cancelled	Work that will not be completed by the station or Refurbishment organization.
Closed	All work, actions and reports have been completed.
Not Refurb	DSR is not part of the refurbishment project and will follow Darlington's normal processes for evaluation.
Not Required	Contingency work that has been analyzed and determined to be not required, usually due to a report, analysis or inspection results.
Superseded	The DSR's scope is covered by another existing or new DSR. Superseded to station AR, ASIC project, PM, etc for Non-IIP Station owned DSR.

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### **4.15 Initiating work requests from DSR items**

Detailed work orders will be required during the Detailed Planning phase. D-GUID-09701-10013, Initiating Work Request for DSR Items, helps establish the correct nomenclature and sufficient level of detail used when initiating the work request.

When Unit, SCI, Device, Scope of Work and Unit condition information is known, the DSR line item is ready to initiate a work request, as per N-PROC-MA-0008, Work Initiation and Prioritization.

### **4.16 Work Requests to Work orders**

Work Control SPOC reviews submitted work requests for N-PROC-MA-0008 compliancy, assigns appropriate attributes/tags and approves the work request to a work order.

### **4.17 Health of Scope (HoS)**

#### **4.17.1 Background**

The Darlington Nuclear Refurbishment scoping strategy includes a Health of Scope grouping number representative of the work required to progress a DSR from the identification stage to the definition stage. Each DSR in the DSR database has been categorized with a Health of Scope number identifying how well the scope is known and understood. A unit suffix has been added to HoS 04 and the newly created HoS N/A. Therefore each unit will need to be dispositioned for every DSR. This will enable a better history of the DSR when doing the DSR closure report for each unit. The target is to get Health of Scope to 04.X (work orders have been input on X unit) or N/A.X (work orders will not be input on X unit). This will enable the work to have sufficient clarity that it can enter into the Work Management processes (ECC, work order etc.) at RO-24 (OMS Work Order Scope Definition Complete Milestone).

#### **4.17.2 Health of Scope number definitions:**

HOS	Definition
0	New items which have not been assigned a Health of Scope by the Project Manager. The expectation is that the HoS is assigned within 2 weeks after the PSRB approval.
03	No further work required on DSR.
N/A.1	This DSR line item will not generate work orders on Unit 1 and does not require any other work orders to support Unit 1's Refurb Outage.
N/A.2	This DSR line item will not generate work orders on Unit 2 and does not require any other work orders to support Unit 2's Refurb Outage.
N/A.3	This DSR line item will not generate work orders on Unit 3 and does not require any other work orders to support Unit 3's Refurb Outage.
N/A.4	This DSR line item will not generate work orders on Unit 4 and does not require any other work orders to support Unit 4's Refurb Outage.

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04.1	All Work Orders that this DSR requires on Unit 1 and to support Unit 1's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
04.2	All Work Orders that this DSR requires on Unit 2 and to support Unit 2's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
04.3	All Work Orders that this DSR requires on Unit 3 and to support Unit 3's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
04.4	All Work Orders that this DSR requires on Unit 4 and to support Unit 4's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
05	DSR is adequately known such that it is ready for Work Order to be input on all Units (Scope of work and unit condition known).
10	Work is known at the component / MEL level (unit, SCI and Device known).
20	Work is known at the system or project level but not component
30	Actions to implement selected, may be a component strategy across many systems. Options developed and preferred selected at system level (potentially many systems).
40	Analyze the completed report to determine actions / path forward. Required assessments or analysis have been completed and issue, priority, constraints and success criteria are understood.
50	Further assessment is required to build a report for analysis to understand the identified issue before the scoping process can begin. At this point the extent, the impacts, the significance, nor the potential resulting actions are known
60	Pure engineering or procedures with no likely field work (i.e. provide CNSC with a report, update procedure, etc). Activities identified as pure engineering or requiring documentation update will be planned by the responsible functional organizations and will be scheduled in the functional organization schedule ensuring that the deliverables meet the timelines identified in the overall Project Integrated Master Schedule.
90	DSR recommended to be removed from NR scope and will not be executed in Nuclear Refurbishment. DSR will be removed from NR scope, pending PSRB approval. The expectation is that the Project Manager who owns the Scope Health 90 item will have the DRAS completed and approved 14 days prior to the next SRB and communicated to the NR Outage Manger for inclusion and scope removal approval at the next SRB.

Note: Any required unit 0 work will be tagged with the unit requiring the implementation.

#### **4.17.3 HoS change process**

- Change request initiated in DSR database
- Change request approved by the Project Manager, Nuclear Refurbishment
- Change request concurred (electronically signed) by appropriate stakeholders
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.
- Review and update any affected work orders in Asset Suite.

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**Note:** HOS 90 scope removals approved by SRB at next scheduled meeting.

### 4.17.4 Requirements to Progress HoS

This section identifies deliverables required to take a DSR from the Identification phase to Definition phase at a system level through identifying examples of deliverables for each category.

#### **Health of Scope 50 to 40**

Review the scope for the need to prepare an assessment for further analysis. Deliverables to move DSR to 40 may include:

- Nuclear Safety Assessments/Analysis
- Detailed system assessments
- Code gap analysis
- Reliability assessments
- Life Cycle Management plan
- Material/fatigue analysis

To obtain these deliverables an in-house resource may be assigned or a contracting strategy developed and an outside vendor used. The assessments, plans, analysis should end in recommendations that lead to a better understanding of the issue identified in the DSR. At this point the DSR is considered to be HoS 40.

#### **Health of Scope 40 to 30 or 20 if only 1 System or Project**

Review results of the assessments and identify if DSR requires a modification to the plant, maintenance on a system (i.e. repair, replace) inspection or test. Identify options and select preferred to resolve the DSR issue. Steps to progress to 30 may include the following:

- New DSR presented to PSRB for approval
- Prepare and process DRAS form N-FORM-11390 as per N-PROC-LE-0008 if required to either progress DSR or close the item.
- Prepare EDM (Engineering Decision Making Meeting) materials and hold EDM if required to progress complex scope issues as per N-GUID-01900-10001, if EDM agrees with potential scope then generate ECR (Engineering Change Request)
- Prepare Project Gate documents as per N-MAN-00120-10001-GRB.

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- Prepare Conceptual Study/Report as required identifying potential options to address the problem/needs statement. May be prepared by Refurbishment, OSS (Owner Support Services) or EPC (Engineer, Procure, Construct) vendors.
- Generate inspection requirements or plans to support planning of recommended testing or inspections

Additional assessment or analysis may be required to further define the options where the initial assessment cannot conclusively recommend a path forward to resolve the DSR. In this case the DSR Health of Scope is returned to 50 for further assessment.

### **Health of Scope 30 to 20**

Work scope should be defined at a system level. Inspections and Conceptual studies may define a need for further scope to be added into the project, contingencies should be planned for by this time and high risk contingency items should progress through the gated process as required if the inspection work cannot be done until a later date. Activities to progress to 20 may include:

- Options developed and preferred selected at system level.
- Prepare Project Gate documents as per N-MAN-00120-10001-GRB

### **Health of Scope 20**

Work is known at the system or project level but not component. Initiation Phase complete, the following activities can begin:

- Generate a project charter or needs statement for potential modifications to be implemented outside of the Darlington Refurbishment organization.
- Identify non-modification work recommended in the assessments and contact Nuclear Refurbishment WCTLs to input work request for the work, if DSR item issue can be resolved through execution on non-modification work the DSR item can be reclassified as 5 in the Health of Scope
- Develop Preliminary Design Requirements for potential modifications where scope has been adequately defined
- Definition Phase begins. System or project scope is defined. ECR can be generated (ECR identifying problem statement for potential modifications as per N-PROC-MP-0090)
- Sufficient information available to begin to prepare preliminary and detailed design scope of work for EPC RFP (Request for Proposal)
- Long lead items identified

### **Health of Scope 20 to 05**

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Unit, SCI, Device, Scope of Work and Unit condition is known for the DSR and is ready to initiate work requests, as per N-PROC-MA-0008, Work Initiation and Prioritization. Detailed work orders will be required during the Detailed Planning phase. D-GUID-09701-10013, Initiating Work Request for DSR Items, helps establish the correct nomenclature and sufficient level of detail used when initiating a work request from a DSR. It is expected that once ECR's are approved, conceptual design options are identified and preliminary design requirements are prepared. The EPC contracts can then be issued where the contractor will further define the work and ensure that work order planning is completed. Work will be managed via the Gated Process (N-MAN-00120-10001-GRB).

### **Health of Scope 05 to 03 or 04.X or N/A.X**

Work have been input for unit X (04.X) or work orders will not be input for unit X (N/A.X). This requires each unit to be dispositioned for every DSR, which creates a better history for DSR closure reports. If there is no work required for DSR, it can go to HoS 03.

## **4.18 Scheduling**

Darlington Refurbishment Project Managers are accountable to identify the deliverables required to progress DSRs through the Scope Health Definition levels to Health of Scope 03 or 04.X or N/A.X. P6 schedule activities will be created for the deliverables that progress a DSR to HOS 03 or 04.X or N/A.X. The Project Managers will update and maintain the health of scope rating of the DSR in the DSR database.

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### 5.0 DSR DATABASE DEFINITIONS

<b>Acct_Org</b>	Accountable Organization
<b>Add_Info</b>	Additional information
<b>APP_ISR</b>	Indicates that the DSR is included in the Integrated Safety Review (ISR)
<b>Bundle</b>	Work Grouped by Project Manager area of responsibility (i.e. Balance of Plant [BOP], Fuel Handling [FH]) translates to Complex code on the work order.
<b>CCA</b>	Component Condition Assessment Number
<b>CONTINGENCY</b>	Contingency Flag
<b>Cost_Element</b>	Category from original Darlington Refurbishment Business Case to which the cost is allocated
<b>Cost_Estimate</b>	Cost estimate
<b>Description</b>	Description of work encompassed by the DSR (usually from CCA)
<b>DSR</b>	DSR related to the Line item
<b>DSR_Init</b>	DSR initiator (LAN ID)
<b>Dsr_Line</b>	DSR Line Item Number
<b>Ex_Owner</b>	Execution Owner by name
<b>Fog</b>	Functional Outage Grouping
<b>FUN_STR</b>	Funding Stream i.e. Station funded or Refurb funded, etc.
<b>Gate</b>	Last Gate of the Gate Review Process the DSR has passed through
<b>Grouping</b>	Health of Scope indicator
<b>Economic Evaluation</b>	Indicator of completion of the economic evaluation (Y=yes economic evaluation completed, N=no economic evaluation not completed, Not Required= economic evaluation not required; i.e. HOS 60 DSRs and Core Scope DSRs)
<b>Hierarchy</b>	Priority Ranking of DSRs
<b>Inspection</b>	Indicator that an inspection is required
<b>Item</b>	DSR Line item number
<b>Meet_Date</b>	SRB meeting date
<b>Not_Refurb_Reason</b>	Reason for the scope being rejected by PSRB and not included in the Refurbishment of Darlington
<b>Prereq_Type</b>	Categories for Prerequisite work. (The scope bucket may be non Pre-req but have some pre outage Work Orders)
<b>Priority</b>	Not Used at This Time
<b>PSRB_Sponsor</b>	Manager level or higher who sponsors the scope for consideration by PSRB



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<b>Risk_Rank</b>	Risk Ranking per Risk Governance (N-MAN-00120-10001-RISK)
<b>SCI</b>	System Component Identification number
<b>Scope_Owner</b>	Nuclear Refurbishment Project Manager who owns the scope Execution and Planning
<b>Scope_Bucket</b>	Darlington Refurb Window for Execution of the Scope (i.e. Pre-req means work execution is completed prior to Refurb)
<b>SCOPE_TYPE</b>	Scope type (Refer to Appendix D)
<b>Status</b>	DSR Status, Refer to section 4.13 of this document.
<b>SUB_Bundle</b>	Smaller work grouping of a Bundle (i.e. Safety Systems is a sub bundle of BOP)
<b>TEC_REC1</b>	Technical Screening Committee Recommendation
<b>Title</b>	DSR Title
<b>Type</b>	Work type, i.e. regulatory, campus plan, technical, etc.
<b>Unit</b>	Darlington Unit
<b>WBS</b>	Work Breakdown Structure ID

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### 6.0 ACRONYMS

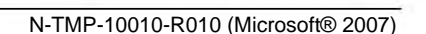
BCS	Business Case Summary
CCA	Component Condition Assessment
CCF	Change Control Form
CS	Core Scope
DNGS	Darlington Nuclear Generating Station
DRAS	Decision Record Analysis Summary
DSR	Darlington Scope Request Line Item
EA	Environmental Assessment
ECC	Engineering Change Control
ECR	Engineering Change Request
EDM	Engineering Decision Making Meeting
EPC	Engineering, Procure, Construct
GAR	Global Assessment Report
HOS	Health of Scope
IIP	Integrated Implementation Plan
LISS	Liquid Injection Shutdown System
MEL	Master Equipment List
NCS	Non-Core Scope
NR	Nuclear Refurbishment
OM&A	Operations, Maintenance and Administration
OMS	Outage Management System
OSS	Owner Support Services
PM	Preventative Maintenance or Project Manager
PSRB	Program Scope Review Board
Refurb	Refurbishment
RFP	Request for Proposal
RFS	Ready for Service
RO	Refurbishment Outage
SAFS	System Available for service
SVP	Senior Vice President
VP	Vice President
WCTL	Work Control Team Leader

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## 7.0 REFERENCES

- [R-1] Darlington NGS Refurbishment Project Reference Plan – Scope Definition (NK38-PLAN-01060-10003)
- [R-2] Darlington Refurbishment Program – Program Scope Review Board – Terms of Reference (NK38-PLAN-09701-10003)
- [R-3] Darlington Refurbishment Planning activities Project Charter (D-PCH-09701-10000)
- [R-4] Developing and Documenting Business Cases (OPG-STD-0076)
- [R-5] Nuclear Refurbishment – Darlington (N-PROG-LE-0002)
- [R-6] Nuclear Projects gated Process (N-MAN-00120-10001-SHT-GRB)
- [R-7] Nuclear Refurbishment Actions, Issues, Decisions, and Key Assumptions Management (N-MAN-00120-10001-RISK-07)
- [R-8] Decision Record and Analysis Summary form (N-FORM-11390)
- [R-9] Nuclear Refurbishment Change Control Form (N-FORM-11252)
- [R-10] Refurbishment Program Structure and Summary Management Plan (NK38-PLAN-09701-10067-SHT-0001)
- [R-11] Refurbishment Program Scope Management Plan (NK38-PLAN-09701-10067-SHT-0002)
- [R-12] Initiating Work Request for DSR Items (D-GUID-09701-10013)
- [R-13] Work Initiation, Approval, and Prioritization (N-PROC-MA-0008)
- [R-14] Records and Document Control (N-PROG-AS-0006)
- [R-15] Modification Process (N-PROC-MP-0090)
- [R-16] Engineering Decision Making (N-GUID-01900-10001)
- [R-17] NR Planned Outage Management (NK38-MAN-09701-10005)



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## DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL

### Appendix B: Darlington Refurbishment Program Scope Categories and Standard Scope Justification Questions

#### B.1.0 CORE SCOPE

Core Scope directly supports the Program Objectives to ensure the success of Refurbishment.

Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>CS01</b>	Regulatory Improvements to meet current Standards	<ul style="list-style-type: none"> <li>Scope that is not optional in order to support the Station License and Regulatory Requirements.</li> </ul>	Q. What is the required regulatory commitment date? Is it required to be completed during the Refurbishment Outages?	<ul style="list-style-type: none"> <li>Environmental Assessment and IIP Actions.</li> <li>Integrated Safety Review and IIP Actions.</li> </ul>
			Q. Are there any technical alternatives for this particular regulatory requirement (i.e. can it be met in any other way? Is there another solution?)	
<b>CS02</b>	Life Limiting Components	<ul style="list-style-type: none"> <li>Major component modification, repair or replacement that cannot survive operation for an additional 30 years (post-synchronization for each unit) – note the exception below.</li> </ul> <p><i>** Note: Components which are assessed to be able to operate effectively for a significant time post-refurbishment, but would then need extensive repairs or replacement, are not to be included in the proposed refurbishment scope, unless they would have a detrimental impact on unit reliability, safety or if they could only be repaired or replaced under refurbishment outage plant condition (i.e. De-</i></p>	Q. Is the proposed scope supported by a life cycle management plan?	<p>Major life limiting components are identified as:</p> <ul style="list-style-type: none"> <li>Replacement of pressure tubes</li> <li>Replacement of calandria tubes</li> <li>Replacement of Feeders</li> <li>Balance of Plant System components (supported by Plant Condition Assessment)</li> </ul>
			Q. Is it considered necessary (component would otherwise be not fit for service)?	
			Q. Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
			Q. Is the work only feasible in the drained and defueled state achieved in the refurbishment outage?	
			Q. Is the work date-sensitive?	
			Q. Can the work be completed while the unit is online?	
			Q. Can the work be completed during a regularly scheduled maintenance outage before or after the Refurbishment Outage? If so, what is the impact on that maintenance outage?	

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
		<i>fuelled/dewatered). These recommendations will be made through the review of Technical Scope documentation (Plant Condition Assessments).</i>	<p><b>Q.</b> Has the alternative of doing the work during the pre-refurbishment period been considered/assessed? Provide clear rationale why not feasible; i.e. discuss drawbacks, major risks.</p> <p><b>Q.</b> Is the equipment assessed to operate for a significant time post-refurbishment?</p> <p><b>Q.</b> Does the proposed solution impact on refurbishment outage schedule?</p> <p><b>Q.</b> Is it more economical to complete the work when scheduled in the refurbishment outage (rather than before or after)? If so, provide economic rationale.</p>	
<b>CS03</b>	Mandatory Support for Core Scope	<ul style="list-style-type: none"> <li>Must do in order to support execution of Core Scope.</li> </ul>	<p><b>Q.</b> Would the refurbishment core scope still be possible to execute without this scope / infrastructure?</p>	<ul style="list-style-type: none"> <li>Program Management deliverables (non-construction work): Program and Project Management, QA, Supply Chain, Op&amp; Commissioning Management, Health and Safety Management.</li> <li>Required Pre-Outage Inspections (to support definition of Core Scope) - Station Outage or Online work management required.</li> <li>Islanding activities for each unit outage.</li> <li>Infrastructure Master Campus Plan listed work that is mandatory only to support Core Scope (i.e. Retube Control Centre) and absolutely must be executed. The Core Scope could not be executed without this Infrastructure in place (with or without efficiencies).</li> <li>All work required to</li> </ul>
			<p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</p>	
			<p><b>Q.</b> Are the parts:</p> <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
				shut down, start-up and test the unit for the Refurbishment Outage.
<b>CS04</b>	Mandatory 'Construction Period' Outage Work	<ul style="list-style-type: none"> <li>Preventative Maintenance Work that would normally be executed during the time period during the Refurbishment Outage</li> <li>Mandatory Inspections that would normally be executed during the time period during the Refurbishment Outage.</li> </ul>	<b>Q.</b> Is the proposed scope Preventative Maintenance included in the PM strategy document for each unit? If not, why is it being requested now?	<ul style="list-style-type: none"> <li>PM for oil change on auxiliary boiler feed pump</li> <li>PM for electrical breaker testing</li> <li>FAC program inspections on service water pipe work</li> <li>Mandatory RV testing/calibrations</li> </ul>
			<b>Q.</b> Is the inspection considered mandatory? Why (what is the supporting mandating documentation)?	
			<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>CS05</b>	Regulatory Improvements beyond current Standards	<ul style="list-style-type: none"> <li>Regulatory suggested improvements that are not required as per current codes and standards.</li> </ul>	<b>Q.</b> Are there any technical alternatives for this particular regulatory requirement (i.e. can it be met in any other way? Is there another solution?)	<ul style="list-style-type: none"> <li>Improvements To EPS Availability</li> <li>Emergency Heat Sink for Accidents</li> </ul>
			<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	



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## DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL

### B.2.0 NON -CORE SCOPE (NCS)

#### B.2.1 Sustaining (SU) - Non - Core Scope

Sustaining Scope is not mandatory to execute the Refurbishment Outage and achieve the Program Objectives. It may provide long term benefits to the Darlington Site and stations outside the primary Program Objectives. All Non-core Scope requires economic justification (i.e. DRAS).

Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>SU01</b>	Sustaining Infrastructure	<ul style="list-style-type: none"> <li>Infrastructure upgrades required to sustain an additional 30 years of operations.</li> <li>Work is listed as part of the Darlington Master Campus Plan and the Darlington Program Campus Plan Scope Statement</li> <li>Is not part of, nor does it directly support core scope.</li> </ul>	Q. Can the work be executed after Refurbishment is complete without impacting ongoing plant operations?	<ul style="list-style-type: none"> <li>Salt Shed</li> <li>Heavy Vehicle Storage Building</li> <li>Boiler House</li> <li>Lakeshore Garage</li> <li>Gas Bottle Storage</li> </ul>
			Q. What is the economic benefit to refurbishment or to the continued operation of DNGS for an additional 30 years?	
			Q. What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			Q. Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>SU02</b>	Station Upgrades	<ul style="list-style-type: none"> <li>Non-infrastructure station upgrades required to sustain an additional 30 years of operations.</li> <li>Is not part of, nor does it directly support core scope.</li> </ul>	Q. Can the work be executed after Refurbishment is complete without impacting ongoing plant operations?	<ul style="list-style-type: none"> <li>New or improvements to permanent stairway, lifting device, floor grating, access hatches.</li> <li>Logistics improvements to loading bays, cafeteria, walkways</li> </ul>
			Q. What is the economic benefit to refurbishment or to the continued operation of DNGS for an additional 30 years?	
			Q. What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			Q. Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>SU03</b>	Equipment Renewal	<ul style="list-style-type: none"> <li>One time replacement at current end of component life</li> </ul>	Q. Would the refurbishment core scope still be possible to execute without this scope / infrastructure?	<ul style="list-style-type: none"> <li>Steam Turbines and Turbine Auxiliaries: Main Lube Oil Pump</li> </ul>

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Category	Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
	(Nominal 30 years). <ul style="list-style-type: none"> <li>Replacement of obsolete components</li> <li>Inspections to determine equipment condition not part of normal PM program.</li> </ul>	<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later? <b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	<ul style="list-style-type: none"> <li>Main Condensate System: LP Heaters</li> <li>Fuel Handling Inverters Replacement</li> <li>Turbine Control Upgrade</li> </ul>

### B.2.2 Value Enhancing (VE) - Non - Core Scope

Value Enhancing Scope is not mandatory to execute the Refurbishment Outage. There may be significant advantages to the station or to OPG by executing some value enhancing scope. It will primarily have an impact on the post-refurbishment time period. Value Enhancing scope would optimize (primarily) the cost efficiencies post-refurbishment and may help the Station meet efficiency targets (these are not Refurbishment targets). Value Enhancing scope could also provide cost or resource efficiencies during Refurbishment, but are not absolutely essential in completing the work. All Non-core Scope requires economic justification (i.e. DRAS).

Category	Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>VE01</b>	Operations, Outage, Cost, Resource & Maintenance Efficiencies	<ul style="list-style-type: none"> <li>Scope can be proven to add value to the station operations in future by improving maintenance methods, saving costs on outages, optimizing resources or improving operations.</li> </ul>	<ul style="list-style-type: none"> <li>Outage Heat Sink modification expected to reduce outage durations post-refurbishment.</li> <li>Modification to enable a valve to be replaced with a new design instead of repairing a valve.</li> <li>Modification to allow specified maintenance to be completed at-power rather than during an outage condition.</li> <li>Technically required work which is known to extend outage duration or incur greater dose in regular outages and makes an economic case to include in the Refurbishment Program.</li> </ul>
		<b>Q.</b> Has a clear explanation been provided as to why the expected impacts/ savings (e.g. OM&A costs, planned outage time, forced loss rate, operator work around, dose reduction, etc) are defensible and attributable to this specific scope of work?	
		<b>Q.</b> Has a review been done to ensure that the expected savings/impacts of this scope of work have not already been included in other proposed work scope?	
		<b>Q.</b> Have all major stakeholders (and potentially an independent 3rd party) validated the expected savings/ impacts?	
		<b>Q.</b> Have all potential post-project implementation costs been included?	
		<b>Q.</b> Have required infrastructure and support work costs been included?	
		<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do	

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
			<p>in Refurb rather than later?</p> <p><b>Q.</b> Are the parts:</p> <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>VE02</b>	Safety Improvements beyond Standards	<ul style="list-style-type: none"> <li>Station or Refurbishment suggested improvements that are not required as per current codes and standards.</li> </ul>	<b>Q.</b> Has the improvement been requested by a group in the Station or an external stakeholder?	<ul style="list-style-type: none"> <li>Installation of a new railing, signage, overhead door or ergonomic enhancement is currently not in place and is in compliance with safety standards and not in violation of any OPG standards.</li> </ul>
			<b>Q.</b> Is there a time constraint for this improvement? If so, what is it? What are the reasons for the constraint?	
			<b>Q.</b> Why should this improvement be considered for execution during refurbishment? Can it be done before Refurbishment?	
			<b>Q.</b> What are the benefits to executing this during the refurbishment outage?	
			<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			<b>Q.</b> Are the parts:	
			<ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>VE03</b>	Environmental Improvements beyond Standards	<ul style="list-style-type: none"> <li>Station or Refurbishment suggested improvements that are not required as per current codes and standards.</li> </ul>	<b>Q.</b> Has the improvement been requested by a group in the Station or an external environmental stakeholder?	<ul style="list-style-type: none"> <li>Installation of a new oil dyke around equipment that was not previously in place and is currently in compliance with environmental laws and not in violation of any OPG standards.</li> </ul>
			<b>Q.</b> Is there a time constraint for this improvement? If so, what is it? What are the reasons for the constraint?	
			<b>Q.</b> Why should this improvement be considered for execution during refurbishment? Can it be done before Refurbishment?	
			<b>Q.</b> What are the benefits to executing this during the refurbishment outage?	

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>VE04</b>	Infrastructure upgrades that are expected to increase efficiencies for the <u>Refurbish</u> Outage period only, but do not directly support Core Scope.	<ul style="list-style-type: none"> <li>Scope that can improve efficiencies during the refurbishment such as improved resource effectiveness, reduction of delays, improved site transportation/logistics.</li> </ul>	<b>Q.</b> What are the economic benefits to executing the work during the refurbishment outage? What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	<ul style="list-style-type: none"> <li>Increased security monitors or security equipment to make entrance to the station more efficient</li> <li>Moving existing facilities closer to the work face to decrease travel time for trades or management staff</li> </ul>
			<b>Q.</b> How can the station benefit from this work post-refurbishment?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>VE05</b>	Enhance Corporate Reputation	<ul style="list-style-type: none"> <li>Proposed scope that will/may enhance OPG's or Darlington Refurbishment Program's corporate reputation with Clarington, Ontario or other groups.</li> </ul>	<b>Q.</b> Is the scope directly related to Refurbishment? (Is this something where funding would normally be obtained through another business unit as part of that unit's core business?)	<ul style="list-style-type: none"> <li>Modification to improve environmental emissions</li> <li>Modification to reduce sound emissions from the station</li> <li>Public Affairs communications (billboards, additional temporary communication stations in the community).</li> </ul>
			<b>Q.</b> How will the scope improve OPG's corporate reputation?	
			<b>Q.</b> Why should this scope be part of the Refurbishment program (and not part of Darlington Nuclear's ongoing operations?)	
			<b>Q.</b> What external groups does this impact (i.e. is there a group that is specifically interested in this initiative?).	
			<b>Q.</b> Is there a strategy in place to communicate this improvement, should it be added to scope?	

### B.2.3 Performance Improvement (PF) - Non - Core Scope

Performance Improvement Scope is non-core scope that supports the reduction of Unit backlog work orders or supports System Health targets beyond the condition at unit turnover to the Refurbishment Program management team. All Non-core Scope requires economic justification (i.e. DRAS).

Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>PF01</b>	Reduce Unit Backlog (non-core, most likely CM or	<ul style="list-style-type: none"> <li>Non-core work that will help reduce backlogs on Darlington Units.</li> </ul>	<b>Q.</b> Does this work exceed the condition in which Refurbishment received the unit from Operations?	<ul style="list-style-type: none"> <li>Valve that has been in disrepair for many years (through many outages). Parts have</li> </ul>

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	EM work orders)	<ul style="list-style-type: none"><li>Work may be required for unit start-up (i.e. you need the CM or EM equipment fixed to perform start-up of the unit). This may be mandatory to execute for unit condition, but is still not core scope.</li></ul>	<div><div>Q. Does this work contribute to the backlog reduction for the unit?</div><div>Q. Has the unit been started before (after a previous outage) with this condition present? Were there significant conventional safety, nuclear safety, maintenance or operations issues?</div><div>Q. What is the impact on the refurbishment outage schedule?</div><div>Q. What is the impact on the outage cost? What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</div><div>Q. Are the parts:<ul style="list-style-type: none"><li>Available (for purchase or spares on hand)?</li><li>Obsolete?</li><li>Long lead items?</li></ul></div></div>	<div>not been available and this has not been a high priority and does not significantly impact the operation of the system.</div> <ul style="list-style-type: none"><li>Switch that breaks upon commissioning of a system that previously had no work performed on it during the refurbishment outage, but must be repaired or replaced in order to start up the unit/system.</li></ul>
PF02	Operator Work-Around (non-core)	<ul style="list-style-type: none"><li>Non-core work that will remove a requirement for an Operator Work Around. Work <u>may</u> be mandatory for start-up, but is still not core scope.</li></ul>	<div><div>Q. Can this work be executed pre-Refurbishment?</div><div>Q. What is the impact to Operations and the unit if the work is not completed in Refurbishment?</div></div>	<ul style="list-style-type: none"><li>PNGS B example: moderator spool piece for refill was removed years ago during moderator commissioning and not reinstalled. Ops cannot use refill header from S&amp;I tanks to refill moderator, uses a hose under a jumper. Increases refill duration. Mod could be done while unit is operating.</li></ul>
PF03	Design Modifications (non-core) required to maintain operation of an existing non-life limiting component (likely a CM or EM backlog work order	<ul style="list-style-type: none"><li>Proposed modification may be required to continue operations of a system or component, but is not core scope and does not contribute in the greater '30 year' life span of the equipment or system.</li><li>May be required for Unit start-up if it is</li></ul>	<div><div>Q. Is this a requirement for unit start-up?</div><div>Q. If the request is before the scope freeze date; can the work be completed pre-Refurbishment?</div><div>Q. The work does not support core scope and was not identified by Aging Management or Life Cycle Plans as a requirement for an additional 30 years of</div></div>	<ul style="list-style-type: none"><li>Modification to install a balancing weight on a fan due to unacceptable vibrations at system start-up/commissioning – it is minimal work to fix a balance issue, but is not a 30 year fix. May actually be required for start-up, but is not related to core scope</li></ul>

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
	origin).	emergent.	<p>operation. Provide justification for this modification and the near-term benefits to the station.</p> <p><b>Q.</b> Is there a better alternative that will contribute to a longer life-span of the equipment?</p> <p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</p> <p><b>Q.</b> Are the parts:</p> <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	and does not guarantee that equipment or mod will last for the life of the station.
<b>PF04</b>	Reliability Improvement	<ul style="list-style-type: none"> <li>Proposed scope has high likelihood of improving unit reliability and contributes to reducing unit forced loss rate and optimizing unit capacity factor.</li> <li>Has caused an Equipment Reliability Reset (see criteria below):               <ol style="list-style-type: none"> <li>Causes of Reactor Trip, Stepback or Setback</li> <li>Causes a Turbine or Generator Trip</li> <li>Results in a Unit Transient &gt; 5%</li> <li>Results in &gt; 250 Mwhr Forced Loss</li> <li>Categorized as a Reactivity Management Event (Categories 1&amp;2 per N-STD-OP-0009)</li> <li>Results in a Unit/Station entering = 24 Hr Shutdown Clock per AIM</li> <li>Categorized as an Event Reset</li> </ol> </li> </ul>	<p><b>Q.</b> Can this scope be performed online or in an outage prior to or post-refurbishment?</p> <p><b>Q.</b> What is the priority on this improvement for the station? Is it likely to contribute to another ER reset or has an investigation shown otherwise?</p> <p><b>Q.</b> Has this reliability issue occurred more than once at Darlington or other stations? What is the probability of reoccurrence?</p> <p><b>Q.</b> Does the cost of the proposed scope outweigh the cost of MW loss of generation? Has an economic assessment been completed?</p> <p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</p>	<ul style="list-style-type: none"> <li>Unit 5 East F/M stuck on channel E-06. East B-ram will not retract to allow for separation of the second pair. 48 hour shutdown clock initiated June 2, 2009 @ 21:06. WR #00685020.</li> <li>5-71210-P2 tripped. Field investigation reported that the power supply 5-53200-CB7D tripped on a ground fault resulting in &gt;6MW loss in output.</li> </ul>

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
		(where an equipment failed that did not meet any of the above criteria but deemed as very significant)	<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>• Available (for purchase or spares on hand)?</li> <li>• Obsolete?</li> <li>• Long lead items?</li> </ul>	

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General Questions for all Scope Requests (in any category)	
<b>Stakeholders/ Integration/ Objectives</b>	<ul style="list-style-type: none"> <li>Has an assessment been done of other upcoming scope/projects to determine whether there are opportunities for integration of work to realize cost/schedule savings?</li> </ul>
	<ul style="list-style-type: none"> <li>Is this scope or proposed project dependent on other planned scope/ projects being included in refurbishment scope? If so, specify.</li> </ul>
	<ul style="list-style-type: none"> <li>Have all key stakeholders (e.g. DN Refurbishment, DN Operations, Nuclear Engineering, and Regulatory Affairs) provided input and have their issues been dispositioned?</li> </ul>
	<ul style="list-style-type: none"> <li>How does this scope or proposed project address one or more of the Refurbishment Program Objectives? Specify.</li> </ul>
<b>Alternatives</b>	<ul style="list-style-type: none"> <li>Has the alternative of doing the work during the pre- refurbishment period been considered/assessed? Provide clear rationale why not feasible; i.e. discuss drawbacks, major risks.</li> </ul>
	<ul style="list-style-type: none"> <li>Has the alternative of doing the work during the post- refurbishment period been considered/assessed? Provide clear rationale why not feasible, i.e. discuss drawbacks, major risks.</li> </ul>
	<ul style="list-style-type: none"> <li>Is the technical justification for completing the work during the refurbishment outage robust?</li> </ul>
	<ul style="list-style-type: none"> <li>Have all feasible alternatives (or alternative approaches) of executing the work during the refurbishment outage been developed?</li> </ul>
	<ul style="list-style-type: none"> <li>Has the impact on refurbishment outage schedule and cost of the preferred alternative been assessed?</li> </ul>
<b>Scope/ Project Cost Estimate</b>	<ul style="list-style-type: none"> <li>Has a scope and cost estimate been developed for all feasible alternatives?</li> </ul>
	<ul style="list-style-type: none"> <li>Is the basis for the estimate of scope/ project costs clearly stated?</li> </ul>
	<ul style="list-style-type: none"> <li>Have cost estimate ranges been provided for scope/ project costs to indicate the accuracy of the estimate?</li> </ul>
	<ul style="list-style-type: none"> <li>Does the estimate include contingency and provide the basis for the contingency?</li> </ul>
<b>Economic Analysis of Feasible Alternatives/ Risk Assessment of Preferred Alternative</b>	<ul style="list-style-type: none"> <li>Have major risks and mitigating actions been identified? (Risks areas include finance, schedule, quality, corporate reputation, regulatory, health &amp; safety, environment &amp; nuclear safety).</li> </ul>
	<ul style="list-style-type: none"> <li>Have potential incremental schedule /cost impacts been assessed if these risks materialize?</li> </ul>
	<ul style="list-style-type: none"> <li>Has specific contingency been included in the schedule/cost estimates to address these potential risks?</li> </ul>
	<ul style="list-style-type: none"> <li>Has the alternative of doing the work during the pre-refurbishment period been considered / assessed?</li> </ul>
	Does the NPV analysis include a table showing a breakout of the contributions to NPV of each of the expected savings/impacts?

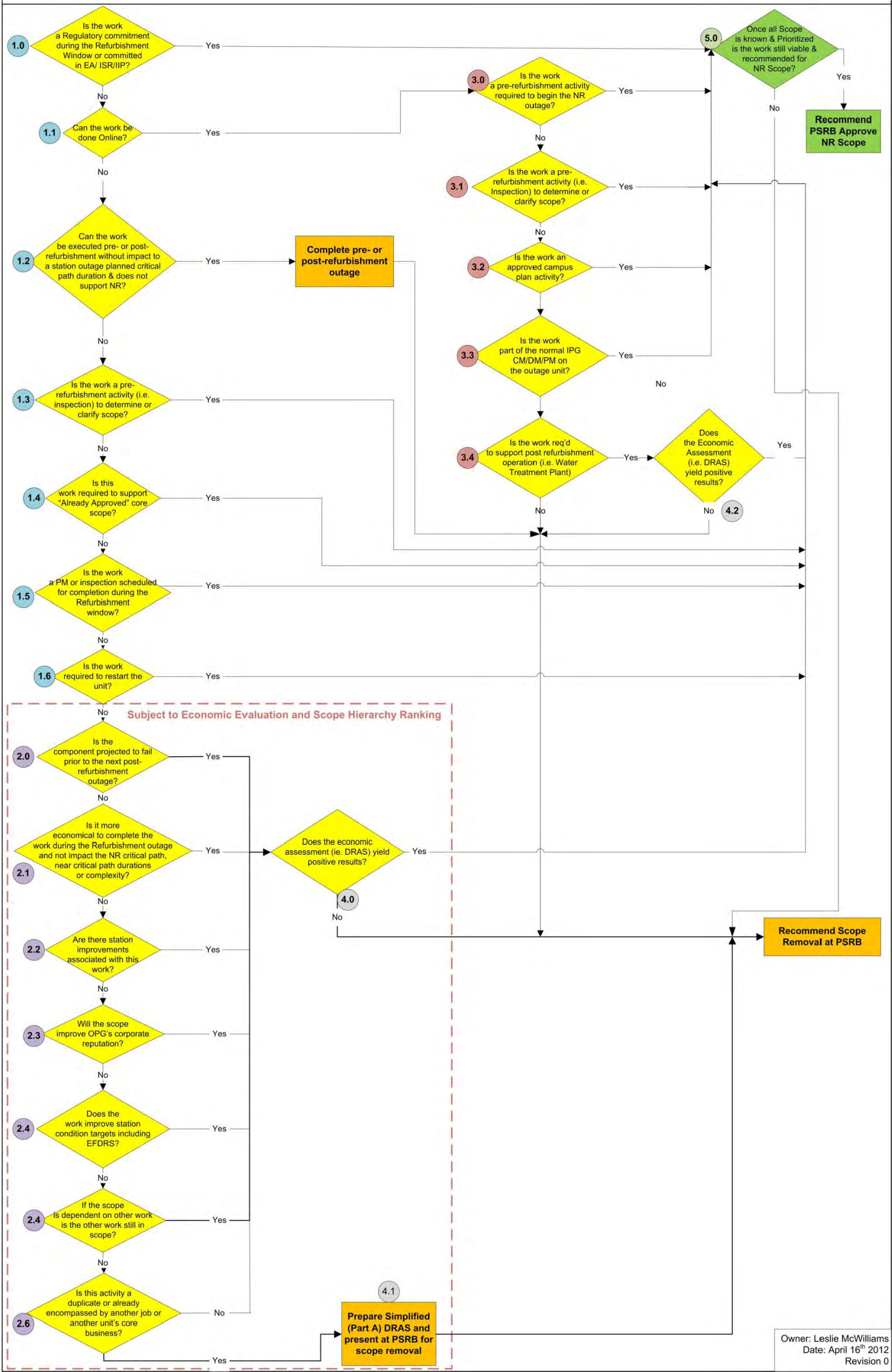


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Appendix C: Nuclear Refurbishment Scope Decision Matrix









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## Appendix E: Core Scope of the Darlington Refurbishment Program

### Refer to NK38-PLAN-01060-10003, Darlington NGS Refurbishment Project Reference Plan – Scope Definition

Core Scope of the Refurbishment Program will support the primary objectives of the Program. Core Scope is included in the Business Case Summary for the Program.

The following is a **brief** summary of the current documented major components of Core Scope.

- Replacement of all Fuel Channels (calandria tubes and pressure tubes)
- Replacement of all Feeders
- Balance of Plant life limiting components only where justified to support Program Objectives and support an economic business case
- Regulatory work required to be performed in order to extend the life of the station by an additional thirty years, as indicated in the CNSC approved Integrated Safety Report (ISR), Environmental Assessment (EA), and Integrated Implementation Plan (IIP).
- Work related to outage preparation, including development of tooling, mock-ups, training, unit islanding, installation of barriers, modifications, etc. to support the outage, and all planning activities related to items included in the scope of the Darlington Refurbishment Program.
- Infrastructure development to directly support the refurbishment outage
- Work Management work committed to be performed on the unit within the start and end date of that unit refurbishment outage.

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**Appendix F: Darlington Refurbishment Program – Funding Matrix for Program Level Scope**

The following is a funding guide for all scope related to the Darlington Refurbishment Project.

Funding Program \ Program Phase	Pre-Refurbishment Period	Refurbishment Period	Post-Refurbishment Period
	Schedule Accountability <sup>(1)</sup> – NGS Operations (Non-Outage, Outside Protected Area and Outage Work Control)	Schedule Accountability <sup>(1)</sup> – NR Program Management Office (PMO)	Schedule Accountability <sup>(1)</sup> – NGS Operations (On-line and Outage Work Control)
<b>Darlington Operations (Business Plan)</b>  <i>Operate and Maintain the plant pre- and post- refurbishment</i>	<ul style="list-style-type: none"> <li>Maintain the plant until Refurbishment: <ul style="list-style-type: none"> <li>All Cyclic Outage work and inspection programs associated with normal operations and maintenance.</li> <li>Life-cycle management work including items identified in CCAs.</li> <li>Pre-refurbishment outages</li> <li>Minor Mods Program</li> </ul> </li> <li>Execution of station strategies to meet DN Station Vision</li> </ul>	<ul style="list-style-type: none"> <li>No budget for online and outage work programs for unit(s) during the refurbishment period.</li> </ul>	<ul style="list-style-type: none"> <li>Maintain the plant post Refurbishment: <ul style="list-style-type: none"> <li>All Cyclic Outage work and inspection programs associated with normal operations and maintenance.</li> <li>Life-cycle management work including items identified in CCAs.</li> <li>Post-refurbishment outages</li> <li>Minor Mods Program</li> </ul> </li> <li>Execution of station strategies to meet DN Station Vision</li> </ul>
<b>Darlington Refurbishment Program</b>  <i>Prepare for and execute the refurbishment outage on time, on budget, and with 100% scope completed; as identified in Release Quality Estimate.</i>	<ul style="list-style-type: none"> <li>Any Core <sup>(2)</sup>, Scope approved by SRB where NR has requested delivery of scope prior to the refurbishment outage<sup>(3)</sup>, and / or where station work management agree to perform scope in pre-refurbishment period (outage or online).</li> <li>Non Core <sup>(2)</sup> scope, as approved by SRB, and where required to be done prior to the refurbishment outage; including</li> </ul>	All execution activities, including: <ul style="list-style-type: none"> <li>All Core <sup>(2)</sup> scope approved by the SRB, as generated by CCA, ISR, and EA process.</li> <li>All Non Core <sup>(2)</sup> scope approved by the SRB, where executed during the refurbishment outage period, and not funded by AISC.</li> <li>All staff engaged in the refurbishment program, whether directly assigned or other-business-unit support; including</li> </ul>	<ul style="list-style-type: none"> <li>Refurbishment funded scope, Core <sup>(2)</sup> or Non Core <sup>(2)</sup>, approved by the SRB, which is deferred to a post-refurbishment period <sup>(4)</sup>.</li> </ul>

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Funding Program	Program Phase	Pre-Refurbishment Period	Refurbishment Period	Post-Refurbishment Period
		Schedule Accountability <sup>(1)</sup> – NGS Operations (Non-Outage, Outside Protected Area and Outage Work Control)	Schedule Accountability <sup>(1)</sup> – NR Program Management Office (PMO)	Schedule Accountability <sup>(1)</sup> – NGS Operations (On-line and Outage Work Control)
		facility and infrastructure modifications, or islanding modifications in support of the refurbishment outage. <ul style="list-style-type: none"> <li>Incremental inspection programs, beyond normal life-cycle management inspection programs, required to define scope of work for the refurbishment outage.</li> <li>All staff engaged in the refurbishment program, whether directly assigned or other-business-unit support; including staff supporting planning, scoping, engineering, etc.</li> </ul>	staff supporting project oversight and/or execution activities. <ul style="list-style-type: none"> <li>All regular online and outage work programs optimized during the refurbishment period including mandatory PM's and Inspections.</li> <li>All commissioning and unit clean-up costs to turn-over the station to Operations.</li> </ul>	
Project Portfolio	Support the station in the development of regulatory or value enhancing modifications	<ul style="list-style-type: none"> <li>Approved projects per AISC</li> </ul>	<ul style="list-style-type: none"> <li>Approved projects per AISC where project is to be performed during refurbishment outage, and where Darlington Refurbishment Program Management Office approves work to be performed during refurbishment window.</li> </ul>	<ul style="list-style-type: none"> <li>Approved projects per AISC</li> </ul>
Capital Spares		<ul style="list-style-type: none"> <li>As identified by station to support 30 year end of life for major components</li> </ul>		

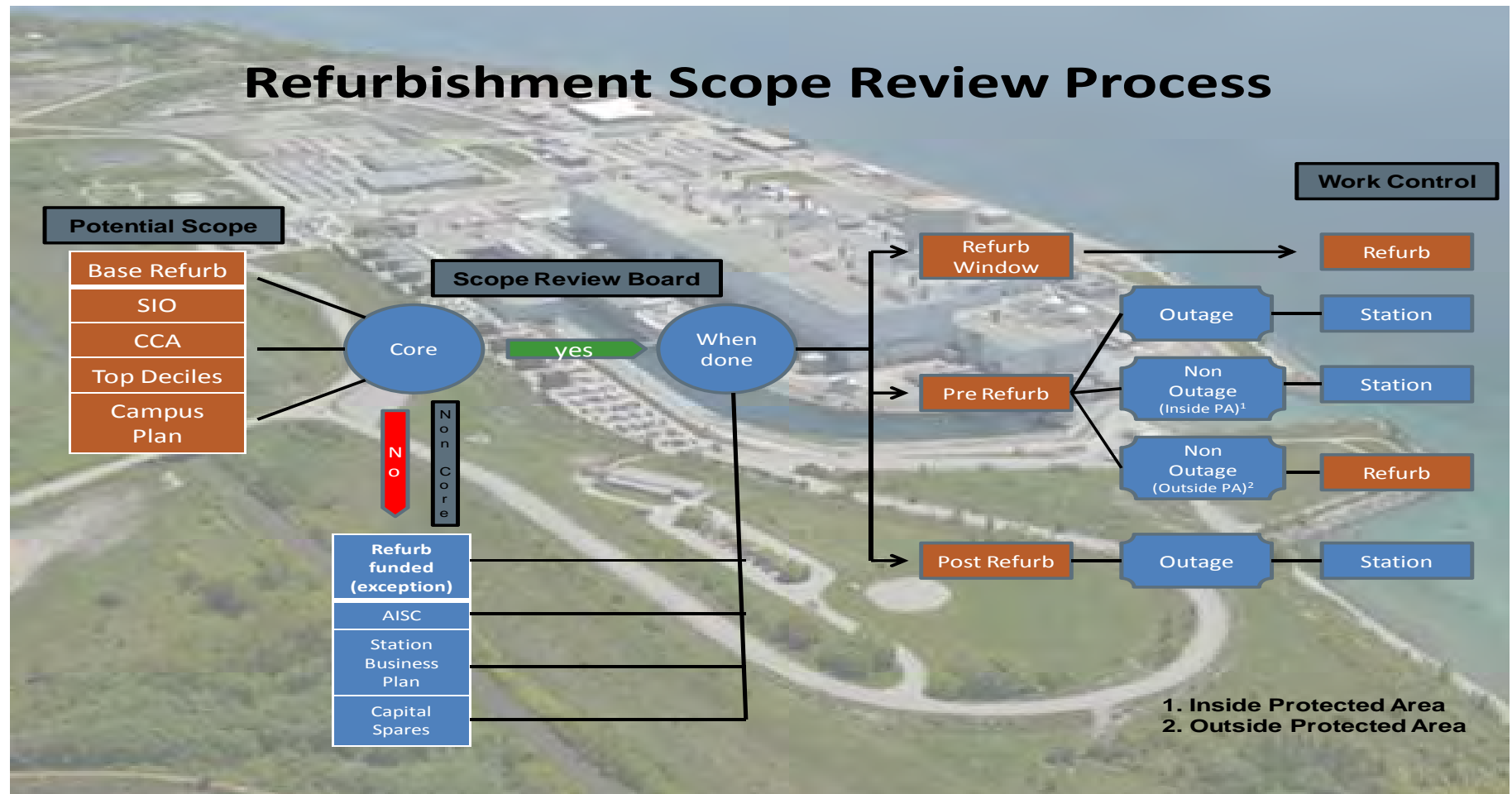
**Note:** Activities performed in station outages pre-refurbishment, and post-refurbishment, will be controlled by Darlington NGS (Operations) work control. Activities performed during Refurbishment, including station and project activities, will be co-ordinated through the Darlington Refurbishment Program Management Office to confirm do-ability and scheduling window.

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## Appendix G: Refurbishment Scope Review Process



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**Appendix H: Nuclear Refurbishment Scope Hierarchy**

CODE	SCOPE TYPE	ISR	RISK	PREREQ	NPV
AA1	CS01	Y		Y	
AA2	CS01			Y	
AA3	CS02			Y	
AA4	CS02		>=H15		
AA5	CS02		<H15		
AA6	VE02	Y		Y	>\$1M
AA7	CS05			Y	
AA8	CS01	Y	>=H15		
AA9	CS01	Y	<H15		
AA10	VE02	Y			>\$1M
AA11	CS05				
AA12	CS04		>=H15		
AA13	CS04		<H15		
AA14	CS03		>=H15		
AA15	CS03		<H15		
BA1	SU			Y	>\$1M or N/A
BA2	SU		>=H15		>\$1M
BA3	SU		<H15		>\$5M
BA4	VE/PF				>\$100M
CA1	VE/PF				>\$10M<\$100M
CA2	VE/PF				>\$5M<\$10M
CA3	VE/PF				>\$1000k<\$5000K
CA4	VE/PF				>\$500k<\$1000K
CA5	VE/PF				<\$500K

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**Appendix I: Scope Decision Matrix Summary Table**

#DSR's Owned:	<b>Appendix J: Scope Decision Matrix Summary Table</b>			Date :	
#DSR's Presented:	<i>Note: To be used in conjunction with Appendix C</i>			Project Manager:	
Item #	DSR Line Item	IN/OUT	Removal Point (i.e. 2.1,etc)	Comments / Recommendation	DRAS#
1					
2					
3					
4					
5					
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## Appendix J: DSR types (DSR number pre-fixes)

DSR Database

Select a DSR type

- ☒ Campus Plan (DR03)
- ☐ Refurb Technical (DR02)
- ☐ Regulatory (DR04)
- ☐ Strategic Initiative (DR05)
- ☐ Other
- ☐ Unit Work Management

Enter a descriptive Title (Cannot be changed after DSR created)

Back Next

(Prompt window from the DSR database)

DSR Type	Prefix		Description
Campus Plan (DR03)	CP	Campus Plan	Facilities & Infrastructure upgrades to (inside and outside) the plant to support a successful refurbishment
Regulatory (DR04)	IP	Improvement Plan	Station or Safety or improvements beyond standard that provide benefits to the station in terms of increased reliability and/or lower operating costs.
Other	MS	Maintenance Scope	Related to or generated by Maintenance. Includes assessment of station services and equipment.
Strategic Initiative (DR05)	SI	Strategic Initiative	It is not required but good to have (long term benefit).
Refurb Technical (DR02)	TS	Technical Scope	Engineering Design Support: Create; modify technical specifications and Standards within NR scope. Design within the EPC framework items assigned to the NR Design Department.
Unit work management	WM	Work Management (DR06)	Work schedule and windows management.

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Appendix K: MEMO: Value-Enhancing Investment at DNGS during Refurbishment



700 University Avenue, H7G5, Toronto, ON M5G 1X6

MEMORANDUM

April 12, 2013

MR. D. REINER  
Senior Vice President  
Nuclear Refurbishment

Value-Enhancing Investment at DNGS during Refurbishment

The Refurbishment of Darlington represents a significant milestone in the evolution of OPG. During the life of this project, we will see the cessation of coal (2014) and the potential end of operations at both Pickering A and Pickering B (2020). Both of these major events will lead to a significant shrinking of OPG's operations. At this time, there is no guarantee of New Nuclear becoming a reality, or a repowering of the Thermal sites. This downsizing of operations, and the need to be cost competitive going forward puts significant pressure on our ability to raise capital and to sustain operations over the long-term.

To minimize our capital requirements during the refurbishment outage and to make quality investments in the plant that support high quality, profitable operations going forward, I am proposing that the Refurbishment Project adopt more stringent criteria for assessment of sustaining, value-enhancing and performance improvement work that is to be included in the refurbishment outages. The criteria will apply to all scope that is not considered core scope as defined by the Scope Review Board governance.

The adoption of more stringent criteria on sustaining, value-enhancing and performance improvement initiatives during the refurbishment outage, would help to constrain scope to only those high value scope items that show a significant contribution to the bottom line. These more stringent criteria would include a hurdle rate of 9.5% (WACC) valued on the forecast System Economic Values and a simple payback period of six years, or 2 outage cycles.

A handwritten signature in black ink, appearing to read "Donn Hanbidge".

Donn Hanbidge

c: W. Robbins  
D. Power  
R. Heard



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Title:

**NUCLEAR REFURBISHMENT EARNED VALUE MANAGEMENT**

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## Nuclear Refurbishment Earned Value Management

**N-MAN-00120-10001-SCH-07-R002**

2015-02-04

Order Number: N/A  
Other Reference Number:

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Prepared by:

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Nuclear Refurbishment	

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Revision Summary

Revision Number	Date	Comments
R000	2013-03-15	Initial issue
R001	2014-07-07	Added Engineering Earned Value Process
R002	2015-02-04	Overall update, EV Management Processes Updated, Earning Rules Added

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## 1.0 INTRODUCTION

### 1.1 Objective

This document establishes the Earned Value Management (EVM) methodology for Nuclear Refurbishment (NR) as a management tool for program and project planning and control.

The intended audience of this manual is all staff involved in NR work, including OPG, direct work contractors and their major sub-contractors.

### 1.2 Guidance

Earned Value Management is a standard project management technique for quantifying and measurement of project progress performance. It not only provides comparison of actual costs against that budgeted, but also allows continual analysis of progress achieved against that planned throughout the project timeline and across individual tasks at the Control Account/Work Package level.

In other words, the project (or a Control Account/Work Package) “earns” progress as work steps are completed thus allowing management to implement strategies should the project (or a Control Account/Work Package) track “off-plan”.

EVM provides necessary incentive mechanisms to project teams and contractors; it also provides effective approaches to assess program/project progress and cost status, and is the basis for a more precise forecast for time and cost control during schedule implementation.

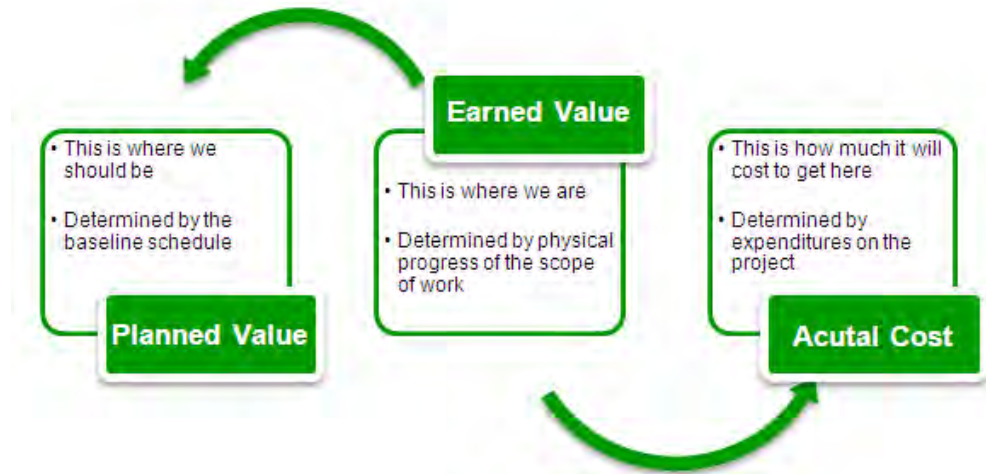
In order to conduct Earned Value Analysis, three components are needed; Planned Value to be earned, Earned Value (physical progress percent complete against budgeted value) and Actual Costs (from finance/ accounting or contractor invoices and accruals). Earned Value Process Summary is described below:

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## REFURBISHMENT EARNED VALUE MANAGEMENT



### 1.3 Purpose

Earned Value Management benefits are well identified by major industry key players, such as:

- EVM provides a sound basis for problem identification, corrective actions and management re-planning as may be required. It provides for early identification of performance trends and variances from the management plan and allows management decision making while there is adequate time to implement effective corrective actions (ANSI/EIA-748-B Earned Value Management Systems).
- Earned Value is a commonly used method of performance measurement. It integrates project scope, cost and schedule measures to help the project management team assess and measure project performance and progress (PMI – A Guide to the Project Management Body of Knowledge).

Utilizing Earned Value Management methodologies and tools allow:

- The integration of scope, schedule and cost.
- Assessment of past and current performance.
- Comparison of progress against plan.
- Assessment of trends over time.
- Early identification of issues and allow the development of mitigation or recovery plans.
- Project teams to provide improved forecasts of future performance.



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## 2.0 DEFINITIONS

Refer to Project Controls Definitions for definitions used in the development of and within the Darlington Nuclear Generation Refurbishment Program Project Controls governance documents and manuals.

Additionally, a comprehensive list of P&C definitions is maintained by the NR Project Controls to provide program-wide read access, which is amended on a more frequent basis.

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### 3.0 PROCESS

The EVM process can be summarized under three major phases as below:

- EVM Planning
- EVM Monitoring
- Change Management

#### 3.1 EVM PLANNING

3.1.1. **Scope Definition** – OPG projects define scope, Refer to Scope Manual N-MAN-00120-10001/ SCOPE and NK38-INS-09701-10001

3.1.2. **Prepare WBS and Define Control Accounts/Work Packages:** The WBS will represent all of the work to be completed. It will form the basis for developing project schedule, resource estimation, performance measurement, management control and reporting. As the program progresses from one phase to another, WBS will be reassessed. If the program requirement changes, the WBS will evolve with the program. Establishing WBS Standard structure and guideline is first deliverable under this subject:

WBS Standard Structure/Guideline	
Responsible Organization	Manager – PMO – Scheduling
Key Output	WBS Guideline

Project and Functional managers are accountable for preparing standard WBS structure for use in all bundles.

Detailed WBS Defining All Work Packages	
Responsible Organization	Project Managers Functional Managers
Key Output	Detailed WBS define all work packages

Detailed WBS preparation includes:

- Preparing detailed WBS following WBS Guidelines to break the work to the lowest possible work packages (WP) based on defined scope
- Establish WP Numbering system (refer to NR standard WBS)

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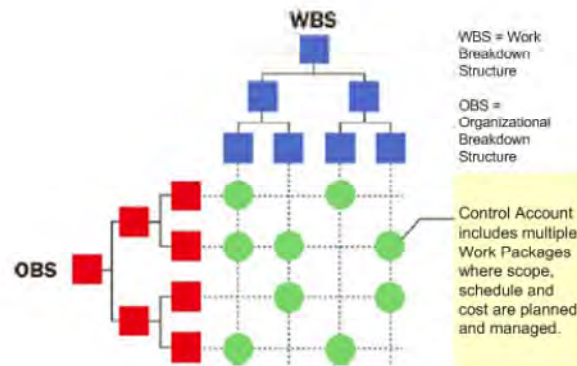
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### REFURBISHMENT EARNED VALUE MANAGEMENT

- Issue Rev 0 of WBS

Define Control Account: Control Account can be understood as a group of related Work Packages that can be completed by a unique organization in a continuous time window. Refer to WBS Guideline N-MAN-00120-10001/SCH-05



- 3.1.3. **Prepare CBS:** NR Program is utilizing Activity Based Cost (ABC) and practically defined Work Breakdown structure is considered as Cost Breakdown Structure (CBS).
- 3.1.4. **Prepare Estimate by WP:** Based on WBS/CBS, prepare resources cost for every work package for Project Manager Approval.

Prepare Estimate by WP	
Responsible Organization	Estimating Group Project Managers Functional Managers
Key Output	Prepare estimate for every Work Package

- 3.1.5. **Prepare WBS Dictionary and get Manager's Approval:** The WBS dictionary defines the work scope represented in each element of WBS.

Prepare WBS Dictionary and get Manager's Approval	
Responsible Organization	Project Managers Functional Managers
Key Output	WBS Dictionary for all associated work packages

WBS Dictionary mainly contains the following:

- Summary scope description
- Deliverables

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- Estimate data resources/dollars
- Assumptions/Constraints
- Baseline schedule for the CA/WP
- Earning Rules

3.1.6. **Establish Rules of Credit:** In order to establish the Earned Value, the achieved progress must be assessed for each scheduled element and entered into the Cost Management System (this can be thought of as the “earned value”).

Establish Rules of Earning	
Responsible Organization	Project/Functional Manager
Key Output	Rules of earning guideline

- There are 3 basic methods for determining schedule progress (percent complete) and they should be selected and recorded in the WBS Dictionary for each Work Package (Level 3 activities progress contribution into their associated Work Package and Work Packages progress contribution into their associated control account should also be defined under Rules of Credit):
  - Discrete Effort – Discrete tasks are those tasks which are quantifiable to individual work products or predetermined tangible measurement. Techniques utilized for discrete efforts are:
    - Fixed Formula – 0/100, 50/50, 25/75 etc. With this method, x% of work is credited as complete for the measurement period in which the work begins, regardless of how much work has actually been accomplished. Remaining % is credited when the work is completed. Fixed formula techniques are most effectively used on small, short-duration task (typically less than two reporting periods)
    - Units Complete (Physical % Complete) – physical quantity count converted into a percent. Hours are often used for labour tasks such as engineering deliverables or

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installation Work Packages, (For example, for a total fuel channels of 480 if we complete the removal of 48 then the physical % complete would be 10% for the fuel channel removal Work Package).

- Valued Milestone (Steps) – It involves predetermined percent complete based on internal milestones within the Work Package. That value is earned as the milestones are completed (generally applicable to Fixed Price or Procurement Work Packages). This method is sometimes called weighted milestones.
- Level 3 activities progress contribution into their associated Work Package and Work Packages progress contribution into their associated control account should also be defined under Rules of Credit.
- Apportioned Effort – Apportioned effort is work for which the planning and progress are tied to other efforts. The budget for the apportioned account will be time-phased in relation to the resource plans for the base account(s). Status and the taking of earned value are driven by the status on the base account(s). If the base account(s) are on schedule, the apportioned account will be on schedule and an appropriate amount of value will be earned.
  - For example, Non-Manual Construction Support could be evaluated at 90% of the composite percent complete of all direct construction Work Packages. The final 10% would be earned when the paperwork closeout at the end of the project is complete (which is generally after the craft is gone).
- Level of Effort (LOE) – LOE is work scope of a general or supportive nature for which performance cannot be measured or is impracticable to measure. Resource requirements are represented by a time-phased budget scheduled in accordance with the time that the support will likely be needed. The earned

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value is earned by the passage of time and is equal to the budget scheduled in each time period. The performance data provided is simply a comparison of budget to actual cost. For LOE  $SPI = 1$ ;  $EV = PV$  and  $CPI = EV/AC$ .

3.1.7. **Baseline Schedules:** Please refer to the Program Schedule Management Procedure, NK38-PLAN-09701-10067-0004, for the definition of Baseline Schedules. Responsibilities and deliverables are as follow:

Level 3 Baseline Schedules Preparation	
Responsible Party	Project Managers Function Managers
Key Output	Baseline schedules

- Gate Submission Baseline, the Level 3 baseline schedules will be finalized with resource loaded (labour/quantity) and approved by management.
- In order to set up the project and its work package in planned values the Cost Control group must be provided with the following:
  - Work Package number
  - Work Package title
  - Work Package owner
  - Work Package baseline early start date
  - Work Package baseline early finish date
  - Work Package monthly resources distribution

Baseline Schedule Approval	
Responsible Party	Manager – PMO – Scheduling
Key Output	Review and approve L3 Schedule Baseline for use Ensure alignment with guidelines and procedures

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- 3.1.8. **Establish Planned Value (PV):** Planned Values per each work package under projects will be calculated and stored. This information will be utilized as basis for earned value and performance calculation.

Generate BCWS for all Work Packages and Generate Various Reports	
Responsible Party	PMO – Reporting
Key Output	Various cost reports original budget/BCWS

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## REFURBISHMENT EARNED VALUE MANAGEMENT

### 3.2 EVM Monitoring

3.2.1. Calculating Earned Value, collecting Actual Costs, Schedule Performance Index (SPI) and Cost Performance Index (CPI), Cost and Schedule Variances by Work Package are supposed to be performed under monitoring phase.

3.2.2. **Progressing:** Level 3 Schedule activities would get progressed based on their physical progress (i.e. comparing physical quantity of complete work vs. physical quantity of scope), progress values from Level 3 activities contribute into their associate Work Package progress as per defined and documented earning rules.

Progressing	
Responsible Party	Contractors/Project Managers
Key Output	Percent Progress for every WP

- Every WP is represented by many activities in the Level 3 Schedule to cover the scope of work/resource loaded to an agreed level of RBS and based on the established rules of earning
- Physical % complete will be calculated by Level 3 activities rolled into the WP level
- In some cases progress may be calculated in a dedicated progress measurement/monitoring system and then input into the Level 3 activities (This assumption should be document as part of Earning Rules).



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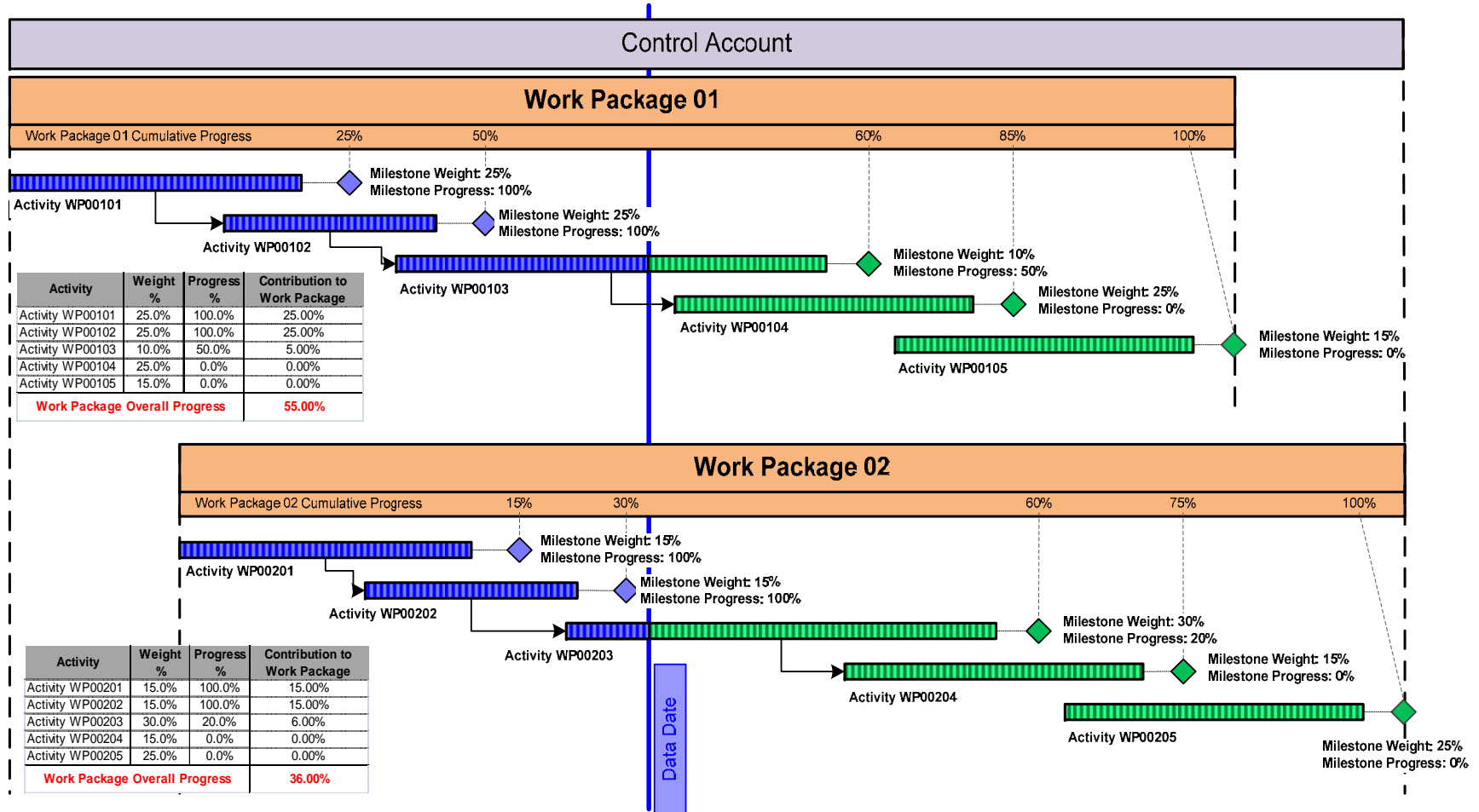
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- For example, activities from Level 3 are contributing into their associated work package progress and work packages are contributing into Control account. Weighted milestones are basis for rolling up percent progresses.



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- 3.2.3. **Collecting Cost:** Collect Actual Cost by Work Package; Generate SPI/CPI; cost and schedule variance

Generate SPI/CPI cost and schedule variance	
Responsible Party	Manager – PMO – Reporting
Key Output	Calculate EV; collect AC Calculate SPI,CPI Calculate cost and schedule variance

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**3.3 Change Management**

3.3.1. Refer to Change Management Section of this Document

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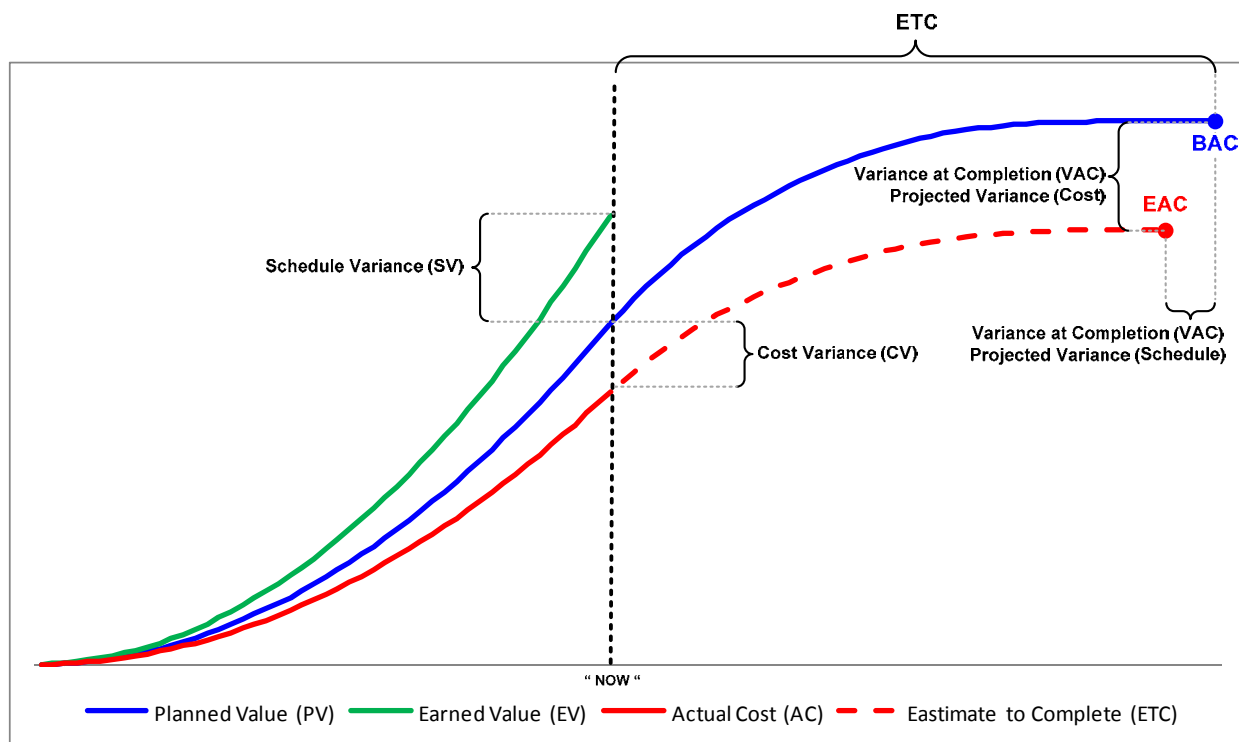
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## REFURBISHMENT EARNED VALUE MANAGEMENT

### 4.0 GRAPHS, FORMULAS, AND DEFINITIONS



**AC (or ACWP):** Actual cost of work performed to date; the actual costs charged against the activities

**PV (or BCWS):** Budgeted cost of work scheduled to date (planned value); the total baseline costs budgeted for the activities scheduled or planned

**EV (or BCWP):** Budgeted cost of work performed to date (earned value of accomplished work)

**BAC:** Budget at completion; BCWS at end of project, or original budget + changes

**ETC:** Estimate to Complete

**EAC:** Estimate at Completion

$$EAC = AC + ETC$$

**CV:** Cost Variance

$$CV = AC - EV$$

**CPI:** Cost Performance Index  
=  $EV / AC$

**SV:** Schedule Variance  
=  $EV - PV$

**SPI:** Schedule Performance Index  
=  $EV / PV$

**VAC:** Variance at Completion (Projected Variance)  
=  $EAC - BAC$

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The distinction between **PV** and **EV** is that the former represents the budget of the activities that were planned to be completed and the latter represents the budget of the activities that actually were completed.

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### 5.0 ANALYSIS AND MEANINGS

The Earned Value analysis is conducted by creating the Planned Value, calculating Earned Value, collecting Actual Cost, calculating the CPI, SPI, Cost Variance (CV) and Schedule Variance (SV).

The following are quick indicators:

- $CPI > 1$  indicates that the project is progressing under budget
- $CPI < 1$  indicates that the project is progressing over budget
- $SPI > 1$  indicates that the project is progressing ahead of schedule
- $SPI < 1$  indicates that the project is progressing behind schedule

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### 6.0 CHANGE MANAGEMENT

The Performance Measurement Baseline will only be changed for Directed Changes. Directed Changes should be reflected in both Cost and Schedule at the same time if they affect both. Directed Changes may be issued to cover variances so great that they impact the ability to obtain a meaningful measure of performance. Approval process will follow the workflow as per the change management process.

Refer to the Project Controls Plan, N-MAN-00120-10001-PC.

- The Cost Control group will lead the Change Management Process; the Scheduling group will support running “what-if” scenarios and assess schedule impacts (Original Baselines should always be retained and new baseline should get populated).
- Once the change is approved, it will be implemented to both cost and schedule baselines.

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## 7.0 P6 – PROLIANCE INTERFACES

- Proliance is the software for managing Planned Values, Cost Control, Earned Values plus performing analysis on each work package and control account level.
- SPI/CPI shall be calculated at the Work Package level where Actual Cost is collected. Cost reports and earned value can be rolled to various levels according to the WBS/CBS.
- Percent complete shall be calculated for every work package using Level 3 schedule and earning rules.

### 7.1 Initial Setup of the Plan

- 7.1.1. Level 3 schedules shall represent every work package in the WBS contributing into Earned Value Management.
- 7.1.2. Level 3 schedules shall be resource loaded with labour and quantity according to the predefined resource library.
- 7.1.3. After completing baseline schedules; the following will be generated from by the Project Cost and Schedule Analysts:
  - 7.1.3.1. Early Start/Early Finish date for every work package in the WBS.
  - 7.1.3.2. Monthly labour distribution for Early Plan (Planned Values per Work Packages by units).
  - 7.1.3.3. Level 3 schedules shall not contain any cost values or cost calculation or cost related activities (such as escalation or interest).
  - 7.1.3.4. Planned Values (PV)/Budgeted Cost for Work Scheduled (BCWS) for every work package shall be calculated and transferred to Proliance according to WBS/CBS. This will ensure that Planned Values (PV)/Budgeted Cost for Work (BCWS) are available on units and equivalent cost and roll up to the overall project.

### 7.2 Monitoring and Calculating SPI/CPI

- 7.2.1. Level 3 schedules shall be updated under P6 and on agreed frequencies and lead to Earned Value calculations.



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- 7.2.2. Level 3 schedules shall be integrated and percent complete and status will be calculated for every work package.
- 7.2.3. Work packages percent progress, forecast early date, and forecast finish dates from Level 3 schedules shall be obtained and transferred to Proliance.
- 7.2.4. Actual Cost will collected through Nuclear Financial Reporting and Analytics (NFRA) and stored under Proliance.

### **7.3 P6 / Proliance Change Management**

- 7.3.1. Scope, Cost, and Schedule changes shall be recorded in Proliance (Budgets, Planned Values, earning Rules, etc.).
- 7.3.2. All changes except pure cost related changes shall be implemented in P6.

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## REFURBISHMENT EARNED VALUE MANAGEMENT

### 8.0 EARNED VALUE MEASUREMENT GUIDELINES

In EVM, the progress of all work must be measured. Measuring project performance is a complex task involving many interrelated and progressive steps. The key to performance measurement is the objective assessment of work in progress. Measuring the amount of work scope completed is planned at the task level in conjunction with the performance measurement baseline. An EV technique is selected for each task based on temporal and physical quantities. Objective measurement of physical progress on tasks with tangible outcomes is superior to other all other measurements. Tasks that can be completed in one progress-reporting period require only one measurement and are preferred. Tasks that span several reporting periods should be measured objectively with milestones representing intermediate, tangible outcomes. Appendixes subsections provide the guidelines for measuring the project progress objectively.

#### Earned Value Management Guidelines

- Modification Design Request (MDR)
- Design
- Planning & Assessing
- OPG Procurement – Long Lead Items
- OPG Procurement – Non-Long Lead Items
- Vendor Procurment
- Construction
- RTS

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## 9.0 TOOLS

Earned Value will be managed by the following systems:

- Primavera P6 – Scheduling, Resourcing and Progress Updating
- Proliance – Planned Value, Actual Costs, Earned Values and Forecasts
- BI Tool –Reporting, CPI/SPI , Forecasting, Budget, Actual

### 9.1 Primavera P6

- 9.1.1. The original program baseline schedule will be developed by the respective teams based on the latest funding release, resource requirement, and timeline.
- 9.1.2. The project baseline schedule for each project will be developed by OPG at gate using the standard Work Package fragnets.
- 9.1.3. The above baseline may be revised on agreement of the contract schedule with the appropriate EPC contractor. The EPC contractor's schedule must roll up to the work packages included in the project baseline schedule.
- 9.1.4. Project teams shall update each of the work packages with the progress achieved based on the established Earning Rules.
- 9.1.5. A progress values will be developed on a cyclical basis to transfer work package attributes and progress information to Proliance.

### 9.2 Proliance

- 9.2.1. The Original Program Budget and Planned Value will be developed by the Program P&C Department, based on information developed by the projects in the development of the Original Program Schedule Baseline.
- 9.2.2. The Control Budget and Planned Value for each project will transferred to Proliance, developed by the respective projects for their scope of work which, will comprise:
  - 9.2.2.1. Work Packages for Work that has been approved under latest fund release.
  - 9.2.2.2. Work Packages for future Work at Control Account level.
  - 9.2.2.3. Work Packages schedule information and progress information will be uploaded from Primavera P6 on a cyclical basis.

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### 9.3 BI Tool

9.3.1. The BI Tool will use data from both Primavera and Proliance to develop required reports for:

9.3.1.1. Project Performance (CPI, SPI)

9.3.1.2. Cost and Schedule Planned and Actual Data

9.3.1.3. Forecasts

9.3.1.4. Risks

9.3.1.5. Other related information.

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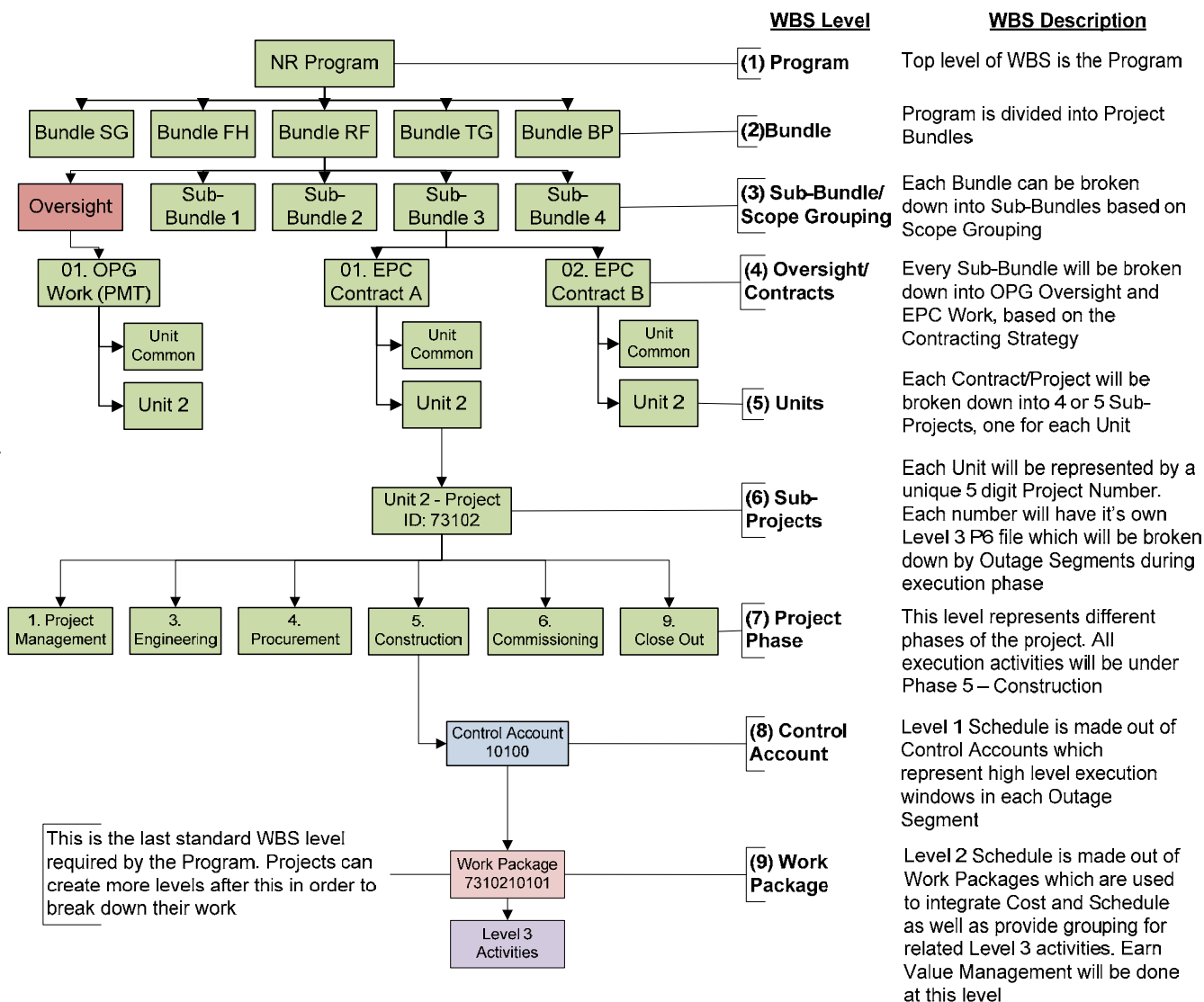
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## Appendix A: Control Account/Work Packages

### Program Breakdown Structure



### Project WBS

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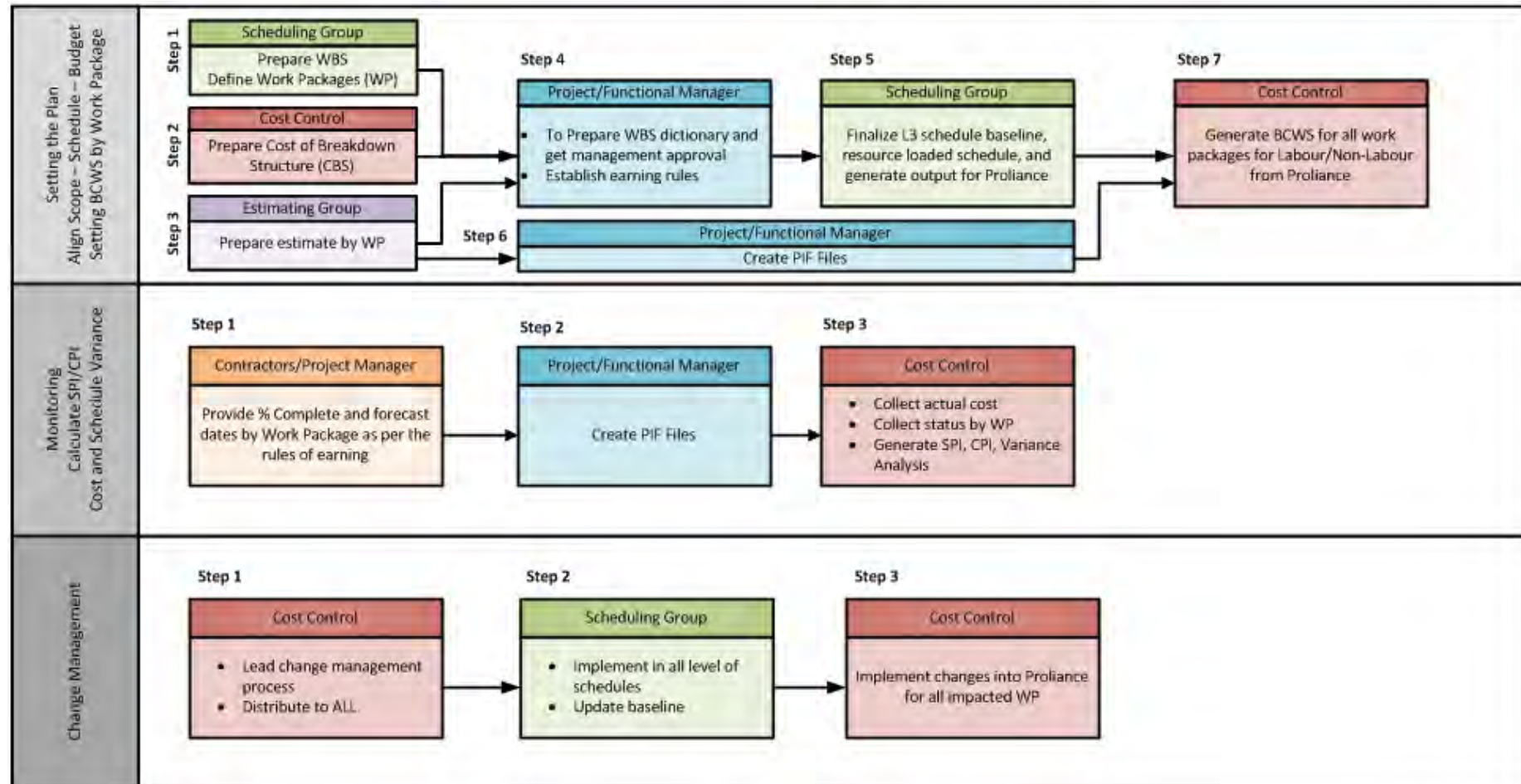
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**Appendix B: Earned Value (EV) Process**



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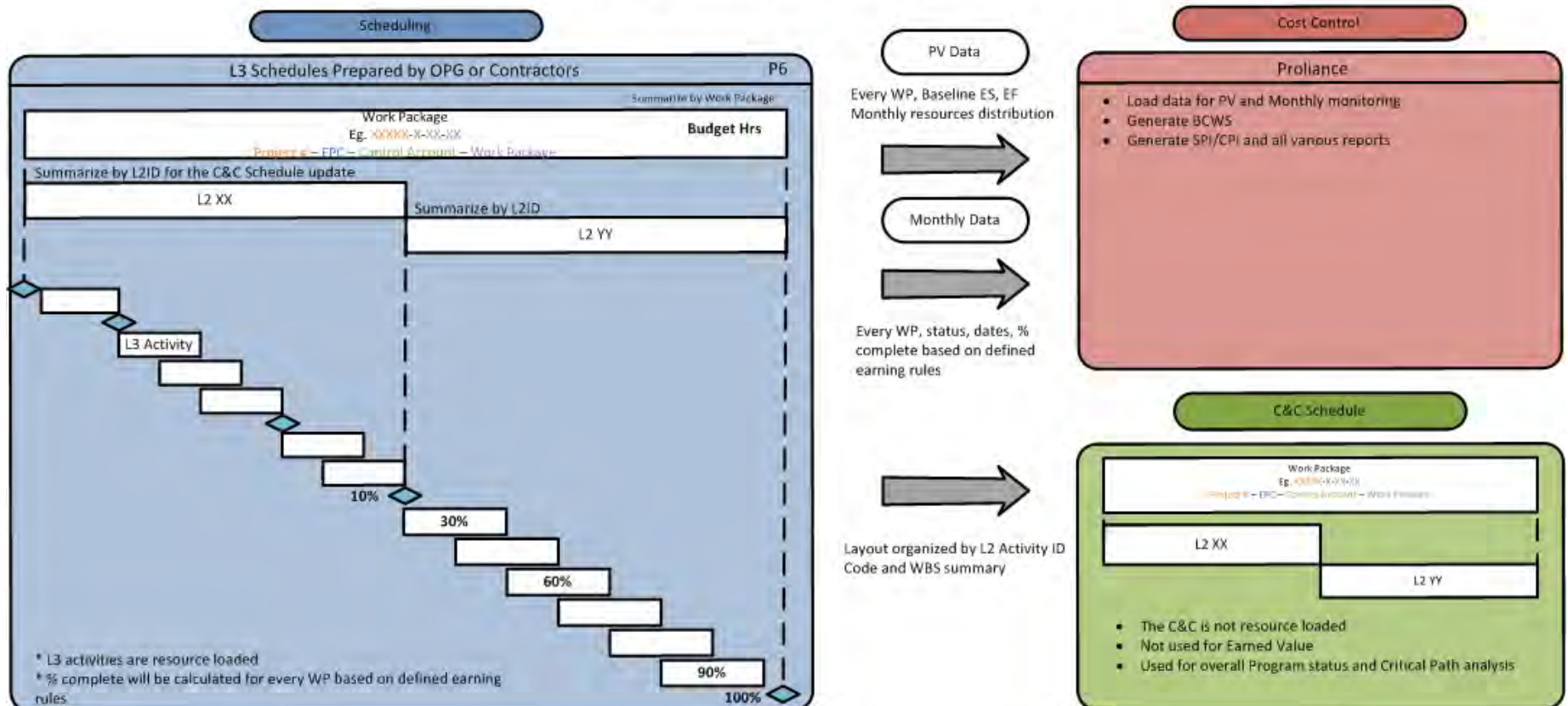
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## Appendix C: Primavera/Proliance Interfaces

### L3 Schedule/C&C Interfaces

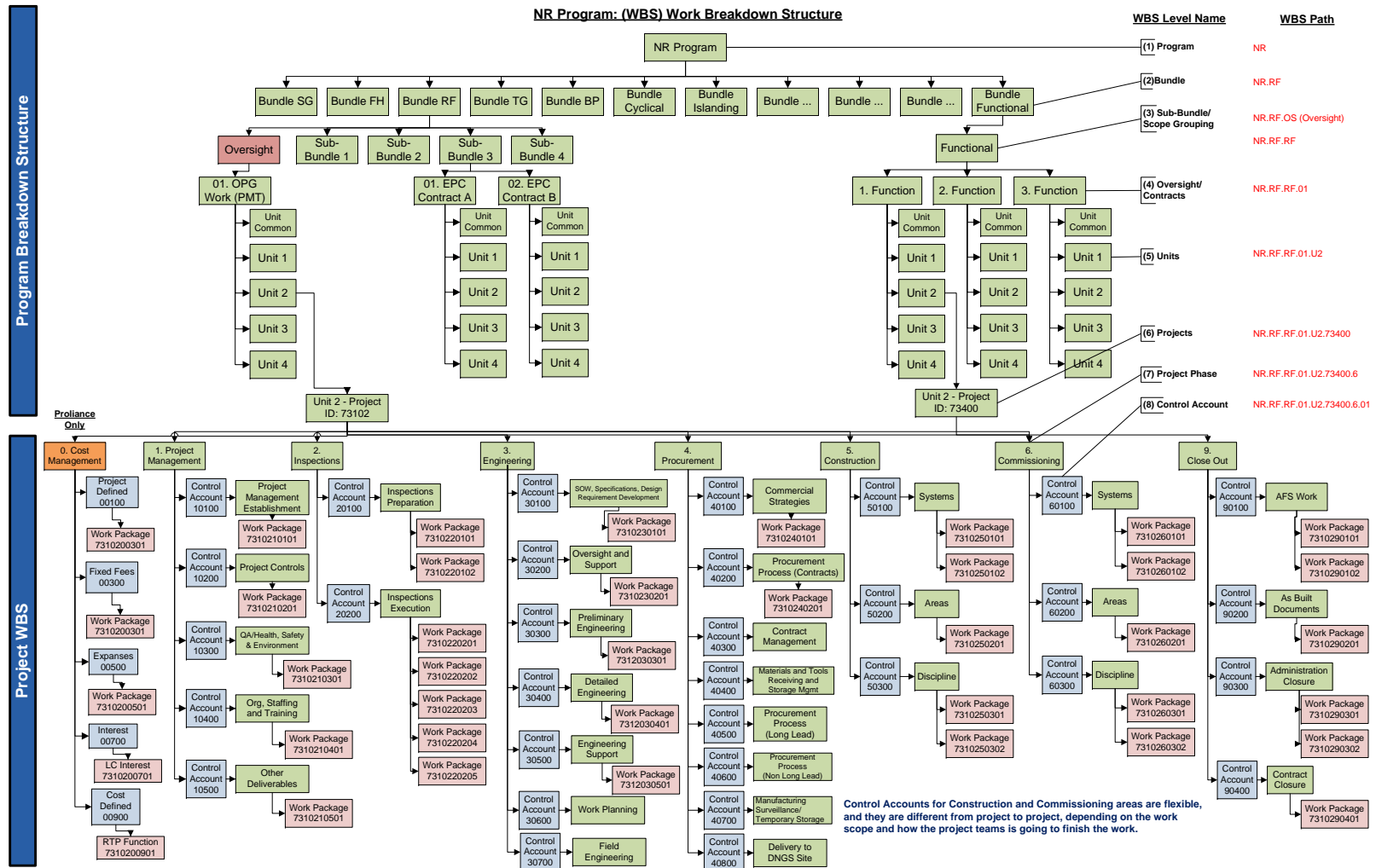


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### Appendix D: Program and Project Work Breakdown Structure





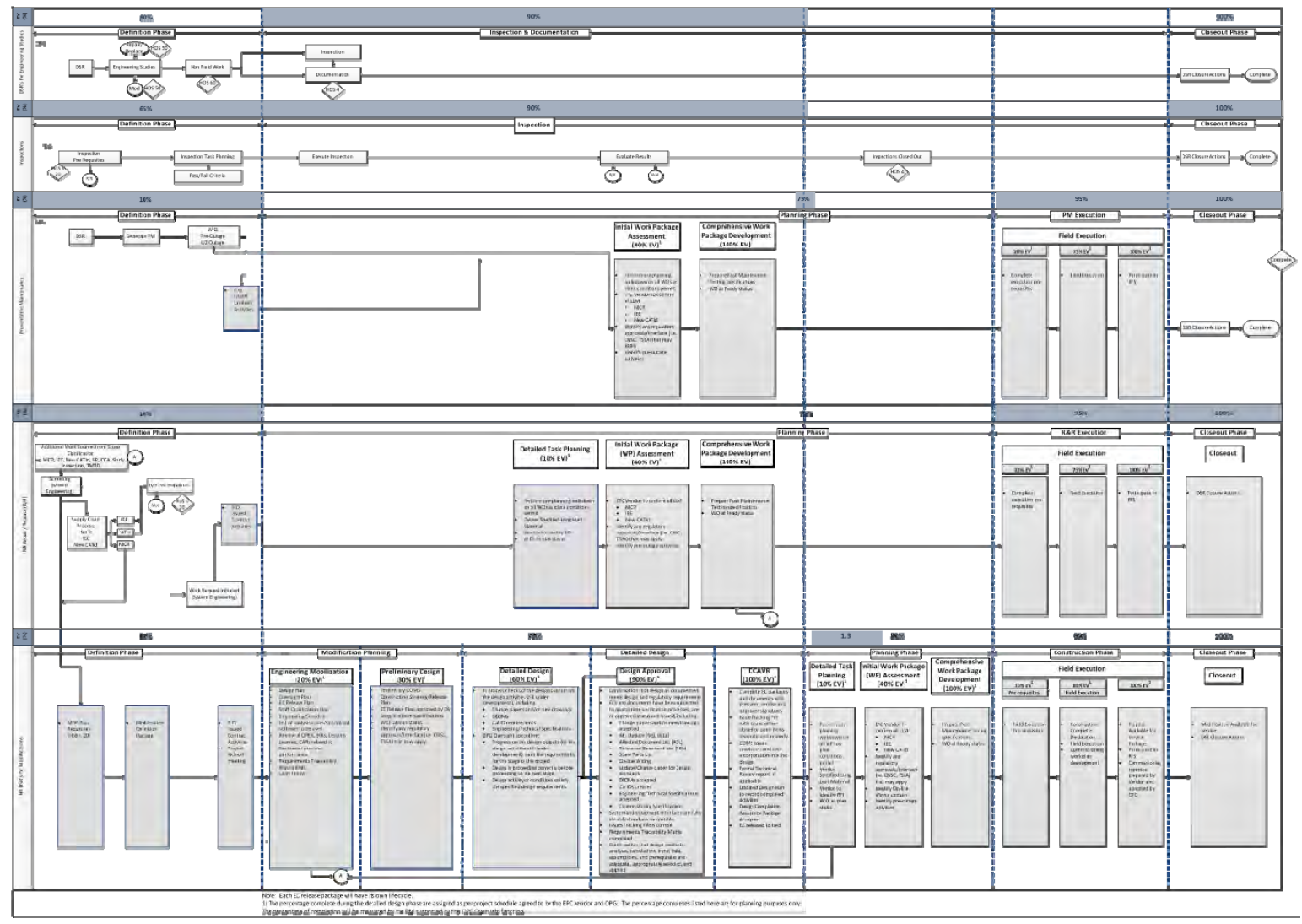
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Appendix E: Engineering Major Work Streams

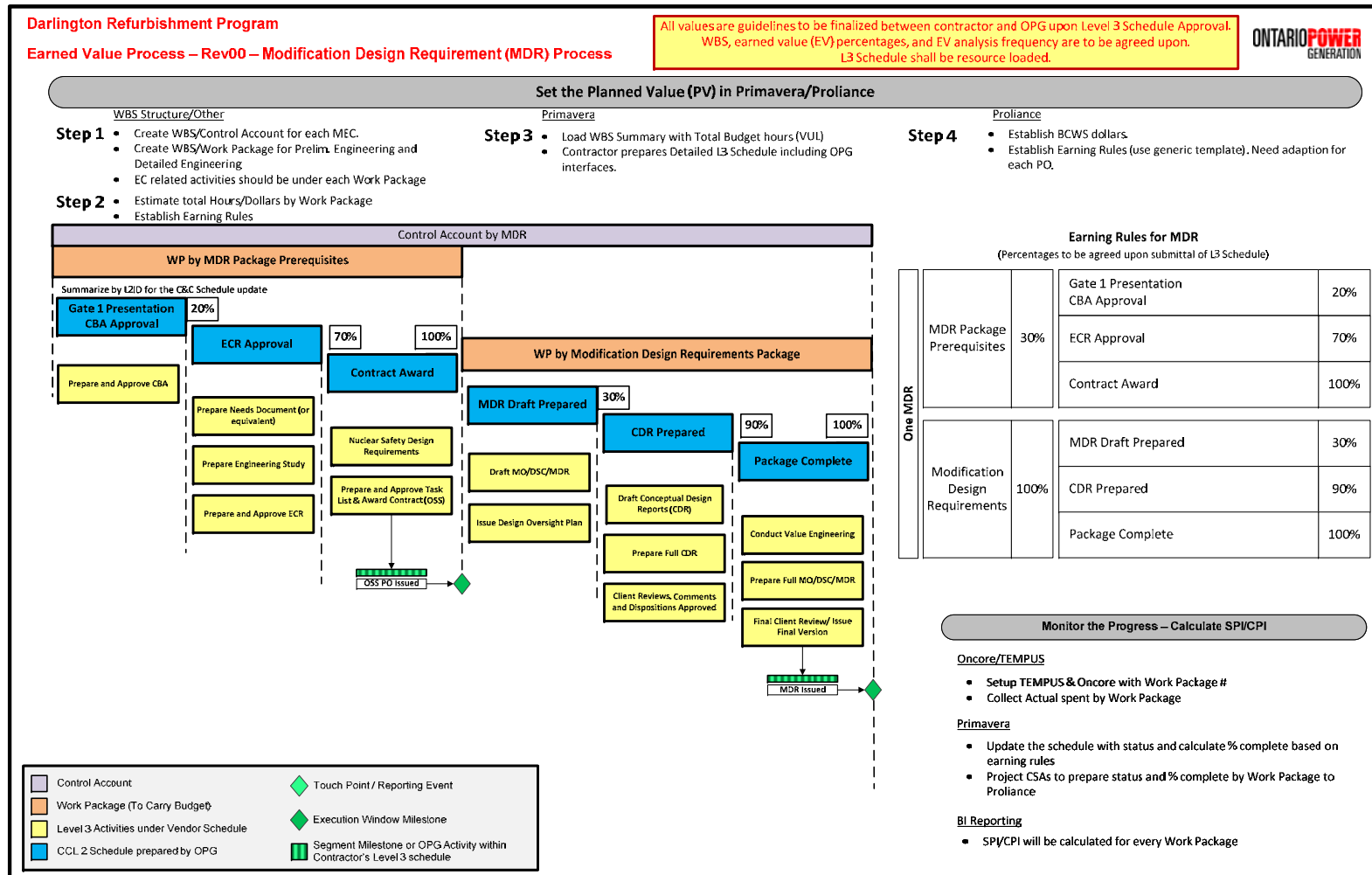


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**NUCLEAR REFURBISHMENT EARNED VALUE MANAGEMENT**

## Appendix F: Earned Value Management / MDR Development

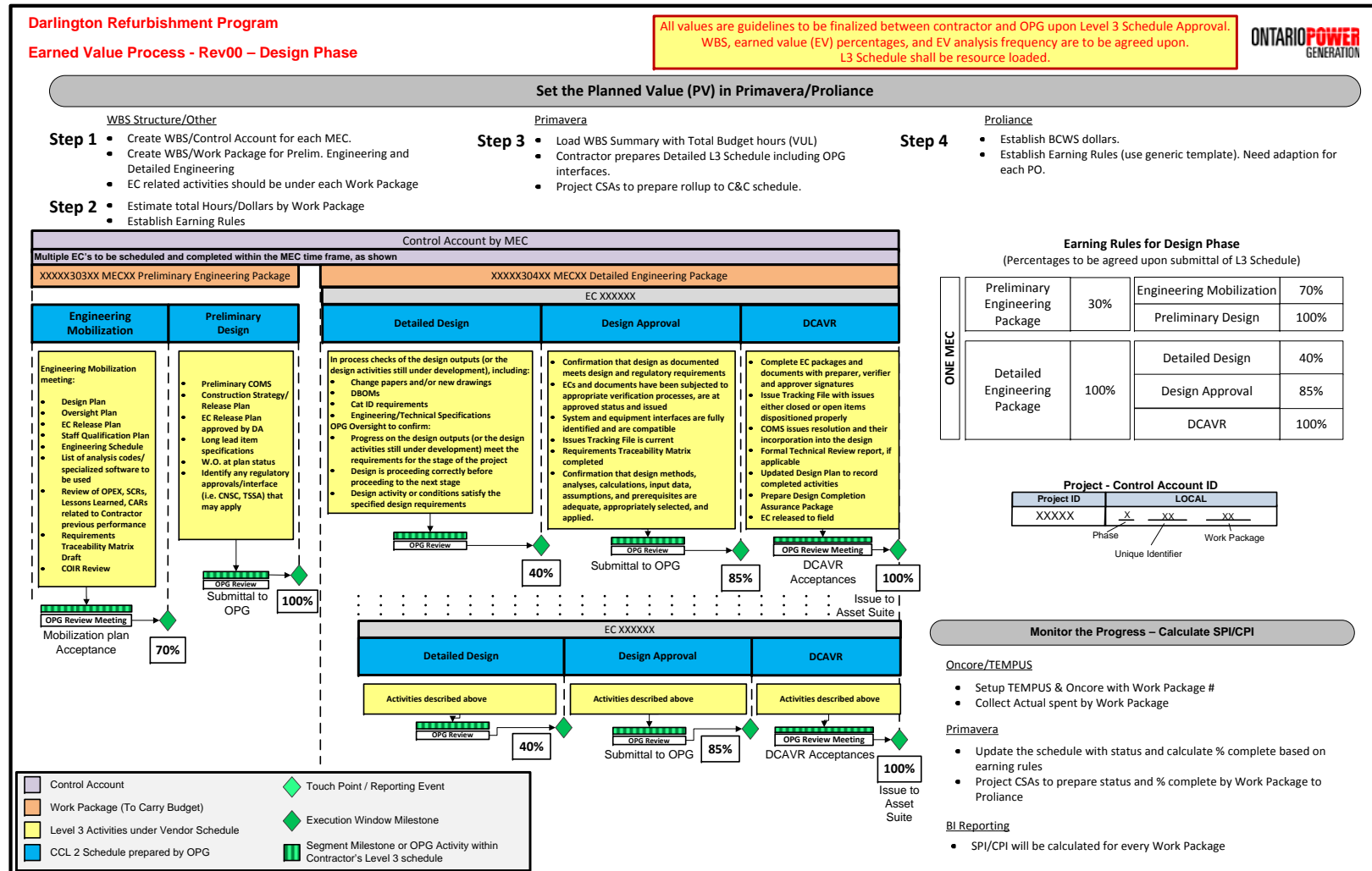


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## Appendix G: Earned Value Management / Design Phase



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## NUCLEAR REFURBISHMENT EARNED VALUE MANAGEMENT

### Appendix H: Earned Value Management / Planning Assessing

#### Darlington Refurbishment Program

#### Earned Value Process – Rev00 – Planning Assessing Phase

All values are guidelines to be finalized between contractor and OPG upon Level 3 Schedule Approval. WBS, earned value (EV) percentages, and EV analysis frequency are to be agreed upon. L3 Schedule shall be resource loaded.



#### Set the Planned Value (PV) in Primavera/Proliance

##### WBS Structure/Other

- Step 1**
- Create WBS/Control Account for each MEC.
  - Create WBS/Work Package for each MEC
  - EC related activities should be under each Work Package

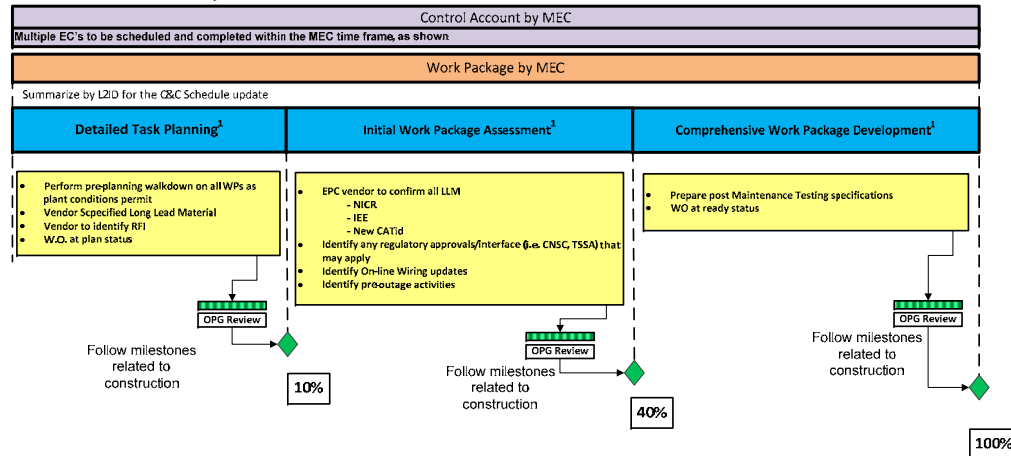
- Step 2**
- Estimate total Hours/Dollars by Work Package
  - Establish Earning Rules

##### Primavera

- Step 3**
- Load WBS Summary with Total Budget hours (VUL)
  - Contractor prepares Detailed L3 Schedule including OPG interfaces.

##### Proliance

- Step 4**
- Establish BCWS dollars.
  - Establish Earning Rules (use generic template). Need adaption for each PO.



#### Earning Rules for Planning Assessing

(Percentages to be agreed upon submittal of L3 Schedule)

ONE MEC	One WP per MEC	100%	Detailed Task Planning	10%
			Initial Work Package Assessment	40%
			Comprehensive Work Package Development	100%

#### Monitor the Progress – Calculate SPI/CPI

##### Oncore/TEMPUS

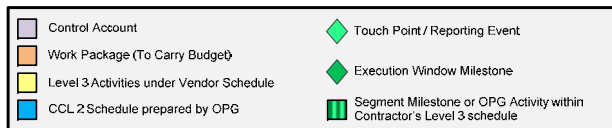
- Setup TEMPUS & Oncore with Work Package #
- Collect Actual spent by Work Package

##### Primavera

- Update the schedule with status and calculate % complete based on earning rules
- Project CSAs to prepare status and % complete by Work Package to Proliance

##### BI Reporting

- SPI/CPI will be calculated for every Work Package



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### Title: NUCLEAR REFURBISHMENT EARNED VALUE MANAGEMENT

## Appendix I: Earned Value Management / OPG Procurement – Long Lead Items

### Darlington Refurbishment Program

### Earned Value Process – Rev00 – OPG Procurement – Long Lead Items

All values are guidelines to be finalized between contractor and OPG upon Level 3 Schedule Approval. WBS, earned value (EV) percentages, and EV analysis frequency are to be agreed upon. L3 Schedule shall be resource loaded.



#### Set the Planned Value (PV) in Primavera/Proliance

##### WBS Structure/Other

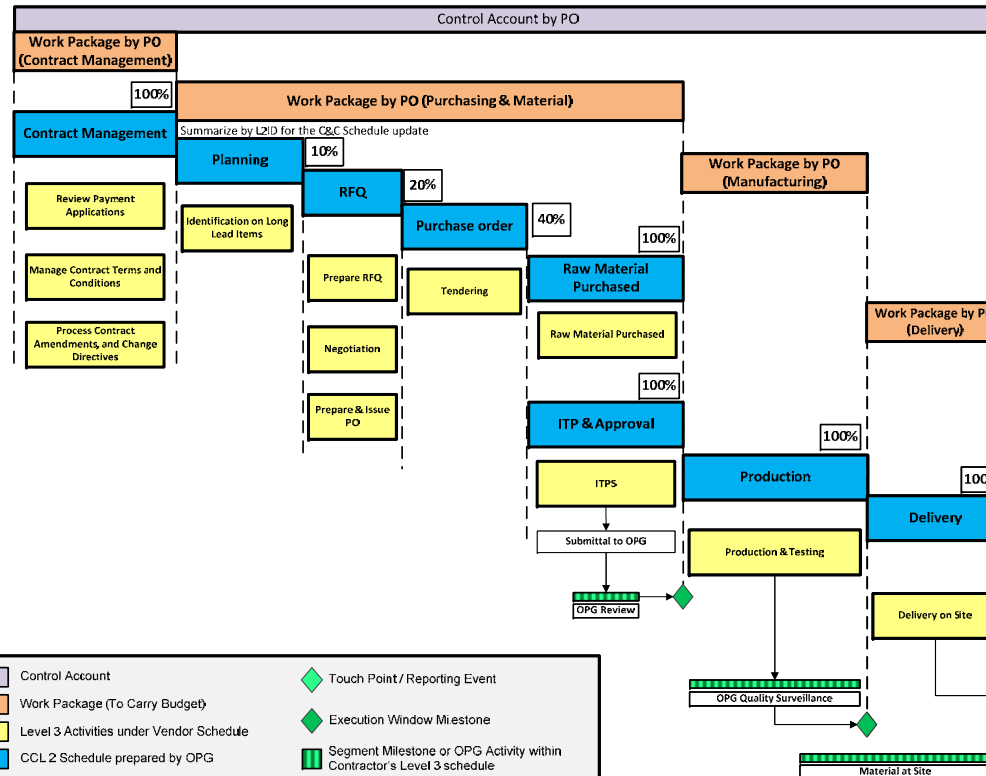
- Step 1** • Create WBS/Work Package for each Purchase Order (PO).
- Step 2** • Estimate total Hours/Dollars by Work Package  
• Establish Earning Rules

##### Primavera

- Step 3** • Load WBS Summary with Total Budget hours (VUL)  
• Contractor prepares Detailed L3 Schedule including OPG interfaces.

##### Proliance

- Step 4** • Establish BCWS dollars.  
• Establish Earning Rules (use generic template). Need adaption for each PO.



#### Earning Rules for Long Lead Items

(Percentages to be agreed upon submittal of L3 Schedule)

WP (Contract Management)	100%	Contract Management	100%
		Planning	5%
		Planning	5%
		RFQ	10%
		Purchase Order	20%
		Raw Material Purchased	50%
		ITP & Approval	50%
WP (Contract Management)	100%	Production	90%
WP (Contract Management)	100%	Delivery	100%

#### Monitor the Progress – Calculate SPI/CPI

##### Oncore/TEMPUS

- Setup TEMPUS & Oncore with Work Package #
- Collect Actual spent by Work Package

##### Primavera

- Update the schedule with status and calculate % complete based on earning rules
- Project CSAs to prepare status and % complete by Work Package to Proliance

##### BI Reporting

- SPI/CPI will be calculated for every Work Package

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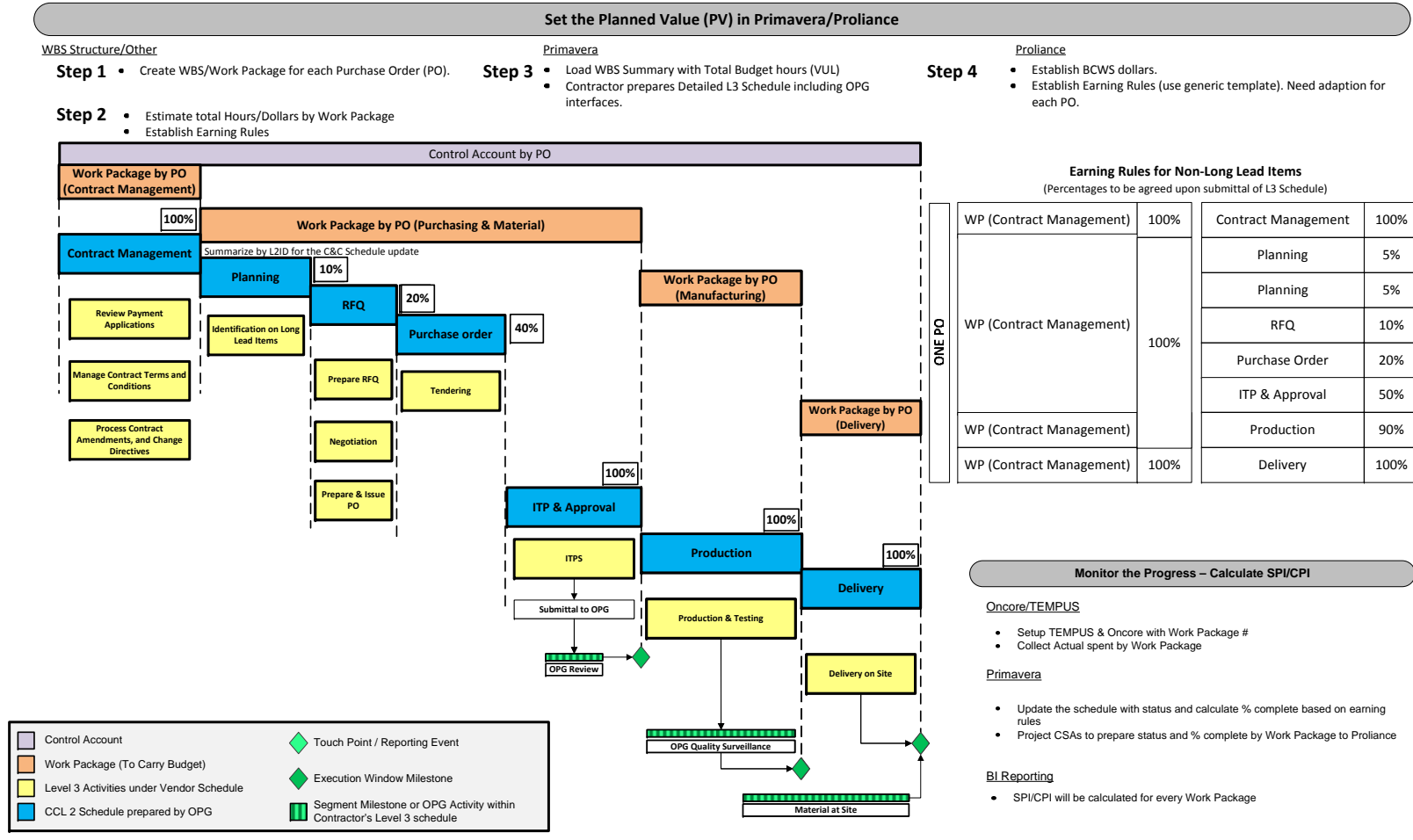
## Title: NUCLEAR REFURBISHMENT EARNED VALUE MANAGEMENT

### Appendix J: Earned Value Management / OPG Procurement – Non-Long Lead Items

#### Darlington Refurbishment Program

#### Earned Value Process – Rev00 – OPG Procurement – Non-Long Lead Items

All values are guidelines to be finalized between contractor and OPG upon Level 3 Schedule Approval. WBS, earned value (EV) percentages, and EV analysis frequency are to be agreed upon. L3 Schedule shall be resource loaded.



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**NUCLEAR REFURBISHMENT EARNED VALUE MANAGEMENT**

## Appendix K: Earned Value Management / Vendor Procurement

### Darlington Refurbishment Program

#### Earned Value Process – Rev00 – Vendor Procurement

All values are guidelines to be finalized between contractor and OPG upon Level 3 Schedule Approval. WBS, earned value (EV) percentages, and EV analysis frequency are to be agreed upon. L3 Schedule shall be resource loaded.



#### Set the Planned Value (PV) in Primavera/Prolance

##### WBS Structure/Other

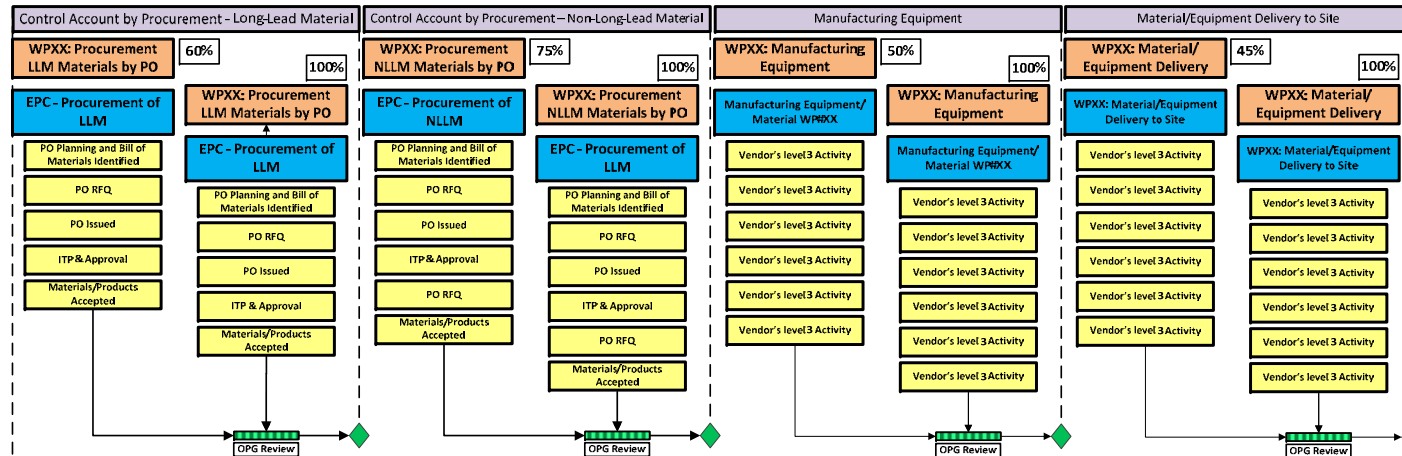
- Step 1**
- Create WBS/Work Package for each phases requirements and strategies.
- Step 2**
- Estimate total Hours/Dollars by Work Package
  - Establish Earning Rules

##### Primavera

- Step 3**
- Load WBS Summary with Total Budget hours (VUL)
  - Contractor prepares Detailed L3 Schedule including OPG interfaces.

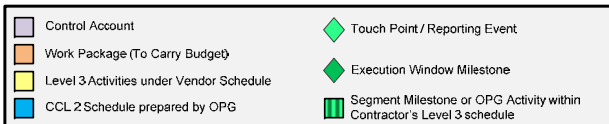
##### Prolance

- Step 4**
- Establish BCWS dollars.
  - Establish Earning Rules (use generic template). Need adaption for each PO.



#### NOTE:

Material/Equipment Delivery to Site Milestone (from Vendor's Schedules) needs to be linked into all associated "Execution Windows" Readiness Milestones



#### Earning Rules for Vendor Procurement

(Percentages to be agreed upon submittal of L3 Schedule)

LLM Procurement	100%	WPXX: Procurement LLM Materials by PO	60%
		WPXX: Procurement LLM Materials by PO	100%
Non-LLM Procurement	100%	WPXX: Procurement Non-LLM Materials by PO	75%
		WPXX: Procurement Non-LLM Materials by PO	100%
Manufacturing Equipment	100%	WPXX: Manufacturing Equipment/Material	50%
		WPXX: Manufacturing Equipment/Material	100%
Material/Equipment Delivery to Site	100%	WPXX: Material/Equipment Delivery	45%
		WPXX: Material/Equipment Delivery	100%

#### Monitor the Progress – Calculate SPV/CPI

##### Oncore/TEMPUS

- Setup TEMPUS & Oncore with Work Package #
- Collect Actual spent by Work Package

##### Primavera

- Update the schedule with status and calculate % complete based on earning rules
- Project CSAs to prepare status and % complete by Work Package to Prolance

##### BI Reporting

- SPV/CPI will be calculated for every Work Package

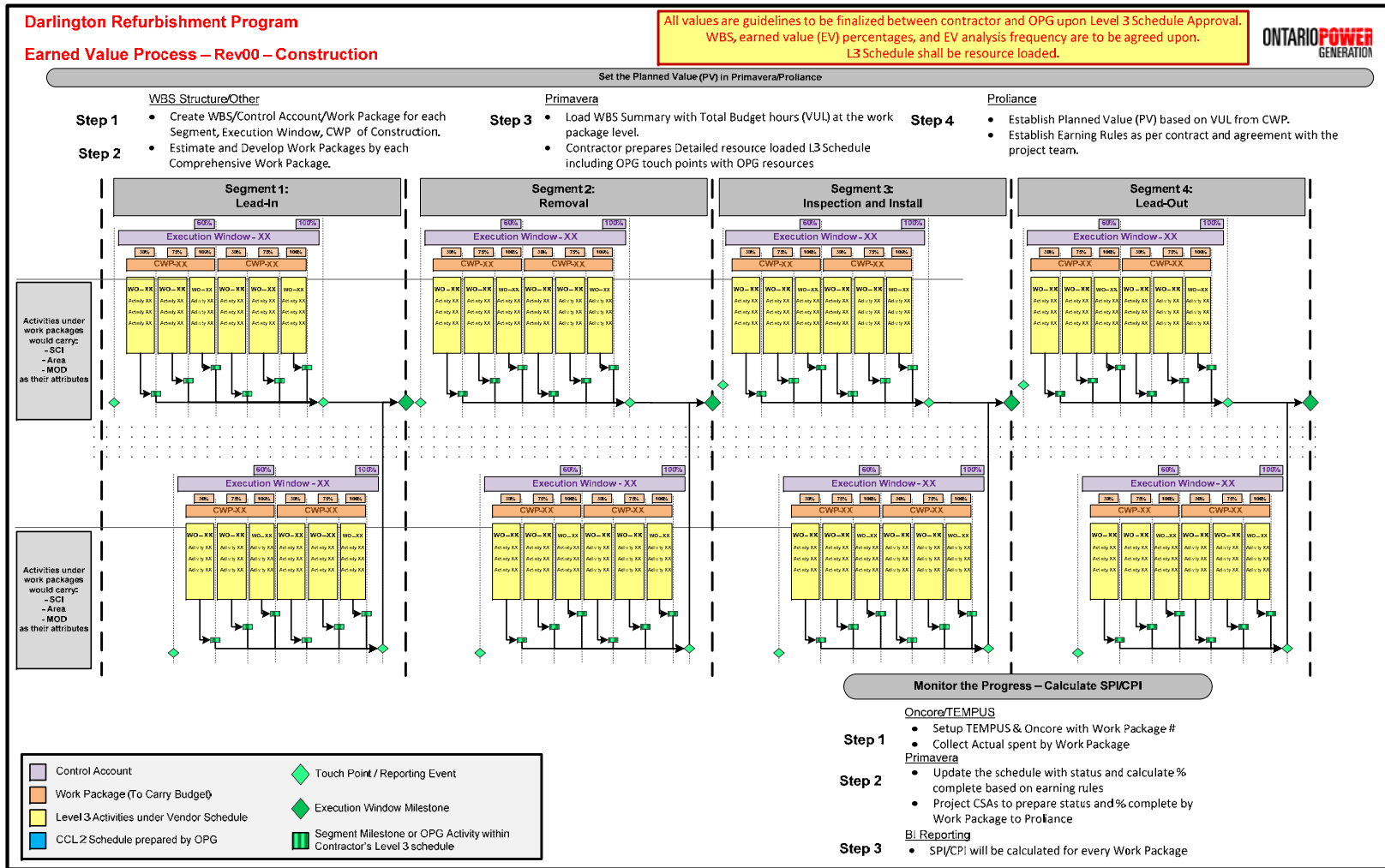
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**NUCLEAR REFURBISHMENT EARNED VALUE MANAGEMENT**

## Appendix L: Earned Value Management / Construction





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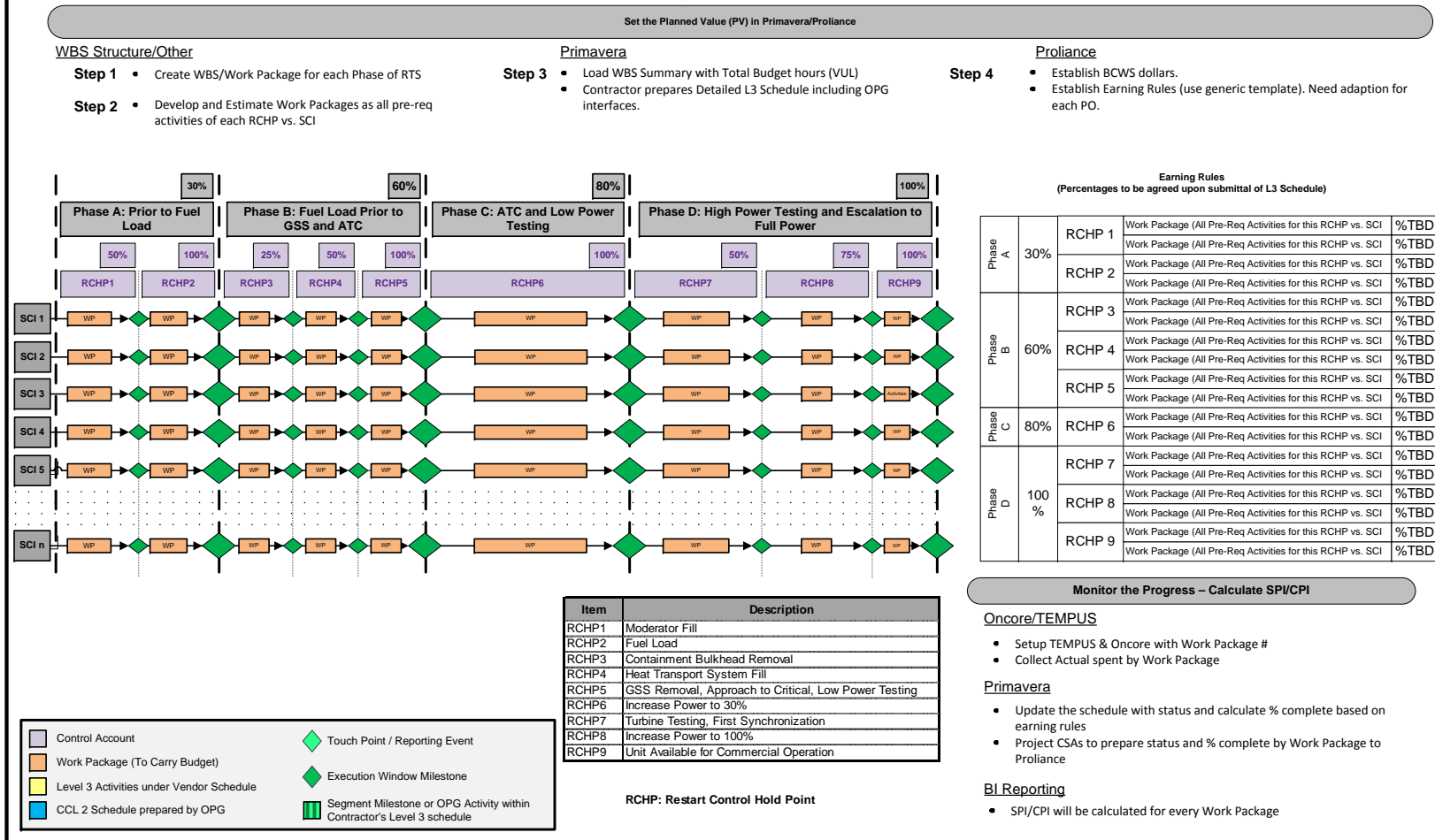
Title:  
**NUCLEAR REFURBISHMENT EARNED VALUE MANAGEMENT**

## Appendix M: Earned Value Management / Return to Service

### Darlington Refurbishment Program

#### Earned Value Process – Rev00 – Return to Service

All values are guidelines to be finalized between contractor and OPG upon Level 3 Schedule Approval.  
WBS, earned value (EV) percentages, and EV analysis frequency are to be agreed upon.  
L3 Schedule shall be resource loaded.



## Nuclear Refurbishment Change Control Form

TO VIEW OR HIDE INSTRUCTIONS FOR FORM COMPLETION GO TO: START, WORD OPTIONS, DISPLAY, HIDDEN TEXT-CHECK BOX.

Date: (YYYY-MM-DD) \_\_\_\_\_

CCF #: \_\_\_\_\_

### SECTION 1: INITIATE

<b>Project No.:</b>		<b>Project Title:</b>			
<b>Initiator:</b>		<b>Initiating Organization</b>			
<b>Change Title:</b>					
<b>Description:</b>					
<b>Reason:</b>					
<b>Classification:</b>	Choose an item.	<b>Level:</b>	Choose an item.	<b>ROM \$K:</b>	

### SECTION 2: REVIEW & EVALUATE

<b>COST IMPACT (ATTACH WORK PACKAGE CHANGE REPORT):</b>		
Is a re-baseline of the Planned Value being requested for this change?	YES <input type="checkbox"/>	NO <input type="checkbox"/>

<b>ESTIMATE AT COMPLETION IMPACT:</b>			
Is the EAC impacted by this change?	YES <input type="checkbox"/>	NO <input type="checkbox"/>	EAC \$:

<b>SCHEDULE IMPACT:</b> <span style="float: right;">(Ensure Schedule is Updated)</span>					
Milestone / Work Package ID	Description	Approved Date (mm/dd/yyyy)	Forecast Date (mm/dd/yyyy)	Requested Date (mm/dd/yyyy)	Variance Days

<b>SCHEDULE REBASELINE IMPACT:</b>		
Is a re-baseline of the schedule being requested for this change?	YES <input type="checkbox"/>	NO <input type="checkbox"/>

<b>RISK IMPACT:</b> <span style="float: right;">(Ensure RMO tool is Updated)</span>		
Risk ID	Description	Impact

<b>OPG/VENDOR ESTIMATE REVIEW:</b>	
------------------------------------	--

N-FORM-11252-R004

Nuclear Refurbishment Change Control Form

Estimate Validation Required?	YES <input type="checkbox"/>	NO <input type="checkbox"/>
AACE Estimate Class:	Estimate Accuracy Level:	
Value of Vendor Estimate: \$		
Value of NR Estimating Estimate: \$		N/A <input type="checkbox"/>
Notes:		
	NAME	DATE
PREPARED BY:		
REVIEWED BY:		

<b>REVIEW &amp; EVALUATION ISSUES/NOTES:</b>

**SECTION 3: DECISION**

Title	Name	Signature	Date (YYYY-MM-DD)	Approve	Reject
Initiator:					
Project Manager:				<input type="checkbox"/>	<input type="checkbox"/>
Project Director:				<input type="checkbox"/>	<input type="checkbox"/>
CCB (Chair):				<input type="checkbox"/>	<input type="checkbox"/>
Additional Approvals:				<input type="checkbox"/>	<input type="checkbox"/>
Is a re-baseline approved for this change?	YES <input type="checkbox"/>		NO <input type="checkbox"/>		
Decision Notes:					

**SECTION 4: IMPLEMENTATION**

IDB:	<input type="checkbox"/>	RMO TOOL:	<input type="checkbox"/>	iTWO:	<input type="checkbox"/>
MPL:	<input type="checkbox"/>		<input type="checkbox"/>	P6:	<input type="checkbox"/>
ECOSYS:	<input type="checkbox"/>		<input type="checkbox"/>	AS7:	<input type="checkbox"/>



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Sheet Number: <b>N/A</b>	Revision: <b>R003</b>

Title:

**DARLINGTON REFURBISHMENT PROGRAM MILESTONE & INTEGRATED MASTER SCHEDULE**

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## Darlington Refurbishment Program Milestone & Integrated Master Schedule

**NK38-PLAN-00300-10000-R003**

2014-09-25

Order Number: N/A  
Other Reference Number:

**Internal Use Only**

Prepared by:

\_\_\_\_\_  
Derek McAuley  
Manager, Scheduling  
Planning & Control  
Nuclear Refurbishment  
Date

Concurred by:

\_\_\_\_\_  
Gary Rose  
Director, Planning &  
Project Control  
Nuclear Refurbishment  
Date

Approved by:

\_\_\_\_\_  
Dietmar Reiner  
SVP  
Nuclear Refurbishment  
Date

Plan

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**DARLINGTON REFURBISHMENT PROGRAM MILESTONE & INTEGRATED MASTER SCHEDULE**

**Revision Summary**

Revision Number	Date	Comments
R000	2010-12-21	Initial Issue
R001	2012-01-31	First Revision - Reflects a 2016 first unit Refurb start date and further development of the program milestones and individual project milestones. See Section 2.0 of this document for further details.
R002	2014-01-31	Second Revision – Reflects no overlapping between Unit 2 and Unit 1 outages; Additional milestones to align with NK38-MAN-09701-10005 NUCLEAR REFURBISHMENT PLANNED OUTAGE MANAGEMENT and based on current status of all project bundles.
R003	2014-09-25	<p><b>(1)</b> The document name is changed to <i>Darlington Refurbishment Program Milestone &amp; Integrated Master Schedule</i>, to better reflect the content.</p> <p><b>(2)</b> Third Revision – Aligns milestone changes in NK38-MAN-09701-10005, <i>Nuclear Refurbishment Planned Outage Management</i>.</p> <p><b>(3)</b> Based on current planning assumptions, the unit refurb outage sequence order has been changed to Unit 2, Unit 3, Unit 1 and Unit 4. Please refer to <i>Darlington Refurbishment – Unit Outage Sequence Update</i> (File: NK38-00531 P, CD#: NK38-CORR-00531-17008).</p> <p><b>(4)</b> Every refurb outage is broken into 4 segments: Lead-in Segment, Removal Segment, Inspections &amp; Installation Segment and Lead-out Segment.</p> <p><b>(5)</b> Several milestone dates are changed, including</p> <ul style="list-style-type: none"> <li>• OP2015 (Initial Work Order Assessment Complete): from 15-Sep-14 to 30-Jan-15 (RO-20.5).</li> <li>• OP2040 (Long Lead and At Risk Materials Identified): from 15-Nov-14 to 15-Feb-15 (RO-20).</li> <li>• OP2070 (U2 Segment 1 Work Package Assessing Complete) to OP2070S1: 15-Sep-15 to 15-Apr-16 (SS-06).</li> <li>• OP2060 (U2 Segment 1 Readiness Assessment Finished) to OP2060S1: 15-Oct-15 to 15-Jul-16 (SS-03).</li> <li>• OP2160 (All U2 Segment 1 Documentation Ready) to OP2160S1: from 15-Oct-15 to 15-Feb-16 (SS-08).</li> <li>• OP2200 (Unit Refurb High Level Permitry Level 1 Plan Completed: from 15-Feb-16 to 15-Dec-15 (RO-10).</li> <li>• OP2260 (U2 Segment 1 Reactor Safety Challenge Meeting) to OP2260S1: from 15-Jul-16 to 15-Sep-16 (SS-01).</li> <li>• OP2100 (U2 Segment 1 Materials Staged and Tools on Site) to OP2100S1: from 15-Jul-16 to 30-Aug-16 (SS-01.5).</li> <li>• OP2230 (U2 Segment 1 Work Permits Prepared &amp; Reviewed and Challenge Meeting held by Operations) to OP2230S1: from RO-03 to SS-03 (15-Jul-16).</li> <li>• OP2240. Change word in title from “Support” to “Strategic Plan” (Radiation Protection Strategic Plan Support, Waste Minimization &amp; Outage Environmental Safety Plan Prepared).</li> </ul> <p><b>(6)</b> New Milestones are added, including</p> <ul style="list-style-type: none"> <li>• OP2290 (Cyclical Scope/Cost/Duration Reconciliation Review): RO-15 (15-Jul-15).</li> <li>• RP290 (Refurb Inspection &amp; Installation Segment Training Readiness) RO+19 (15-</li> </ul>

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		<p>May-18).</p> <ul style="list-style-type: none"> <li>• Created instances of RP200, RP210, RP270 and RP290 and for the other 3 units.</li> <li>• OP2300S1 (U2 Segment 1 At-Risk Materials List Generated): SS-13 (15-Sep-15).</li> <li>• OP2310S1 (All U2 Segment 1 Holds Removed): SS-06.5 (30-Mar-16).</li> <li>• OP2350-S1 (U2 Segment 1 Dose Estimate Complete): SS-03 (15-Jul-16).</li> <li>• OP2200-S1 (U2 Segment 1 Detailed Permitry Level 1 Plan Completed): SS-05.5 (30-Apr-16).</li> <li>• OP2330-S1 (All U2 Segment 1 materials on-site or dispositioned): SS-03 (15-Jul-16).</li> <li>• OP2320-S1 (All U2 Segment 1 Applicable walk-downs complete): SS-00.5 (30-Sep-16).</li> </ul>
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## 1.0 OVERVIEW

In order to sufficiently prepare and efficiently implement the Darlington Nuclear Refurbishment Program, a multi level scheduling approach is applied, including

- Level 0: Program Milestone Schedule
- Level 1: Program Integrated Master Schedule
- Level 2: Program Coordination & Control Schedules
- Level 3: Project Detailed Production Schedules

The Darlington Refurbishment Program Milestone & Integrated Master Schedule (PMIMS, NK38-PLAN-00300-10000) is the preamble of the Program Level 0 Schedule and Program Level 1 Schedule, and it describes

- The Program Milestone Dates and Owners
- The Responsibility Allocation and Control Accounts
- Assumptions
- Alignment with station and planned outages

All Project Bundles and functional groups have Control Accounts (Level 1 Activities) shown on the Program Level 1 Schedule. These Control Accounts are further broken down to Work Packages (Level 2 Activities) in Program Level 2 Schedules.

The Level 1 Activities (Control Accounts) in the Program Level 1 Schedule and Level 2 Activities (Work Packages) in Program Level 2 Schedules are logically tied to relevant Program Milestones, where applicable.

The PMIMS Revision 3 has been developed with current contracting strategies for each project bundle. Once a contract is awarded, an assessment against the Program Milestones will be performed. Program Milestones are re-evaluated when necessary and on an annual basis.

## 2.0 DESCRIPTION

The Darlington Refurbishment Program Integrated Master Schedule Revision 0 (R000) was approved in December 2010, Revision 1 (R001) was approved in January 2012, and Revision 2 (R002) was approved in January 2014.

Revision 3 (R003) is required based on the following changes,



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- The unit refurb outage sequence order identified in the Darlington Life Extension Model shows the unit sequence order being unit 2, unit 1, unit 3 and unit 4. Based on current planning assumptions, a different unit order has been confirmed by OPG and is now Unit 2, Unit 3, Unit 1 and Unit 4. This change has been formally communicated with CNSC. Please refer to **Darlington Refurbishment – Unit Outage Sequence Update** (File: NK38-00531 P, CD#: NK38-CORR-00531-17008);
- This new sequence order has no impact on the planned unit outage dates associated with the Nuclear Refurbishment Program also identified in the Darlington Life Extension Model;
- Every refurb outage is broken into 4 segments: Lead-in Segment, Removal Segment, Inspection & Installation Segment and Lead-out Segment, so that the project teams will focus on the specific segment, and integration can be achieved segment by segment;
- Accordingly, segmentised Outage Preparation Milestones are added and they are documented in NK38-MAN-09701-10005, Nuclear Refurbishment Planned Outage Management.

The PMIMS Revision 3 documents have been updated to reflect these changes and to provide additional details as the planning phase is further developed.

## Plan

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### 3.0 RESPONSIBILITY ALLOCATION

Following the matrix structure of the Darlington Refurb Program Work, the responsibility allocation is stated as,

Project Bundles	Scope of Work	Responsible	Accountable
<b>R&amp;FR</b>	<ul style="list-style-type: none"> <li>Tooling for R&amp;FR</li> <li>Mock-up &amp; Training for R&amp;FR</li> <li>Retube and Feeder Replacement work</li> </ul>	Project Manager	VP, Refurb Execution
<b>Turbine Generator</b>	<ul style="list-style-type: none"> <li>TG Engineering Services and Equipment Supply work</li> <li>TG Minor Procurement and TG Refurb Construction work</li> <li>TG Inspections and Repairs</li> </ul>	Project Manager	VP, Refurb Execution
<b>Steam Generator</b>	<ul style="list-style-type: none"> <li>SG EPC Contract work, including Primary Side Cleaning, SG Water Lancing, SG Access Port, SG Tube and Divider Inspections and SG Minor Projects</li> <li>SG Inspections and Repairs</li> </ul>	Project Manager	VP, Refurb Execution
<b>Fuel Handling &amp; Defueling Bundle</b>	<ul style="list-style-type: none"> <li>Defueling Preparations</li> <li>Fuel Handling Refurb</li> <li>Fuel Handling Specialised Projects</li> </ul>	Project Manager	VP, Refurb Execution
<b>Balance of Plant</b>	<ul style="list-style-type: none"> <li>BOP Common Systems Refurb</li> <li>BOP Nuclear Systems Refurb</li> <li>BOP Conventional Systems Refurb</li> </ul>	Project Manager	VP, Refurb Execution
<b>Islanding</b>	<ul style="list-style-type: none"> <li>Bulkhead &amp; Containment Isolation</li> <li>Barriers Project</li> <li>Islanding Pre-Outage Modifications</li> <li>Islanding Outage Modifications</li> </ul>	Project Manager	VP, Refurb Execution
<b>Shutdown, Layup and Services</b>	<ul style="list-style-type: none"> <li>Unit Takeover from the Station</li> <li>Unit Shutdown</li> <li>Shutdown Pre-Req. Modifications</li> <li>Shutdown Outage Mods.</li> <li>Unit Layup Services</li> </ul>	Project Manager	VP, Refurb Execution

**Plan**

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<b>Refurb Support Facilities</b>	<ul style="list-style-type: none"> <li>• RSF-Work Control Area (73711)</li> <li>• Radiation Protection Teledosimetry (73712)</li> <li>• Washroom Facility and Turbine Lunch Room (73716)</li> <li>• Shops and Work Areas (73715)</li> <li>• TAB West Elevation Elevator (73713)</li> <li>• Decontamination Shops /Contaminated Shops and Work Areas (73714)</li> <li>• Off-Site Security X-Ray Scanner (73718)</li> <li>• Vestibule, Storage Pad, PB Lay-down Area and Pathways (73716)</li> <li>• Electronic Work Authorization Areas Kiosks (73719)</li> </ul>	Project Manager	VP, Refurb Execution
<b>Facilities and Infrastructure Projects- Inside</b>	<ul style="list-style-type: none"> <li>• D2O Storage Facility (31555)</li> <li>• R&amp;FR Island Support Annex (73810)</li> <li>• Nuclear Waste Processing Facility</li> <li>• R&amp;FR Replacement Facilities</li> <li>• R&amp;FR Command Centre</li> </ul>	Director, Facilities and Infrastructure Projects	VP, Projects & Modifications
<b>Facilities and Infrastructure Projects - Outside</b>	<ul style="list-style-type: none"> <li>• Retube Waste Storage Facility (60162)</li> <li>• West Security &amp; Office Building (73808/73815)</li> <li>• Darlington Energy Complex (73803)</li> <li>• DNGD Maintenance Facility (31717)</li> <li>• Warehouse Facilities (73822)</li> <li>• Contractor Trailer Park (73826)</li> <li>• OSB Refurb (25619)</li> <li>• Facility Services Building (73825)</li> <li>• Facility Support Services – A,B (73823/73824)</li> <li>• Demolition Projects – A,B,C (73891/73892/73893)</li> <li>• Boiler House Replacement (34000)</li> <li>• Information Centre (73804)</li> <li>• GM Office Lease (73814)</li> </ul>	Director, Facilities and Infrastructure Projects	VP, Projects & Modifications
<b>Facilities and Infrastructure Projects - Infrastructure</b>	<ul style="list-style-type: none"> <li>• Water &amp; Sewer Project (73802)</li> <li>• Road &amp; Bridges – DN Operation (73829)</li> <li>• Parking – DN Operation (73828)</li> <li>• Parking – DN Removal (73894)</li> <li>• General Services – DN Operation (73827)</li> <li>• Power &amp; Electrical Distribution (73821)</li> <li>• MTO Holt Road Interchange (73706)</li> <li>• Hepcoe Demolition (73897)</li> <li>• Landscape (73896)</li> <li>• Underground Services Upgrade</li> </ul>	Director, Facilities and Infrastructure Projects	VP, Projects & Modifications
<b>Cyclical Maintenance</b>	<ul style="list-style-type: none"> <li>• Cyclical maintenance work to be performed during 4 Refurb outages</li> </ul>	Manager, NR Operations & Maintenance	Director, NR Operations & Maintenance

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<b>Commissioning &amp; Start-up</b>	<ul style="list-style-type: none"> <li>• Provide test and commissioning guidelines and procedures to contractors</li> <li>• Assist project managers to perform system test and commissioning</li> <li>• Organise systems combined commissioning, unit start up and organize performances test</li> <li>• Unit Handover to the Station</li> </ul>	Director, NR O&M	SVP, Nuclear Refurb
<b>Unit Demobilization</b>	<ul style="list-style-type: none"> <li>• Unit Refurb Outage Demobilization</li> <li>• Contract closeout by units</li> <li>• Site management transferring to successor unit</li> </ul>	VP, Refurb Execution	SVP, Nuclear Refurb
<b>Final Station Demobilization</b>	<ul style="list-style-type: none"> <li>• Post Refurb Programs Identification</li> <li>• Demolition of Temporary Buildings</li> <li>• Landscaping &amp; Rehabilitation</li> <li>• Station Configuration As Built Tech. Docs</li> <li>• Program Final Acceptance</li> </ul>	VP, Refurb Execution	SVP, Nuclear Refurb
<b>Functional Work</b>	Described in NR Program Management Plans	NP Division Directors	SVP, Nuclear Refurb

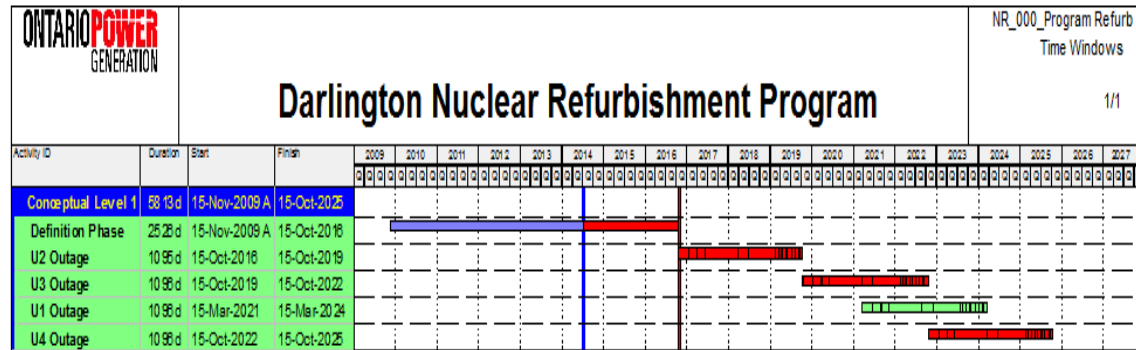
#### 4.0 PROGRAM PHASES

10 Phases were defined for the Darlington Nuclear Refurbishment Program as follows, for financial release purposes.

- Phase 1: Program Initiation Phase, 2007-2008
- Phase 2: Program Approval Phase, 2008-2009
- Phase 3: Preliminary Planning Phase, 2009-2011
- Phase 4: Detailed Engineering & Refurb Scope Definition Phase, 2012-2014
- Phase 5: Outage Preparation Phase, 2014-2015
- Phase 6: Unit 2 Refurb Outage Phase/U2 Release Quality Estimate, 2015-2019
- Phase 7: Unit 3 Refurb Outage Phase/U3 Release Quality Estimate, 2018-2023
- Phase 8: Unit 1 Refurb Outage Phase/U1 Release Quality Estimate, 2020-2024
- Phase 9: Unit 4 Refurb Outage Phase/U4 Release Quality Estimate, 2021-2025
- Phase 10: Program Closure Phase, 2024-2026

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**Note:** this diagram shows only Definition Phase and the 4 Unit Refurb Execution Phases.

## 5.0 PROGRAM MILESTONE DEFINITIONS

As per N-MAN-00120-10001-SCH-06, each individual milestone definition sheet is issued as a record in AssetSuite.

Program Milestone Definitions of PMIMS Revision 3 can be found in PowerSearch and AssetSuite via using the Milestone ID with "NK38-REF-09701-" pre-fix as the record number.

For the Program Milestones and Key Dates, please refer to Appendix B.

## 6.0 ALIGNMENT WITH STATION PLANNED OUTAGES AND OPERATING WORK PROGRAM

### 6.1 Pre-Refurb Work in Station Planned Outages

There are pre-refurb work activities that must be completed in the Darlington planned outages leading up to Refurb. It is the responsibility of the Nuclear Refurb Team to identify these Work Orders and ensure scope rationalization is provided prior to Planned Outage scope freeze. *Planned Outage Management* (N-PROC-MA-0013) will be followed.

### 6.2 Pre-Refurb Work in the On-Line Work Schedule

There is work that can be completed in Darlington's on-line program (IPG). This work is being integrated into the IPG work program, following the *Integrated On-Line Work Schedule* (N-PROC-MA-0022).

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**7.0 ASSUMPTIONS**

The Program Integrated Master Schedule (R003) is based on the following assumptions,

- EPC Contractors will undertake the major work nuclear refurbish work while OPG establishes a team to oversight and support the refurb work.
- OPG will undertake cyclical maintenance work and unit commissioning & start-up.
- There will be no resource demand conflict due to other nuclear stations' refurb program/projects, i.e., the major contractors will have sufficient resources to complete the work for NR Program.
- There will be no further strategic change on the sequence of the four Unit Outages, as described in detail in Section 2.0 and Section 4.0.
- PIMS is developed in a progressive elaboration approach. The Level 1 Activities in the PIMS are originally *instructive version*, and they become *control version* when the relevant work is released and the contractors' detailed schedule is summarised and baselined.

For detailed assumptions and risks of each project bundle, please refer to Nuclear Refurbishment Actions, Issues, Decisions and Key Assumptions Management (N-MAN-0120-10001-RISK-07).

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**Appendix A: Program Integrated Master Schedule before U2 Circuit Breaker Open**

The Program Integrated Master Schedule that contains all Control Accounts (Level 1 Activities) is published on OPG WebPages at the following link and it is monthly updated: <http://catou-ogwspuwdc:9015/webpublishing/nuclear/projects/dr/Pages/CCSchedules.aspx>

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**Appendix B: Program Milestones and Key Dates**

Activity ID	Activity Name	Start	Finish	Owner
<b>Regulatory Key Dates</b>		<b>04-Oct-10 A</b>	<b>4-Jul-22</b>	
<b>UC Regulatory Key Dates</b>		<b>04-Oct-10 A</b>	<b>31-Dec-14</b>	
RG010	Protocol to Manage Interaction on ISR		04-Oct-10 A	VP, Nuclear Services
RG020	CNSC Acceptance of ISR Procedure		30-Dec-10 A	VP, Nuclear Services
RG030	Submission of EA Project Description		28-Apr-11 A	VP, Nuclear Services
RG051	Submission of DNGS License Extension Application		28-Jun-11 A	VP, Nuclear Services
RG040	Submission of Final ISR Report		27-Oct-11 A	VP, Nuclear Services
RG050	Submission of EIS/TSD's		01-Dec-11 A	VP, Nuclear Services
RG060	CNSC Staff Issue Final ISR Report Sufficiency Review		06-Feb-12 A	VP, Nuclear Services
RG085	CNSC EA Hearing		03-Dec-12 A	VP, Nuclear Services
RG080	Current License End Date		28-Feb-13 A	VP, Nuclear Services
RG070	CNSC Decision on EA		14-Mar-13 A	VP, Nuclear Services
RG075	CNSC Approval for NWSF License Renewal		14-Mar-13 A	VP, Nuclear Waste Management
RG100	CNSC Staff Assessment of Final ISR Report		05-Jul-13 A	VP, Nuclear Services
RG110	Submission of IIP & License Renewal Application		22-Nov-13 A	VP, Nuclear Services
RG090	CNSC Certification of RWC Transportation Package Design		23-Jan-14 A	VP, Nuclear Waste Management
RG120	IIP Approval by CNSC		31-Dec-14	VP, Nuclear Services
<b>U2 Regulatory Key Dates</b>		<b>15-Jan-16</b>	<b>15-Jul-16</b>	
RG125	U2 Submit Request for Outage Approvals		15-Jan-16	VP, Nuclear Services
RG130	U2 Outage CNSC Approvals in Place		15-Jul-16	VP, Nuclear Services
<b>U3 Regulatory Key Dates</b>		<b>15-Jan-19</b>	<b>15-Jul-19</b>	
RG153	U3 Submit Request for Outage Approvals		15-Jan-19	VP, Nuclear Services
RG157	U3 Outage CNSC Approvals in Place		15-Jul-19	VP, Nuclear Services
<b>U1 Regulatory Key Dates</b>		<b>15-Jun-20</b>	<b>15-Dec-20</b>	
RG143	U1 Submit Request for Outage Approvals		15-Jun-20	VP, Nuclear Services
RG147	U1 Outage CNSC Approvals in Place		15-Dec-20	VP, Nuclear Services
<b>U4 Regulatory Key Dates</b>		<b>4-Jan-22</b>	<b>4-Jul-22</b>	
RG163	U4 Submit Request for Outage Approvals		15-Jan-22	VP, Nuclear Services
RG167	U4 Outage CNSC Approvals in Place		15-Jul-22	VP, Nuclear Services
<b>Program Release Dates</b>		<b>19-Nov-09 A</b>	<b>15-Oct-21</b>	
RL010	Rel.3: Preliminary Planning Release	19-Nov-09 A		Director, NR P&PC
RL020	Rel.4A: Detailed Planning Release A	17-Nov-11 A		Director, NR P&PC



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Activity ID	Activity Name	Start	Finish	Owner
RL025	Rel.4B: Detailed Planning Release B	15-Nov-12 A		Director, NR P&PC
RL070	Rel.4C: Detailed Planning Release C	14-Nov-13 A		Director, NR P&PC
RL080	Rel.4D: Detailed Planning Release D	13-Nov-14		Director, NR P&PC
RL030	Rel.5/6/RQE: U2 Outage Release	15-Oct-15		Director, NR P&PC
RL040	Rel.7: Unit 3 Outage Release	15-Oct-18		Director, NR P&PC
RL050	Rel.8: Unit 1 Outage Release	15-Mar-20		Director, NR P&PC
RL060	Rel.9: Unit 4 Outage Release	15-Oct-21		Director, NR P&PC
<b>Facilities and Infrastructure MS</b>		<b>15-Apr-16</b>	<b>15-Apr-16</b>	
CP190	All Refurb Related Facilities & Infrastructure Projects Ready for Service		15-Apr-16	VP, Proj.& Mods
<b>Outage Preparation Key Dates</b>		<b>19-Nov-09 A</b>	<b>15-Apr-25</b>	
<b>Unit Common Outage Prep. MS</b>		<b>19-Nov-09 A</b>	<b>15-Jun-16</b>	
RP010	Program Execution Plan (PEP) Approved		19-Nov-09 A	Director, NR P&PC
RP020	R&FR Contract Tech. Spec. Issued		15-Sep-10 A	VP, NR Engineering
RP030	Program Integrated Master Schedule Approved		15-Dec-10 A	Director, NR P&PC
RP039	R&FR Project RFP Issued		22-Feb-11 A	Director, NR P&PC
RP040	Program Scope Identified		12-May-11 A	VP, NR Engineering
RP050	Unit Outage Sequence Duration and Start Date Defined (incl. VBO Pre/Post Outages)		25-May-11 A	VP, NR Execution
RP055	2nd Phase Evolution of Outage Sequence		15-Oct-11 A	VP, NR Execution
RP070	1st Priority Projects RFP's Issued		15-Dec-11 A	Director, NR Supply Chain
RP065	Preliminary Engineering Procedure List Developed		15-Dec-11 A	VP, NR Engineering
RP075	PIMS Revision 2016 Start Issued		15-Feb-12 A	Director, NR P&PC
RP060	R&FR Contract Awarding		01-Mar-12 A	Director, NR Supply Chain
OP2000	U2 Health of Scope < 20		12-Oct-12 A	VP, NR Engineering
RP080	Fuel Channel Annulus Spacer Design Selected		23-Oct-12 A	VP, NR Engineering
OP2005	U2 Level 3 Schedule Developed for Definition Phase		14-Dec-12 A	Director, NR P&PC
RP150	Fuel Channel LCM Project Complete		21-Dec-12 A	VP, NR, Engineering
RP240	Mock-up Installation Starts at DEC		21-May-13 A	VP, NR Execution
RP230	57 DSR's for Engineering Studies Completion/Disposition		31-Oct-13 A	VP, NR Engineering
OP1000	All Units Health of Scope <20		15-Nov-13 A	VP, NR Engineering
RP140	Preliminary Engineering Standards Complete		15-Nov-13 A	VP, NR Engineering
RP250	Mock Ups Site Construction and Assembly Complete		13-Feb-14 A	VP, NR Execution

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Activity ID	Activity Name	Start	Finish	Owner
RP170	R&FR Mock-up Available for Service		31-Mar-14 A	VP, NR Execution
RP280	Blue Ribbon Task Force Scope Recommendations		31-Mar-14 A	VP, NR Execution
RP160	Refurbishment MDR's Complete		15-Aug-14	VP, NR Engineering
RP180	Program Health Review Finished		15-Oct-14	Director, NR P&PC
RP190	R&FR Tooling Available for Service		15-Aug-15	VP, NR Execution
RP130	All Projects Detailed Engineering Finished/U2 Design Mod. Docs Finished		15-Aug-15	VP, NR Engineering
RP260	R&FR Definition Phase Complete/Production Tools Delivered to DEC		15-Jun-16	VP, NR Execution
<b>Unit 2 Outage Prep. MS</b>		<b>15-Apr-14 A</b>	<b>15-Apr-19</b>	
<b>Non-Segmentised Prep. MS</b>		<b>15-Apr-14 A</b>	<b>15-Apr-19</b>	
OP2010	U2 Outage Level 1 Revision A Issued		15-Apr-14 A	NR, Unit Director
OP2020	U2 OMS Work Order Scope Definition Complete		15-Oct-14	VP, NR Execution
OP2120	U2 Refurb Outage Planning Organization Defined		15-Oct-14	NR, Unit Director
OP2130	U2 Refurb Pre-Outage Metrics Prepared		15-Oct-14	Director, NR P&PC
OP2140	U2 Scope Ranked and Approved in OMS		15-Jan-15	NR, Unit Director
OP2015	U2 Initial Work Order Assessment Complete		01-Feb-15	VP, NR Execution
OP2040	U2 Long Lead and At Risk Materials Identified		15-Feb-15	VP, NR Execution
OP2050	U2 Outage Level 1 Revision B Issued		15-Apr-15	NR, Unit Director
OP2290	U2 Cyclical Scope/Cost/Duration Reconciliation Review		15-Jul-15	NR, Unit Director
OP2075	U2 OMS Work Order Scope Freeze		15-Oct-15	NR, Unit Director
OP2170	U2 PC1's Submitted		15-Nov-15	VP, NR Execution
OP2180	U2 Refurb Outage Pre-Requisites Scheduled		15-Dec-15	NR, Unit Director
OP2200	U2 Refurb Outage High Level Permitry Level 1 Plan Completed		15-Dec-15	Director, NR O&M
OP2210	U2 Risk Mitigation Plans Prepared		15-Feb-16	VP, NR Execution
OP2080	U2 Outage Level 1 Revision C Issued		15-Apr-16	NR, Unit Director
OP2110	U2 Outage Level 1 Revision 0 Issued (Control Version)		15-Jul-16	NR, Unit Director
OP2220	U2 Refurb Outage Execution Organization Identified		15-Jul-16	VP, NR Execution
OP2240	U2 Radiation Protection Support, Waste Minimization & Outage Environment Safety Plan Prepared		15-Jul-16	Director, NR O&M
OP2250	U2 Refurb Outage Execution Metrics Prepared		15-Jul-16	VP, NR Execution

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Activity ID	Activity Name	Start	Finish	Owner
OP2270	U2 Refurb Outage Briefing Packages Ready		15-Aug-16	Section Manager, NR Public Affairs
RP200U2	U2 Refurb Training Outage Readiness		01-Oct-16	Director, NR O&M
OP2280	U2 Refurb Outage Pre-Requisites Complete		15-Oct-16	VP, NR Execution
RP270U2	U2 Refurb Training Execution Readiness		15-Apr-17	Director, NR O&M
RP290U2	U2 Refurb Inspection & Installation Training Readiness		15-May-18	Director, NR O&M
RP210U2	U2 Refurb Training Operational Readiness		15-Apr-19	Director, NR O&M
<b>Unit 3 Outage Prep. MS</b>		<b>15-Apr-17</b>	<b>15-Apr-22</b>	
<b>Non-Segmentised Prep. MS</b>		<b>15-Apr-17</b>	<b>15-Apr-22</b>	
OP3010	U3 Outage Level 1 Revision A Issued		15-Apr-17	NR, Unit Director
OP3020	U3 OMS Work Order Scope Definition Complete		15-Oct-17	VP, NR Execution
OP3120	U3 Refurb Outage Planning Organization Defined		15-Oct-17	NR, Unit Director
OP3130	U3 Refurb Pre-Outage Metrics Prepared		15-Oct-17	Director, NR P&PC
OP3140	U3 Scope Ranked and Approved in OMS		15-Jan-18	NR, Unit Director
OP3015	U3 Initial Work Order Assessment Complete		01-Feb-18	VP, NR Execution
OP3040	U3 Long Lead and At Risk Materials Identified		15-Feb-18	VP, NR Execution
OP3050	U3 Outage Level 1 Revision B Issued		15-Apr-18	NR, Unit Director
OP3290	U3 Cyclical Scope/Cost/Duration Reconciliation Review		15-Jul-18	NR, Unit Director
OP3055	U3 Project Detailed Engineering Finished (Design Modification Documents Finished)		15-Aug-18	VP, NR Engineering
OP3075	U3 OMS Work Order Scope Freeze		15-Oct-18	NR, Unit Director
OP3170	U3 PC1's Submitted		15-Nov-18	VP, NR Execution
OP3180	U3 Refurb Outage Pre-Requisites Scheduled		15-Dec-18	VP, NR Execution
OP3200	U3 Refurb Outage High Level Permitry Level 1 Plan Completed		15-Dec-18	VP, NR Execution
OP3210	U3 Risk Mitigation Plans Prepared		15-Feb-19	VP, NR Execution
OP3080	U3 Outage Level 1 Revision C Issued		15-Apr-19	NR, Unit Director
OP3110	U3 Outage Level 1 Revision 0 Issued (Control Version)		15-Jul-19	NR, Unit Director
OP3220	U3 Refurb Outage Execution Organization Identified		15-Jul-19	VP, NR Execution
OP3240	U3 Radiation Protection Support, Waste Minimization & Outage Environment Safety Plan Prepared		15-Jul-19	Director, NR O&M
OP3250	U3 Refurb Outage Execution Metrics Prepared		15-Jul-19	VP, NR Execution

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OP3270	U3 Refurb Outage Briefing Packages Ready		15-Aug-19	Section Manager, NR Public Affairs
RP200U3	U3 Refurb Training Outage Readiness		01-Oct-19	Director, NR O&M
OP3280	U3 Refurb Outage Pre-Requisites Complete		15-Oct-19	VP, NR Execution
RP270U3	U3 Refurb Training Execution Readiness		15-Apr-20	Director, NR O&M
RP290U3	U3 Refurb Inspection & Installation Training Readiness		15-May-21	Director, NR O&M
RP210U3	U3 Refurb Training Operational Readiness		15-Apr-22	Director, NR O&M
<b>Unit 1 Outage Prep. MS</b>		<b>15-Sep-18</b>	<b>15-Sep-23</b>	
<b>Non-Segmented Prep. MS</b>		<b>15-Sep-18</b>	<b>15-Sep-23</b>	
OP1010	U1 Outage Level 1 Revision A issued		15-Sep-18	NR, Unit Director
OP1020	U1 OMS Work Order Scope Definition Complete		15-Mar-19	VP, NR Execution
OP1120	U1 Refurb Outage Planning Organization Defined		15-Mar-19	NR, Unit Director
OP1130	U1 Refurb Pre-Outage Metrics Prepared		15-Mar-19	Director, NR P&PC
OP1140	U1 Scope Ranked and Approved in OMS		15-Jun-19	NR, Unit Director
OP1015	U1 Initial Work Order Assessment Complete		01-Jul-19	VP, NR Execution
OP1040	U1 Long Lead and At Risk Materials Identified		15-Jul-19	VP, NR Execution
OP1050	U1 Outage Level 1 Revision B Issued		15-Sep-19	NR, Unit Director
OP1290	U1 Cyclical Scope/Cost/Duration Reconciliation Review		15-Dec-19	NR, Unit Director
OP1055	U1 Project Detailed Engineering Finished (Design Modification Documents Finished)		15-Jan-20	VP, NR Engineering
OP1075	U1 OMS Work Order Scope Freeze		15-Mar-20	NR, Unit Director
OP1170	U1 PC1's Submitted		15-Apr-20	VP, NR Execution
OP1180	U1 Refurb Outage Pre-Requisites Scheduled		15-May-20	NR, Unit Director
OP1200	U1 Refurb Outage High Level Permitry Level 1 Plan Completed		15-May-20	Director, NR O&M
OP1210	U1 Risk Mitigation Plans Prepared		15-Jul-20	VP, NR Execution
OP1080	U1 Outage Level 1 Revision C Issued		15-Sep-20	NR, Unit Director
OP1110	U1 Outage Level 1 Revision 0 Issued (Control Version)		15-Dec-20	NR, Unit Director
OP1220	U1 Refurb Outage Execution Organization Identified		15-Dec-20	VP, NR Execution
OP1240	U1 Radiation Protection Support, Waste Minimization & Outage Environment Safety Plan Prepared		15-Dec-20	Director, NR O&M
OP1250	U1 Refurb Outage Execution Metrics Prepared		15-Dec-20	VP, NR Execution

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OP1270	U1 Refurb Outage Briefing Packages Ready		15-Jan-21	Section Manager, NR Public Affairs
RP200U1	U1 Refurb Training Outage Readiness		01-Mar-21	Director, NR O&M
OP1280	U1 Refurb Outage Pre-Requisites Complete		15-Mar-21	VP, NR Execution
RP270U1	U1 Refurb Training Execution Readiness		15-Sep-21	Director, NR O&M
RP290U1	U1 Refurb Inspection & Installation Training Readiness		15-Oct-22	Director, NR O&M
RP210U1	U1 Refurb Training Operational Readiness		15-Sep-23	Director, NR O&M
<b>Unit 4 Outage Prep. MS</b>		<b>15-Apr-20</b>	<b>15-Apr-25</b>	
<b>Non-Segmented Prep. MS</b>		<b>15-Apr-20</b>	<b>15-Apr-25</b>	
OP4010	U4 Outage Level 1 Revision A Issued		15-Apr-20	NR, Unit Director
OP4020	U4 OMS Work Order Scope Definition Complete		15-Oct-20	VP, NR Execution
OP4120	U4 Refurb Outage Planning Organization Defined		15-Oct-20	Director, NR P&PC
OP4130	U4 Refurb Pre-Outage Metrics Prepared		15-Oct-20	Director, NR P&PC
OP4140	U4 Scope Ranked and Approved in OMS		15-Jan-21	NR, Unit Director
OP4015	U4 Initial Work Order Assessment Complete		01-Feb-21	VP, NR Execution
OP4040	U4 Long Lead Materials Identified		15-Feb-21	VP, NR Execution
OP4050	U4 Outage Level 1 Revision B Issued		15-Apr-21	NR, Unit Director
OP4290	U4 Cyclical Scope/Cost/Duration Reconciliation Review		15-Jul-21	NR, Unit Director
OP4055	U4 Project Detailed Engineering Finished (Design Modification Documents Finished)		15-Aug-21	VP, NR Engineering
OP4075	U4 OMS Work Order Scope Freeze		15-Oct-21	NR, Unit Director
OP4170	U4 PC1's Submitted		15-Nov-21	VP, NR Execution
OP4180	U4 Refurb Outage Pre-Requisites Scheduled		15-Dec-21	VP, NR Execution
OP4200	U4 Refurb Outage High Level Permitry Level 1 Plan Completed		15-Dec-21	Director, NR O&M
OP4210	U4 Risk Mitigation Plans Prepared		15-Feb-22	VP, NR Execution
OP4080	U4 Outage Level 1 Revision C Issued		15-Apr-22	NR, Unit Director
OP4110	U4 Outage Level 1 Revision 0 Issued (Control Version)		15-Jul-22	NR, Unit Director
OP4220	U4 Refurb Outage Execution Organization Identified		15-Jul-22	VP, NR Execution
OP4240	U4 Radiation Protection Support, Waste Minimization & Outage Environment Safety Plan Prepared		15-Jul-22	Director, NR O&M
OP4250	U4 Refurb Outage Execution Metrics Prepared		15-Jul-22	VP, NR Execution
OP4270	U4 Refurb Outage Briefing Packages Ready		15-Aug-22	Section Manager,

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**DARLINGTON REFURBISHMENT PROGRAM MILESTONE & INTEGRATED MASTER SCHEDULE**

Activity ID	Activity Name	Start	Finish	Owner
				NR Public Affairs
RP200U4	U4 Refurb Training Outage Readiness		01-Oct-22	Director, NR O&M
OP4280	U4 Refurb Outage Pre-Requisites Complete		15-Oct-22	VP, NR Execution
RP270U4	U4 Refurb Training Execution Readiness		15-Apr-23	Director, NR O&M
RP290U4	U4 Refurb Inspection & Installation Training Readiness		15-May-24	Director, NR O&M
RP210U4	U4 Refurb Training Operational Readiness		15-Apr-25	Director, NR O&M
<b>Outage Execution Key Dates</b>		<b>15-Oct-16</b>	<b>15-Oct-25</b>	
<b>Unit 2 Refurb Outage</b>		<b>15-Oct-16</b>	<b>15-Oct-19</b>	
U2010	U2 Circuit Breaker Open	15-Oct-16		VP, NR Execution
	U2 Removal Segment Start	1-Apr-17		VP, NR Execution
	U2 Inspection & Installation Segment Start	1-Jun-18		VP, NR Execution
	U2 Lead Out Segment Start	1-May-19		VP, NR Execution
U2280	U2 Full Power & Handover to DNGS		15-Oct-19	VP, NR Execution
<b>Unit 3 Refurb Outage</b>		<b>15-Oct-19</b>	<b>15-Apr-23</b>	
U3010	U3 Circuit Breaker Open	15-Oct-19		VP, NR Execution
	U3 Removal Segment Start	1-Apr-20		VP, NR Execution
	U3 Inspection & Installation Segment Start	1-Jun-21		VP, NR Execution
	U3 Lead Out Segment Start	1-May-22		VP, NR Execution
U3280	U3 Full Power & Handover to DNGS		15-Oct-22	VP, NR Execution
<b>Unit 1 Refurb Outage</b>		<b>15-Mar-21</b>	<b>15-Sep-24</b>	
U1010	U1 Circuit Breaker Open	15-Mar-21		VP, NR Execution
	U1 Removal Segment Start	1-Sep-21		VP, NR Execution
	U1 Inspection & Installation Segment Start	1-Nov-22		VP, NR Execution
	U1 Lead Out Segment Start	1-Oct-23		VP, NR Execution
U1280	U1 Full Power and Handover to DNGS		15-Mar-24	VP, NR Execution
<b>U4 Unit 4 Refurb Outage</b>		<b>15-Oct-22</b>	<b>15-Apr-26</b>	
U4010	U4 Circuit Breaker Open	15-Oct-22		VP, NR Execution
	U4 Removal Segment Start	1-Apr-23		VP, NR Execution
	U4 Inspection & Installation Segment Start	1-Jun-24		VP, NR Execution
	U4 Lead Out Segment Start	1-May-25		VP, NR Execution
U4280	U4 Full Power & Handover to DNGS		15-Oct-25	VP, NR Execution
<b>Program Closeout Key Dates</b>		<b>30-Jun-26</b>	<b>30-Jun-26</b>	
CL1000	Final Acceptance		30-Jun-26	SVP, Nuclear Refurb

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**Note:**

- (1) Letter A besides dates means *Actual Completion Dates*.
- (2) The segmentised Outage Milestones are Tier 4 milestones that are not listed in the table.

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**Appendix C: Segmentised Reoccurring Milestones Example (Tier 4)**

The table below is a summary of Segment Preparation milestones that are tied to/occur with the start of each of the 4 segments (as defined in the Outage level 1) with Unit 2 Lead-in Segment example titles and Milestone ID's in PMSS -C.

Segment Start – XX Months	Title	Owner	PMSS ID (U2 Segment 1 example)
SS-13	U2 Lead-in Segment At Risk Materials List Generated	VP, NR Execution	OP2300S1
SS-08	All U2 Lead-in Segment Documentation Ready	VP, NR Execution	OP2160S1
SS-06.5	All U2 Lead-in Segment Holds Removed	VP, NR Engineering	OP2310S1
SS-06	U2 Lead-in Segment Work Package Assessment Complete	Unit Director	OP2070S1
SS-05.5	U2 Lead-in Segment Detailed Outage Segment Permitry Level 1 Plan Complete	Director, NR O&M	OP2200S1
SS-03	U2 Lead-in Segment Dose Estimate Complete	Director, NR O&M	OP2350S1
SS-03	U2 Lead-in Segment Readiness Assessment Finished	VP, NR Execution	OP2060S1
SS-03	All U2 Lead-in Segment Materials On-Site or Dispositioned	VP, NR Execution	OP2330S1
SS-03	U2 Lead-in Segment Work Permits Prepared & Reviewed and Challenge Meeting Held by Operations	Director, NR O&M	OP2230S1
SS-01.5	U2 Lead-in Segment Materials Staged and Tools on Site	VP, NR Execution	OP2100S1
SS-01	U2 Lead-in Segment Reactor Safety Challenge Meeting	Director, Nuclear Safety	OP2260S1
SS-00.5	All U2 Lead-in Segment Applicable Walk-downs Complete	VP, NR Execution	OP2320S1

**Note:** Milestones OP2350, OP2230, OP2330 and OP2320 will occur 3 times for Segment 2 and twice for Segment 3. Refer to NK38-MAN-09701-10005 for more details.





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**DARLINGTON REFURBISHMENT PROGRAM MANAGEMENT PLAN STRUCTURE**

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**Darlington Refurbishment Program  
Management Plan Structure**

**NK38-NR-PLAN-09701-10001-0001-R002**  
2016-08-29

Order Number: N/A  
Other Reference Number:

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Plan

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**Revision Summary**

<b>Revision Number</b>	<b>Date</b>	<b>Comments</b>
R002	2016-08-29	<p>Minor Revisions to align with NR execution phase Incorporated DCRs 126205, 135359, and 136304.</p> <p>Revised Section 2.1 to add PgMP criteria.</p> <p>Added Section 2.3 Functional Management Plan.</p> <p>Added Section 2.4, Revision Cycle Requirements.</p> <p>Added definition for FMP.</p> <p>Added References.</p>

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**Records Table**

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<b>Record Created</b>	<b>Associated Form or Template Number</b>	<b>QA Record? Y/N</b>	<b>Filing Information/Retention (AIMS Type/Sub-Type)</b>
None	None	N	NA

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**DARLINGTON REFURBISHMENT PROGRAM MANAGEMENT PLAN STRUCTURE**

## 1.0 PURPOSE

The purpose of this document is to set the framework for the Darlington Refurbishment Program Management Plans (PgMPs) which describe how the Darlington Refurbishment Program meets the intent of OPG's Nuclear Management System while establishing program-specific requirements.

Darlington Refurbishment Program Management Plans are designed to provide assurance that all aspects of the Program (e.g. engineering, procurement, construction, turnover, and program life cycle phases) will be conducted in accordance with the requirements of:

- Canadian Standards Association Standard N286-05, Management System Requirements for Nuclear Power Plants;
- Canadian Nuclear Safety Commission's Regulatory Document RD-360, Life Extension of Nuclear Power Plants;
- N-CHAR-AS-0002, Nuclear Management System; and
- OPG Corporate and Nuclear governance.

Darlington Refurbishment PgMPs integrate requirements from other Management System standards for health, safety, environment, security, economics and quality and is defined to meet the principle that safety is the paramount consideration guiding all decisions and actions.

## 2.0 DIRECTION

Owners of Darlington Refurbishment PgMPs are to follow the minimum structure and content requirements specified in this document to ensure consistency across the entire suite of Darlington Refurbishment PgMPs.

### 2.1 Darlington Refurbishment Program Management Plans

The following are the criteria for when a PgMP is required:

- Where a Nuclear management system program exists and is executed within the Darlington Refurbishment program, and
- Where there are unique Darlington Refurbishment processes, programs or organizations that are required to be defined for the Darlington Refurbishment program. Or
- As deemed required by the Senior Vice President, Nuclear Projects for any program phase.

Darlington Refurbishment PgMPs are accessible to all staff that have access to OPG's Information Management System through Asset Suite. They can also be accessed through Power Search or on the Darlington Refurbishment SharePoint Team Site which are both linked to Asset Suite.



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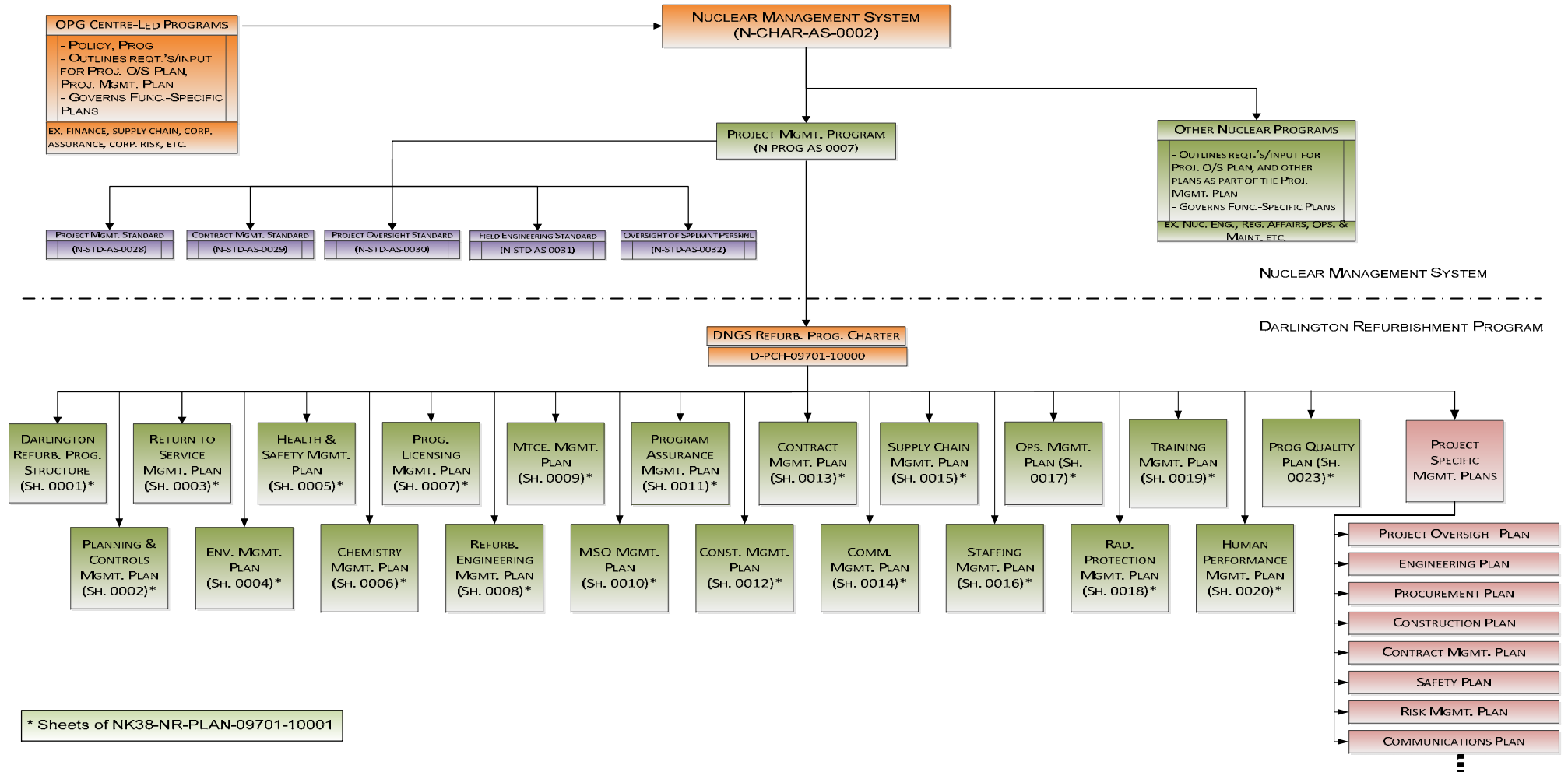


Figure 1: Darlington Refurbishment Program Framework



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### **2.1.1 Darlington Refurbishment Program Framework**

The hierarchy of Darlington Refurbishment Program documents is shown in Figure 1.

As shown in the above figure, the top tier document of the Darlington Refurbishment Program is D-PCH-09701-10000, Darlington Refurbishment Project Charter. The 2<sup>nd</sup> tier documents consist of this document and the remaining PgMPs in the form of sheets to NK38-NR-PLAN-09701-10001. The 3<sup>rd</sup> tier documents (not shown in the framework) include documents such as Manuals, Guides, Instructions, Plans, Contractor/Owner Interface Requirements and Forms which are considered "*Process Support Controlled Documents*" as defined in NK38-MAN-09701-10006, Nuclear Refurbishment - Requirements for Process Support Controlled Documents.

As per the requirement of CSA N286 and N-CHAR-AS-0002, Nuclear Management System, the Darlington Refurbishment Program also makes extensive use of Corporate and Nuclear Line of Business management system documents where applicable.

### **2.1.2 Program Management Plan Section Requirements**

The Darlington Refurbishment PgMPs stipulate function-specific requirements and processes for Darlington Refurbishment project execution.

The PgMPs are meant to convey how employees working within the Darlington Refurbishment Program will do their work while meeting the intent of the existing OPG Management System.

The structure and minimum content requirements for PgMPs are as follows:

#### **Section 1.0, Purpose**

- A clear and concise description of the fundamental intent or focus of the Program Management Plan.
- Limit rationale, background and process details.

#### **Section 2.0, Program Requirements**

This section is the most important section of the PgMP and should be considered a "roadmap" which conveys how employees working within the Darlington Refurbishment Program will meet the Program's requirements.

- Identify and briefly describe any Nuclear, Corporate, or other business unit governance, governance support and non-governance documents that provide implementing details for requirements, activities and processes described by the PgMP.
- State requirements which have been mandated by Darlington Refurbishment Functions for Darlington Refurbishment Projects to follow as part of contract development and project execution.



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### **DARLINGTON REFURBISHMENT PROGRAM MANAGEMENT PLAN STRUCTURE**

- Include a figure illustrating the entire PgMP framework, including implementing and interfacing documents.
- Specify the performance indicators or monitoring activities that are necessary to ensure the overall PgMP requirements are met.

#### Section 3.0, Roles & Accountabilities

- Identify and provide a high-level summary of accountabilities for Manager Level (Stratum IV) or higher positions or roles concerning the accomplishment of activities related to the implementation of the document.
- Do not:
  - ❖ Duplicate actions, activities or tasks already covered by Section 2.0 of the PgMP.
  - ❖ Use personal names.

#### Section 4.0, Definitions & Acronyms

##### **Definitions**

- If there are no definitions, state "None".
- Limit each definition to one or two sentences.
- Place definitions in alphabetical order.
- Do not define:
  - ❖ Generic terms if the dictionary definition conveys the meaning of a term.
  - ❖ Terms commonly used within the applicable business area.
  - ❖ Organizational positions or roles.

##### **Acronyms**

- If there are no acronyms, state "None".
- List acronyms used within the document along with their expanded forms.
- Place acronyms in alphabetical order.

#### Section 5.0, References

- Only list those documents the user **needs** to use in conjunction with the PgMP.
- Identify each reference document number and title in alpha-numeric order. Do not include revision numbers.

## **2.2 Project Management Plan**

Project Management Plans (PMPs) describe how specific projects will develop the scope and execute the work. When Darlington Refurbishment Project Teams are developing or revising their PMPs they will reference relevant sections from applicable PgMPs.

The PMPs follow the requirements of N-PROG-AS-0007, Project Management , and the associated governance.

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## **2.3 Functional Management Plan**

Functional Management Plans (FMPs) describe in detail how the function will execute the requirements outlined in PgMP over the life-cycle of the program. It identifies the work programs and the resource requirements of each function which are in alignment with the currently approved Funding Release plan. The FMP takes authority from the PgMP and should be referenced in the PgMP.

Darlington Refurbishment FMP structure and minimum content requirements are established in NK38-GUID-09701-10023, Functional Management Plan Guide.

## **2.4 Revision Cycle Requirement**

The default revision cycle requirement for the PgMPs is 3 years, or as required at the completion of U2 refurbishment and before start of U3 refurbishment.

## **2.5 Darlington Refurbishment PgMPs and Owners**

The following table summarizes the various Darlington Refurbishment PgMPs and their owners.

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**DARLINGTON REFURBISHMENT PROGRAM MANAGEMENT PLAN STRUCTURE**

Sheet	Title	Owner
0001	Darlington Refurbishment PgMP Structure	Director, Management System Oversight
0002	Planning And Controls PgMP	VP, Planning & Controls
0003	Return to Service PgMP	Director, Operations & Maintenance
0004	Environmental PgMP	Director, Operations & Maintenance
0005	Health and Safety PgMP	Director, Corporate Health And Safety
0006	Chemistry PgMP	Director, Operations & Maintenance
0007	Licensing PgMP	Manager, Refurbishment Licensing Support
0008	Engineering PgMP	VP, Refurbishment Engineering
0009	Maintenance PgMP	Director, Operations & Maintenance
0010	Management System Oversight PgMP	Director, Management System Oversight
0011	Program Assurance PgMP	Director, Management System Oversight
0012	Construction PgMP	Director, Refurbishment Construction
0013	Contract Management PgMP	Director, Contract Management
0014	Communications PgMP	Director, Corporate Relations and Communications
0015	Supply Chain PgMP	Director, Supply Services Refurb Projects
0016	Staffing PgMP	Manager, Human Resources Nuclear Refurbishment
0017	Operations PgMP	Director, Operations & Maintenance
0018	Radiation Protection PgMP	Director, Operations & Maintenance
0019	Training PgMP	Director, Refurbishment Training
0020	Human Performance PgMP	Director, Refurbishment Construction
0023	Quality PgMP	Director, Refurbishment Quality Management

**Table 1: Darlington Refurbishment PgMPs (NK38-NR-PLAN-09701-10001)**

### **3.0 ROLES AND ACCOUNTABILITIES**

#### **3.1 Director, Refurbishment Management System Oversight**

Is the document owner and is accountable for its definition and implementation.

#### **3.2 Darlington Refurbishment Function Teams**

Are accountable for ensuring that PgMPs and subtier documents owned by the Function Team are in compliance with existing Management Systems and that any gaps are resolved to meet the needs of the Darlington Refurbishment Program.

#### **3.3 Darlington Refurbishment Project Teams**

Are accountable for the development and maintenance of project-specific PMPs.

Are accountable for executing projects to PgMP requirements and for providing input to PgMP owners if any gaps or incompatibilities exist.

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### 4.0 DEFINITIONS AND ACRONYMS

#### 4.1 Definitions

**Program Management Plan** The document that describes how function supports the Refurbishment Program with specific requirements that meet the intent of the Nuclear Management System.

**Project Management Plan** The document that describes how the project in Darlington Refurbishment Program will be planned, executed, monitored and controlled, and closed.

**Functional Management Plan** The document that describes the resource requirement to support the Darlington Refurbishment Program.

**Function** The matrix organization grouped by areas of specialization. The function is accountable for developing and maintaining functional excellence, setting standards, and providing required service to Darlington Refurbishment Program.

#### 4.2 Acronyms

**PgMP** - Program Management Plan  
**PMP** - Project Management Plan  
**FMP** - Functional Management Plan

### 5.0 REFERENCES

- [1] N-CHAR-AS-0002, Nuclear Management System
- [2] D-PCH-09701-10000, Darlington Refurbishment Charter
- [3] NK38-NR-PLAN-09701-10001 Sheets 1-23, Darlington Refurbishment Program Management Plans
- [4] NK38-MAN-09701-10006, Nuclear Refurbishment – Requirements for Process Support Controlled Documents
- [5] NK38-GUID-09701-10023, Functional Management Plan Guide

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**DARLINGTON REFURBISHMENT PROJECT PLANNING AND CONTROLS PROGRAM  
MANAGEMENT PLAN**

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**Darlington Refurbishment Project  
Planning and Controls Program  
Management Plan**

**NK38-NR-PLAN-09701-10001-0002-R003 2 CB**

2016-09-07

Order Number: N/A  
Other Reference Number: **176801**

Prepared by:



Carlos Barrios  
Manager  
Project Planning and Controls  
Darlington Refurbishment

Approved by:



Ian Sansom  
Director  
Project Planning and Controls  
Darlington Refurbishment

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MANAGEMENT PLAN**

### Revision Summary

Revision Number	Date	Comments
R002	2016-09-07	Overall review and revision to align with current Functional Management Plan and current U2EE submission.
R001	2015-03-13	Revised to address comments from SA RF14-000625, Updated DRP IT Tools and mapping.
R000	2014-01-31	<p>This document supersedes NK38-PLAN-09701-10067 Sheet 0002. The changes between NK38-PLAN-09701-10067 Sheet 0002 and this document are as follows:</p> <ul style="list-style-type: none"> <li>The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001,</li> <li>The security classification has been removed so that the document can be submitted to the CNSC, and</li> <li>References have been updated.</li> </ul>



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## 1.0 PURPOSE

The purpose of this Management Plan is to clearly define the planning assumptions, strategies, and processes associated with the provision of the Project Planning and Controls (PP&C) functions for the Darlington Refurbishment Program (DRP).

The Project Planning and Controls Program Management Plan provides a strategic overview of the various project planning and project control processes adopted by DRP in compliance with N-STD-AS-0028 Project Management Standard. This plan is applicable to all projects funded by the DRP and is supported by the Project Planning and Controls Functional Management Plan NK38-PLAN-09701-10223-SHT0008-R000.

The hierarchy of the Project Planning and Controls Program Management Plan is shown in Appendix A.

## 2.0 PROGRAM REQUIREMENTS

PP&C is an integral part of the preparation and execution of the DRP as it must establish a solid project management and controls environment to build and support the organization in setting the project and program baseline plan and then monitoring and controlling the program. PP&C has established an organizational model and appropriate procedures consistent with industry best standards including recommended practices from the Project Management Institute (PMI), the Construction Industry Institute (CII), and the Association for the Advancement of Cost Engineering (AACE). PP&C, where appropriate, also adopted operating experience from many large scale Nuclear and non-Nuclear projects. These practices and experience form the basis for this plan.

### 2.1 Scope

Defining project scope is a critical step to project success as it establishes the basis for project cost, schedule, risk management, contracts, and decisions. Improved scope detail leads to improved cost estimate and schedule accuracy.

N-MAN-00120-10001-SCOPE, Nuclear Projects Scoping Process, outlines the scope principles and requirements to be utilized for the DRP.

Project scope includes the set of project deliverables based on the project requirements, assumptions, exclusions, and constraints. The scoping process is integrated with the project phases and gating process. The scope of work for the next project phase should be well defined compared to the scope for the balance of the project in future phases. The scoping process, particularly developing and defining the scope, is a continuous process in the project lifecycle.

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Scope for the DRP was develop and is controlled through the Darlington Scope Request (DSR) Database.

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## 2.2 Schedule

Establishing an accurate and realistic schedule is a critical planning tool for a project. The schedule is the main planning tool used to understand and communicate how a project will be executed and includes the interrelationships and dependencies among project activities and deliverables, and the status of the work. The schedule is critical to properly strategize, plan and prepare for upcoming project work, to determine resource requirements, to understand how work is progressing and to apply corrective actions as required.

N-MAN-00120-10001-SCH, Nuclear Projects Schedule Management, outlines scheduling management principles and requirements for DRP which are applicable to both OPG project teams within the DRP and to contractors whom are performing work for DRP. Schedules are to be developed with inputs from all stakeholders and are monitored and updated throughout the project lifecycle. Schedule detail must be developed at an appropriate level to allow the project team to communicate the plan, monitor project progress and as an input into cost performance metrics in order to make accurate forecasts and to strategize and plan for upcoming work.

Refurbishment uses a multi level schedule structure (L0, L1, L2 and L3) and a standardized Work Breakdown Structure in accordance with best practices. The Program Milestones for Darlington Refurbishment are identified and maintained in the Program Integrated Master Schedule (PIMS). The schedule is maintained regularly and activities are tracked to a baseline. Variances are tracked, reported and mitigated and/or recovery plans developed when required. Critical path to Breaker Open and Breaker Open to Breaker Closed are identified, monitored and reviewed for potential impacts.

The Level 2 Control & Coordination (C&C) schedule is the level of detail that integrates all program work for all units and all bundles. The work packages, (the lowest level in the WBS structure) are represented in the C&C schedule by at least 1 activity and tied to the level 1 milestone schedule. All activities in the C&C schedule are logically tied according to the sequence of work.

Contractors prepare schedules in accordance with N-MAN-00120-10001-SCH-09, Nuclear Projects Scheduling Requirements from EPC Contractors. Level 3 schedules are integrated and aligned with Level 2 and PIMS. Vendors will self perform their schedule updates and maintenance with oversight from the OPG Master Scheduler and the Refurbishment Project Office.

The integrated Level 3 Schedule provides further breakdown of the work below the work package level and shows all interfaces and shared resources between contractors and OPG. All activities in the level 3 schedules are logically tied according to the sequence of work and summarized to the Level 2 activity level.

Milestones are baselined in accordance with N-MAN-00120-10001-SCH-06, Nuclear Refurbishment Milestone Definition Framework. The Milestones are grouped by tiers based on the authority to approve changes.

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## 2.2.1 Schedule Update and Monitoring

On a regular basis, according to the reporting cycle plan, all Level 3 Schedules shall be updated by the person or group who is performing the work (i.e. contractors or OPG). As a product of these updates, schedule progress at the Work Package level for all scheduled work is translated into the cost management system for the purposes of calculating earned value.

The progress data is verified and reviewed by OPG. Once reviewed, a variance analysis is produced to provide reasons for any schedule slippages and to determine necessary corrective action/recovery plans when needed. A critical path analysis is also produced using level 3 schedule details.

## 2.2.2 Schedule and Cost Integration

The Work Package is the lowest level of the WBS that integrates cost and schedule. Once the schedule updates are progressed and statused by work package, the physical percent complete, actual start, actual finish, forecast start and forecast finish are integrated into the cost management system used for earned value calculation in accordance with N-MAN-00120-10001-SCH-07, Nuclear Refurbishment Earned Value Management.

## 2.2.3 Schedule Reporting

When the monthly and weekly updating cycle is complete, all schedules/layouts are posted in SharePoint and accessed by all OPG staff through the Scheduling Link. Reporting requirements will be established based on the phase of the Program and the nature of the work being performed by the vendor.

## 2.3 Cost Management

Cost Management includes the processes required for planning, funding, managing, recording, forecasting, and controlling costs, including contingency management, at the program and project/function levels within approved budgets.

The DRP Cost Management process is currently defined in N-MAN-00120-10001-PC, Project Controls with desktops established below the manual level in the areas of cost management and cost forecasting.

The Cost Management System EcoSys EPC contains the project life cycle cost information (i.e. budget, actual cost, earned value, and forecast) for each work package. The released amount for each work package approved via the Gated Process (N-MAN-00120-10001 Sht: GRB) is also documented in the cost system.

Program releases will also establish contingency funding. The program strategies for managing contingency are detailed in Sections 2.4 and 2.5 of this document. Release of contingency is controlled via the change management process as described in sections 2.3.3.

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The program has established and will maintain a systematic and hierarchical Cost Breakdown Structure (CBS) that identifies all Control Accounts used by the Program. The CBS mirrors the Program Work Breakdown Structure (WBS) and includes cost only accounts not contained in the schedule (e.g. Contingency, Interest). Each Control Account contains one or more Work Packages (WP). Budget is established at the WP level and the associated actual costs are also collected at the respective WP level to support cost performance monitoring. Progress is input into the cost management system based on the progress of each work package. . The process to import progress directly from Primavera to the cost management system is under development.

### 2.3.1 Earned Value Management

Earned Value Management methodology, as defined in N-MAN-00120-1000-SCH-07, Nuclear Refurbishment Earned Value Management is utilized as the primary architecture for cost management. Planned Value (PV) is established at the Work Package level, recorded as a dollar value in cost management tool (EcoSys), and rigorously controlled via the Change Management practices as outlined in Section 2.3.3. Earned Value (EV) is derived via schedule progress and recorded as a dollar value in the cost management tool. Actual Cost (AC) is exported from the financial system, via BI (Business Intelligence) through the cost management tool at the Work Package level.

Standard earning rules are defined for all phases of work (Engineering, Procurement, Construction, Commissioning and Closeout) and shall be rolled out to each contractor before baselining the Level 3 schedule.

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### 2.3.2 Estimating

Cost estimating is the process of determining the expected total cost of labour, materials, equipment, professional fees, and other resources required for the execution of a project. Detailed guidance on estimating for Darlington Refurbishment is provided in N-MAN-00120-10001-EST, Nuclear Projects Cost Estimating.

Project cost estimates for Engineer/Procure/Construct (EPC) scopes of work are prepared internally to support the following processes:

- EPC contract Request for Proposal (RFP) and bid evaluation
- Program/Project life cycle and release planning

In addition, once EPC vendor contracts are in place, internal estimating expertise is utilized to:

- Review vendor Estimate Proposal
- Provide independent review and validation of vendor estimates supplied to OPG as projects progress from definition through execution phases
- Estimate OPG Oversight, services and functions cost supporting the project
- Review and validate any change requests (CCF of CCB) submitted by Project Team
- Support project funding requests.
- Support the Project Team in negotiating with Contractors and Sub Contractors

### 2.3.3 Change Management

Change Management is the Project Management process used to review and disposition all change requests, and manage changes to contingencies and changes to the baseline scope, costs and schedule. Change Management is implemented to maintain the integrity of the project baseline and control cost, and schedule creep.

The DRP Change Management process is currently defined in N-MAN-00120-10001-PC-12, Nuclear Refurbishment Program Change Management. The associated Change Control Form N-FORM-11252: Nuclear Refurbishment Change Control Form has been issued for use and is currently used for all NR funded Projects.

.Changes are rigorously identified, categorized, and recorded in the cost management system in order to effectively maintain project and program baselines and track cost performance against approved plans and budgets.

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#### 2.3.4 Performance Measurement

Cost performance is measured using standard industry metrics at the program, project, and functional levels. Utilizing the Earned Value Management System, the following standard metrics are calculated from the cost management tool and reported via the Business Intelligence (BI) reporting tool:

- **Schedule Performance Index (SPI):** SPI is a measure of schedule efficiency expressed as the ratio of earned value to planned value (EV/PV).
- **Cost Performance Index (CPI):** CPI is a measure of cost efficiency of budgeted resources expressed as the ratio of earned value to actual cost (EV/AC).
- **Cost Variance:** The difference between the earned value and the actual cost of that work. It is expressed as AC - EV. A positive value indicates an unfavorable condition and a negative value indicates a favorable condition.
- **Budget Variance:** The difference between the planned value and the actual cost of work performed. It is expressed as AC - PV. A positive value indicates an unfavorable condition and a negative value indicates a favorable condition.

Cost performance is monitored for various program periods, including life-to-date (LTD), life cycle, current gate, and annual release. Standard BI reports are produced at the program and project levels for these periods.

SPI, CPI, and variance metrics are all past-performance oriented. The program also utilizes forecasts at the program and project levels against approved life cycle estimates in order to proactively assess future success and take early corrective action where ever required.

#### 2.4 Risk

N-MAN-00120-10001-RISK-R003, Nuclear Projects Risk Management, provides a systematic approach on risk management; ensuring risks are identified, assessed, analyzed, mitigated with adequate risk response, and monitored to a robust and consistent standard to ensure that project objectives are achieved.

Risk management provides projects with forward-looking actions and metrics to reduce the likelihood and minimize the impact of undesirable events during the project life cycle. The goal of risk management is to remove obstacles to project success before they occur in order to minimize their consequential effect on project costs, schedule, quality, and safety targets.

Proactive risk management is used to understand the characteristics of the risk, how to manage them, and plan for *contingency* based on the *residual risks*. As such, risk management can have a significant impact on the financial health of the project.

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N-MAN-00120-10001-RISK-R003, Nuclear Refurbishment Risk Management, provides guidance on how to use the risk register to identify, update and close risks in the program and project risk registers. It also defines the Darlington Refurbishment risk assessment criteria and scales, risk assessment heat map and minimum risk review frequency. It sets the expectations for preparing Project Risk Management Plans (RMP) by contractors and refurbishment projects. Risks that only apply to the contractor are the responsibility of the contractor to manage. Oversight is provided by OPG to ensure an effective RMP is in place.

### 2.4.1 Risk Register Administration

The Risk Management (RM) organization is accountable to create and maintain standards, procedures, tools, and shared services resources to facilitate effective risk management within the Nuclear Refurbishment project. Risk Management facilitates the "Knowledge Management" functionality for NR, specifically the documentation and archiving of major risk influencing items such as operating experience, lessons learned integration, planning assumptions, major decisions, actions, and issues. This documentation of these elements will be executed in the form of project logs in the Risk Management and Oversight (RMO) tool.

### 2.4.2 Risk Reporting

(a) As part of the monthly reporting cycle, risks are reported in:

- Top Risks from each Bundle and Function in the Monthly Quad Charts
- Key DRP Program Risks

**Note:** For each risk being reported on quad charts or program risk reports, the following information should be communicated:

- Risk ID
- Risk Title
- Risk Description
- Risk Response Strategy and Status
- Current Risk Score
- Post-Risk Response Risk Score
- Target Completion Date of reaching Post-Risk Response Risk Score

(b) The following reports are communicated to senior management:

- Top DRP Risks reported quarterly in the Nuclear Oversight Committee (NOC) and Executive Advisory Committee (EAC) reports.



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- Key Program risks are reported to ERM using the BURSA template. See OPG-PROC-0094, Enterprise Risk Management Report.
- Risks that are jointly being addressed by the Darlington Station and DRP are presented and discussed on a quarterly basis at the Darlington & Darlington Refurbishment Common Risk Challenge Meeting.

## 2.5 Contingency

N-MAN-00120-10001-RISK-R005, Nuclear Refurbishment Contingency, Development and Management, provides direction for contingent funds development. For the purposes of contingency determination, projects utilize quantitative analysis based on their identified risks.

Contingency development is an integral part of estimating, scheduling and risk management processes. Contingent funds to address uncertainties in a project should be proportionate to the project size, duration and complexity, risk exposure and tolerance, organization's prior experience with the work, and confidence levels set by management. At DRP, there are two main classifications of contingent funds to address different types of uncertainties – contingency and management reserve.

Contingency at DRP is further sub-divided into Project Contingency and Program Contingency to address uncertainties in project bundles and functional groups, respectively. It is not intended for changes in scope or extraordinary major social or natural events such as war, strikes, flood and earthquakes, which are addressed by Management Reserve.

Contingency is managed according to the Change Management process described in section 2.3.3.

## 2.6 Documentation and Project Closure

Records, documents and data collectively form the memory of the Darlington Refurbishment Program. They constitute the business and intellectual assets of critical importance, and must be managed to meet both regulatory and business requirements.

Documents shall be managed throughout their life cycle e.g. project planning, execution and program closure in accordance with OPG-PROC-0178, Records and Document Control.

In addition to the standards and procedures described in N-PROG-AS-0006, Nuclear Refurbishment has developed electronic document control processes in conjunction with the implementation of an Electronic Document Management System (EDMS).

N-MAN-00120-10001-RDM, Nuclear Project Records and Document Management, provides the direction related to electronic management of information.

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### 2.6.1 Document Creation

Requirements for creating, reviewing, approving and issuing Darlington Refurbishment process support controlled documents will be documented in NK38-NR-MAN-09701-10001, Darlington Refurbishment – Requirements for Process Support Controlled Documents (pending issuance).

Process support controlled documents are those documents which support the definition or implementation of a process (e.g. Program Management Plans, Manuals, Guides, Instructions and refurbishment-specific technical documents/procedures developed under N-PROC-AS-0028).

### 2.6.2 Filing and Retention of DRP Records

All records generated as a result of executing work under the DRP Program, must have a documented plan for filing and retention. It is the responsibility of the process owner to confirm the filing and retention requirements.

### 2.6.3 Submission

All Supplier documentation deliverables must be submitted electronically to OPG using the official document filing system. Exceptions apply when the format of the deliverable does not support electronic submission.

### 2.6.4 Review and Acceptance or Approval

Submittals are routed electronically within EDMS for review. Reviews will be conducted by the appropriate stakeholders in accordance with the Gate Review Process described in N-MAN-00120-10001-GRB. Review comments are stored within EDMS, and returned to the submitter within contractually agreed due dates. OPG Records and Document Management (RDM) staff workflow, track, and report on processing dates.

Documents are routed electronically for acceptance or approval (with some exceptions). Once accepted, a document becomes an official project record at which time it is processed by RDM staff into an Approved Information Management System (e.g. Asset-suite).

### 2.6.5 Communicating OPG Requirements to Suppliers

The Communication Protocol document provides direction on how project correspondence and documentation deliverables are managed, and points to the process support documents and tools that the Supplier must reference in order to be compliant.

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## 2.7 Project Management Logs

The Risk Management Oversight (RMO) toll is a repository for Actions, risks, key issues, decisions and assumptions for Darlington Refurbishment Program that will be managed throughout the project lifecycle. The purpose of documenting Actions, Issues, Decisions, and Key Assumptions is to ensure that they are relevant to Darlington Refurbishment and are widely accessible by staff and to maintain an auditable trail for review, reference and monitoring.

N-MAN-00120-10001 Sht. RISK, provides guidance on how to document, review, approve and manage Actions. Risk, Issues, Decisions, and Key Assumptions associated with Darlington Refurbishment.

## 2.8 Reporting

### 2.8.1 Reporting Approach

Timely and effective reporting supports the successful execution of the Darlington Refurbishment Program. Specifically, reporting will support management decision processes, measure progress against established business objectives, and flag any performance gaps that require management attention.

Reporting will follow the same principles for all phases of the program, though the specific metrics and reports may vary to align to the business needs of each phase.

A comprehensive, tiered metrics infrastructure has been established and will be maintained at program, project, and functional levels to measure progress in the areas of:

- Environment, Health, and Safety
- Scope
- Schedule
- Cost
- Quality

The program has established a repository within the Integrated Database (IDB) for metrics and reporting data. This dataset ensures that reports consistently utilise data from the approved single source of truth, and that data fidelity is maintained. Microsoft Business Intelligence (BI) is being used as the program report generation engine to the extent possible. An NR Reporting Website is maintained and utilised across the organization as a repository for approved reports.

### 2.8.2 Standard Reports

A set of standard reports are currently produced to communicate program and project performance to suit various stakeholder needs. These reports will be adjusted as

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required based on the project phase and key program focus areas. Standard reports currently produced include:

- (a) Board Update is a high level program status report prepared for the Ontario Power Generation (OPG) Board of Directors (BOD).
- (b) Periodic program level performance reports are prepared for senior OPG management audiences (e.g. Nuclear Oversight Committee, Nuclear Executive Committee).
- (c) Major Darlington Refurbishment milestones and performance targets are included in corporate, Nuclear, Nuclear Projects, and Darlington Refurbishment level Report Cards produced on a monthly basis by the corporate Finance function.
- (d) Program Status Report is prepared monthly for senior Darlington Refurbishment management. This report summarizes safety, schedule, cost, and quality performance at the program level.
- (e) Project and Function level Quad Charts are prepared monthly. These reports summarize safety, schedule, cost, and quality performance.
- (f) The Controllership Financial & Oversight Report is produced monthly by nuclear finance. This report is a comparison of actual and forecast costs against the approved Business Plan.
- (g) Standard monthly Earned Value performance reports at all levels from the program down to Work Packages are produced by the BI reporting tool for use by line managers to support ongoing monitoring and control of work programs and projects.
- (h) Joint OPG/Vendor scorecards are produced for all major refurbishment contracts. These scorecards assess performance against the terms and conditions of the contracts.

## 2.9 IT Tools and Applications

For a large project such as Darlington Refurbishment, maintaining and managing project data and Project Information Technology (IT) tools is very important throughout the life of the project. Critical project databases are supported by Chief Information Office (CIO) supported data repositories. The demands, priority and business requirements for IT projects and base services and associated benefits of such services are identified by Darlington Refurbishment. For Line of Business (LOB) funded projects, DRP will approve the business case and release funds before CIO undertakes project work. For the CIO funded projects, CIO will approve the business case and release funds after obtaining concurrence of project sponsor. CIO will document the business case in both cases.

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In support of Darlington Refurbishment, the CIO will:

- Prepare an annual demand plan for new projects and base service changes for incorporation into the CIO and DRP business plans.
- Develop and maintain longer term systems strategy and roadmap with collaboration and participation from all levels of Nuclear Projects.
- Execute new projects and base services within the agreed scope, schedule and cost while adhering to the established IT Standards/Strategy, IT Business Plan, IT Project Delivery Framework and OPG investment guidelines.
- Establish technology standards and select vendor and technology for specific projects. DRP will provide input into technology standards and vendor/technology selection decisions. CIO will demonstrate that its decision is the most optimal for OPG.

DRP will provide input into the service levels and quality metrics for the base services. Service levels will be jointly developed and agreed upon with regular reviews and adjustments to meet the evolving needs of business and IT.

### 3.0 ROLES AND ACCOUNTABILITIES

#### 3.1 Director, Planning and Controls, DRP

Ensures that effective managed systems are in place for the planning, execution, monitoring, and reporting of scope, schedule, cost, risk, Operating Experience, Gated Process and records management.

Accountable for the provision of accurate, timely performance reports to senior OPG management and stakeholders.

Is the owner of this document and is accountable for its definition, implementation and continual improvement.

#### 3.2 Manager, Project Reporting and Infrastructure, DRP

The Manager of Nuclear Refurbishment Reporting reports to the Director of Planning and Control. Establishes the process that ensures quality, control and confidentiality where appropriate are maintained regarding cost, schedule and project updates. The manager provides sole source on direction and clarity around Stakeholder required reports to the section manager, report building and writing staff.

#### 3.3 Manager Project Risk, DRP

Establish the processes, instructions, and tools necessary to execute risk and contingency management and operating experience.

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Provide expert support to Darlington Refurbishment client groups in the execution of risk and contingency management and operating experience.

### 3.4 Manager Project Scheduling, DRP

Establish the processes, instructions, and tools necessary to execute schedule management.

Provide expert support to Darlington Refurbishment client groups in the execution of schedule management.

### 3.5 Project Controls Leads, DRP

Prepare, monitor, and control function/project budgets and ensure costs are appropriately charged to the right budget item.

Provide inputs to scope, schedule, cost, risk, and Operating Experience systems to support effective monitoring, reporting, and control to meet program objectives.

Review performance reports and take corrective action in accordance with established thresholds and business goals.

## 4.0 DEFINITIONS & ACRONYMS

**Actual Costs (AC)** is the realized costs incurred for the work performed during a specified time period.

**Earned Value (EV)** is the measure of work performed expressed in terms of the budget authorized for that work.

**Forecast** is an estimate or prediction of conditions and events in the project's future based on information and knowledge available at the time of the forecast. The information is based on the project's past performance and expected future performance, and includes information that could impact the project in the future, such as estimate at completion and estimate to complete.

**Planned Value (PV)** is the authorized budget assigned to scheduled work.

**Work Breakdown Structure (WBS)** is the hierarchical decomposition of the work to be carried out to accomplish the objectives and create the required deliverables.

**Work Package (WP)** is the work defined at the lowest level of the Work Breakdown Structure (WBS) for which cost and duration can be estimated and managed.

**AIDA** Actions, Issues, Decisions, and Key Assumptions  
**BI** Business Intelligence  
**BOD** Board of Directors

Plan

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<b>BURSA</b>	Business Unit Risk Self Assessment
<b>CBS</b>	Cost Breakdown Structure
<b>CCL2</b>	Control & Coordination Schedule Level 2
<b>CIO</b>	Chief Information Office
<b>DRP</b>	Darlington Refurbishment Program
<b>EAC</b>	Executive Advisory Committee
<b>EPC</b>	Engineer-Procure-Construct
<b>ERM</b>	Enterprise Risk Management
<b>LOB</b>	Line of Business
<b>LTD</b>	Life to Date
<b>NOC</b>	Nuclear Oversight Committee
<b>NR</b>	Nuclear Refurbishment
<b>OPG</b>	Ontario Power Generation
<b>P&amp;C</b>	Planning and Control
<b>PIMS</b>	Program Integrated Master Schedule
<b>WBS</b>	Work Breakdown Structure

## 5.0 REFERENCES

- D-PCH-09701-10000, Darlington Refurbishment Project Charter
- OPG-PROC-0178, Controlled Document Management
- N-PROC-AS-0042, Quality Assurance Records
- N-STD-AS-0028, Project Management Standard
- NK38-NR-PLAN-09701-10001 Sheet 0001, Darlington Refurbishment Program Structure
- OPG-STD-0017, Organizational Authority Register
- NK38-PLAN-09701-10223-SHT0008, Functional Management Plan

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Appendix A: Projects Controls Documentation

Standards	<div><div>Nuclear Mgmt System N-CHAR-AS-0002</div><div>Project Management I-PROG-AG-0002</div><div>Project Management Element N-STD-AS-0003</div></div> <div><div>Contract Mgmt Standard N-STD-AS-0029</div><div>Project Oversight Standard N-STD-AS-0030</div><div>Field Engineering Standard N-STD-AS-0031</div></div>											
DNRS Project Controls Guides	1. Project Controls	2. Gated Process	3. Scoping	4. Estimating / RQE	5. Records & Doc Mgmt	6. Scheduling WBS	7. Earned Value Management	8. Cost Management and Forecasting	9. Risk Management	10. Change Management	11. Communications and Reporting	12. Records & Doc Mgmt
	N-MAN-00120-10001-PC-Project Controls	N-MAN-00120-10001-GRB: Nuclear Projects Gated Process	NK38-INS-08701-10001: Darlington Nuclear Refurbishment Program – Scope Control	N-GUID-00400-10000: Nuclear Projects Cost Estimate Review	N-MAN-00120-10001-RDM: Nuclear Projects Records and Document Management	N-MAN-00120-10001-SCH: Nuclear Projects Schedule Management	N-MAN-00120-10001-SCH-07: Nuclear Refurbishment Earned Value Management	N-MAN-00120-10001-PC-01: Nuclear Refurbishment Cost and Schedule Change Control	N-MAN-00120-10001-RISK: Nuclear Projects Risk Management Process		N-MAN-00120-10001-COM: Project Communications	N-MAN-00120-10001-RDM: Nuclear Projects Records and Document Management
	N-MAN-00120-10001-PC-14: Darlington Refurbishment Program Management Work Stream Applications And Coding Requirements		N-MAN-00120-10001-SCOPE: Nuclear Projects Scoping Process	N-MAN-00120-10001-EST: Nuclear Projects Cost Estimating	N-MAN-00120-10001-RDM-01: Nuclear Projects SharePoint 2007	N-MAN-00120-10001-RDM-01: Nuclear Refurbishment Program/ Project WBS Manual		N-MAN-00120-10001-PC-02: Nuclear Refurbishment – Cost and Schedule Change Control Instruction	N-MAN-00120-10001-RISK-04: Nuclear Refurbishment Risk Management and Contingency Development Guide			N-MAN-00120-10001-RDM-01: Nuclear Projects SharePoint 2007
	N-MAN-00120-10001-PC-08: Task Instruction – Process for Submission & Evaluation of IT Services Requests		N-MAN-00120-10001-SCOPE-02: Task Instruction – Darlington Refurbishment Pre-screening Review Process for Late Scope	N-MAN-00120-10001-EST-01: Nuclear Refurbishment Cost Estimate	N-MAN-00120-10001-RDM-01: Nuclear Projects Supplier Document Hub	N-MAN-00120-10001-SCH-06: Nuclear Refurbishment – Milestone Definition Framework		N-MAN-00120-10001-PC-13: Nuclear Refurbishment – Cost Management and Reporting	N-MAN-00120-10001-RISK-06: Nuclear Refurbishment Processing Operating Experience and Key Lessons Learned			N-MAN-00120-10001-RDM-01: Nuclear Projects Supplier Document Hub
				NK38-NR-PLAN-09701-10004 RQE Project – Management Plan	N-MAN-00120-10001-RDM-03: Nuclear Projects Supplier Document Submission	N-MAN-00120-10001-SCH-08: Nuclear Projects Scheduling Requirements from EPC Contractors			N-MAN-00120-10001-RISK-07: Nuclear Refurbishment Actions, Issues, Decisions and Key Assumptions Management			N-MAN-00120-10001-RDM-03: Nuclear Projects Supplier Document Submission
					N-MAN-00120-10001-RDM-03: Nuclear Projects Supplier Document Submissions – OPG RDM	N-MAN-00120-10001-SCH-11: Darlington Refurbishment: Schedule Management Plan for Integrated Level 3 Execution			N-MAN-00120-10001-RISK-08: Nuclear Refurbishment Lessons Learned Desktop Guide			N-MAN-00120-10001-RDM-06: Nuclear Projects Supplier Document Submissions – OPG RDM
					N-MAN-00120-10001-RDM-13: Use of On-line Disposition Form (CDF) for Document Review	N-MAN-00120-10001-SCH-01: Task Instruction – Work Breakdown Structure Direction						N-MAN-00120-10001-RDM-13: Use of On-line Disposition Form (CDF) for Document Review
					N-MAN-00120-10001-RDM-09: Release of OPG Documents to External Oversight Organizations	N-MAN-00120-10001-SCH-02: Task Instruction – DNG Refurb – Standard Projects Milestone List						N-MAN-00120-10001-RDM-09: Release of OPG Documents to External Oversight Organizations
						N-MAN-00120-10001-SCH-03: Task Instruction – DNG Refurb – Program and Project Missed Milestones Recovery Process						
	<div><div>Legend</div><div><div>Completion Status</div><div>Document Type</div></div><div><div><div></div> Deliverable Received</div><div><div></div> Deliverable To be Received</div><div><div></div> Deliverable Issued</div></div><div><div><div>XXXX</div> OPG Project Controls Guide</div><div><div>XXXX</div> Play Book</div><div><div>XXX</div> Road Map</div></div></div>											



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**Darlington Refurbishment Return To  
Service Program Management Plan**

**NK38-NR-PLAN-09701-10001-0003-R001**  
2014-11-28

Order Number: N/A  
Other Reference Number: N/A

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### Revision Summary

Revision Number	Date	Comments
R001	2014-11-28	<p>Incorporate feedback from Self Assessment RF 14-000625</p> <ul style="list-style-type: none"> <li>Section 2.0, added overall description of how RTS fits into the overall program.</li> <li>Section 2.3.5, Return to Service Process Overview, is now Section 2.3.1.</li> <li>Performance Indicators added in Section 2.3.9.</li> <li>Section 2.5.2, Return to Service Roles and Responsibilities moved to Section 3.0.</li> </ul> <p>Incorporate DCR 127425</p> <ul style="list-style-type: none"> <li>Recommended regulatory hold points included in Section 2.3.1.1</li> </ul>
R000	2014-01-31	<p>This document supersedes NK38-PLAN-09701-10067 Sheet 0018. The changes between NK38-PLAN-09701-10067 Sheet 0018 and this document are as follows:</p> <ul style="list-style-type: none"> <li>The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001,</li> <li>The security classification has been removed so that the document can be submitted to the CNSC, and</li> <li>References have been updated.</li> </ul>

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### **DARLINGTON REFURBISHMENT RETURN TO SERVICE PROGRAM MANAGEMENT PLAN**

## **1.0 PURPOSE**

This Return to Service Management Plan describes the processes, procedures and organization that will be used during the Darlington Refurbishment Project to manage the modification commissioning and restart activities. The Return to Service Management Plan and Return to Service (RTS) process documents are compliant with the Canadian Standards Association (CSA) N286-05 Management System Requirements for Nuclear Power Plants and other applicable codes, standards, and laws.

## **2.0 RETURN TO SERVICE PROGRAM REQUIREMENTS**

The RTS portion of the refurbishment outage covers the range of activities from completion of installation work by the contractor to reactor power at 100%, including modification commissioning and restart activities.

The RTS Department will be part of Nuclear Refurbishment – Operations & Maintenance. The RTS Department will:

- (1) Develop and manage RTS processes and procedures (described in Section 2.3).
- (2) Develop an integrated RTS logic that coordinates restart testing and modification commissioning activities.
- (3) Oversee the preparation of modification commissioning and restart instructions.
- (4) Coordinate the execution of modification commissioning and return to service activities by Operations and Maintenance resources. Contractors/Vendors will provide a supporting role during modification commissioning.

During the outage preparation phase, the RTS organization will be comprised of a Department Manager and Section Manager. These individuals will focus on items 1 and 2 (above).

As the organization transitions from preparation to execution, the RTS Department will have resources that will focus on items 2 and 3 (above). The mature organization will have three sections – Preparation, Execution, and Completion Assurance (described in Section 3.0). See Appendix B for a graphical representation of the organization.

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### 2.1 Return to Service Phases

The RTS activities will occur in 4 phases:

- (1) **Phase A:** restart activities prior to fuel load
- (2) **Phase B:** fuel load and activities leading up to, but not including, guaranteed shutdown state (GSS) removal and first approach to critical (ATC)
- (3) **Phase C:** ATC and low power testing (<1%)
- (4) **Phase D:** high power testing and power escalation to full power

During these phases, a test program will integrate:

- normal start-up testing
- non-standard tests that are unique to a refurbishment outage
- outstanding modification commissioning tests

### 2.2 Basis for Return to Service

#### 2.2.1 Refurbishment Categories

The extent of return to service activities required for a System, Structure or Component (SSC) will be commensurate with the scope and duration of the refurbishment work. The following three categories, which are based on the scope of work performed during the refurbishment outage, will be used:

- (1) SSC remained in normal operation:

These are SSCs that remained in normal operation with continued system health and routine maintenance program activities. All OPG or contractor maintenance work shall follow the current normal OPG processes for operating equipment.

- (2) SSC shutdown and/or laid-up:

These are SSCs that were laid-up or in normal shutdown during the refurbishment outage. This category also includes SSCs that were disconnected or dismantled to provide access to perform work during the outage. All OPG or contractor maintenance work shall follow the OPG processes for outage work. If a modification was required to place the SSC in shutdown or lay-up, the modification would be categorized as a "New or Modified SSC" as described below.

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#### (3) New or Modified SSC:

These are newly installed SSCs or existing SSCs that have undergone significant repairs, replacement or modifications, including temporary modifications. All temporary and permanent modifications shall be performed as per OPG's Modification Process, N-PROC-MP-0090.

Strategies will be developed for identification of islanded, shutdown/laid up, and operating equipment in the field and may include physical barriers around the equipment, field tagging, and equipment status logs.

### **2.2.2 Return to Service Elements**

RTS activities are comprised of two elements, which will be integrated into the restart logic:

#### (1) Modification Commissioning:

This is the testing of modified or new equipment, including temporary modifications to confirm their design basis and license requirements are met.

#### (2) Restart:

This is returning equipment and systems to normal operation at the end of the outage. Generally, this equipment would have been in operation or in lay-up during the outage. Equipment specific functional tests and system level tests will confirm the normal operation of the system and ensure that the design basis had not changed from the original design and licensing requirements. This may be accomplished through review of previous modification commissioning reports and baseline data. Additional testing requirements may be identified for systems which were shutdown/laid up and these test requirements will be identified through preparation of a Detailed Restart Specification described in Section 2.3.6.

### **2.3 Return to Service Processes and Procedures**

The following documents are existing OPG governance to be used in the RTS process:

- Modification Process (N-PROC-MP-0090)
- Detailed Commissioning Specifications and Commissioning Reports (N-INS-00960-10000)

A suite of procedures has been issued to define the RTS requirements to ensure the activities are performed in a systematic sequence from pre-operational tests on individual pieces of equipment to integrated system testing and ultimately declaring the Unit in-service. The following documents were prepared for RTS of refurbished units:

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- Nuclear Refurbishment Construction Check and Test Requirements (N-GUID-09701-10019)
- Nuclear Refurbishment Construction Completion Declaration (N-GUID-09701-10021)
- Nuclear Refurbishment Return to Service Process Overview (N-GUID-09701-10020)
- Nuclear Refurbishment Preparation of Detailed Restart Specifications and Restart Reports (NK38-INS-09701-10002)
- Nuclear Refurbishment System Available for Service Process (NK38-INS-09701-10005)
- Nuclear Refurbishment Unit Readiness for Service (NK38-INS-09701-10006)

The process flow of RTS activities is shown in Appendix A.

**Note:** No document referenced by this Return to Service Management Plan, NK38-NR-PLAN-09701-10001 Sheet 0003, should contravene or supersede any engineering change control process governance requirements (as found in N-PROG-MP-0001, Engineering Change Control, or N-PROC-MP-0090, Modification Process, and its referenced governance) or planned outage management governance (as found in N-PROC-MA-0013, Planned Outage Management). Any conflicts between documents referenced by this Return to Service Management Plan, NK38-NR-PLAN-09701-10001 Sheet 0003, and the engineering change control governance or planned outage management governance shall be resolved in favour of the OPGN governance.

Compliance with CSA N286-05 is demonstrated and documented in OPGN governance documents as per N-LIST-08130-10023, CSA N286-05 to OPGN Governance Cross Matrix. RTS documents are non-governing documents that add additional guidance and enhancements to N-PROG-MP-0001, Engineering Change Control, and N-PROC-MA-0013, Planned Outage Management Procedure, and align to CSA N286-05 clauses 6.7 to 6.10 and CNSC Regulatory Document RD-360.

### 2.3.1 Return to Service Process Overview

The overall return to service process for Refurbishment is described in N-GUID-09701-10020, Nuclear Refurbishment Return to Service Process Overview. It contains the process to integrate modification commissioning and restart testing for return to service of the unit. In addition to the RTS Phases described in Section 2.1 of this plan, this process includes the basis for modification commissioning and restart testing, extent of modification commissioning and restart testing, conduct of testing, and evaluation of test results. Details on the use of Restart Control Hold Point (RCHPs), Section 2.3.1.1, and documentation such as System Restart Plans (SRPs), Section 2.3.1.2, is also included.



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#### **2.3.1.1 Restart Control Hold Points (RCHPs)**

Restart Control Hold Points (RCHPs) will be used to ensure prerequisites are complete and approvals are obtained prior to transitioning from one state to another. The hold points will be controlled by the Director Operations and Maintenance, Nuclear Refurbishment. Hold points will be identified in the schedule.

The following table lists the RCHPs, their associated phase, and if they are regulatory.

Phase	Phase Description	RCHP	RCHP Description	Regulatory Hold Point
Phase A	Restart activities prior to fuel load	RCHP 1	Prior to Moderator Fill	No
		RCHP 2	Prior to Fuel Load	Yes
Phase B	Fuel load and activities prior to guaranteed shutdown state (GSS) removal	RCHP 3	Prior to Bulkhead Removal	No
		RCHP4	Prior to Heat Transport System Fill	No
		RCHP 5	Prior to GSS Removal	Yes
Phase C	Approach to critical and low power testing (<1% full power)	RCHP 6	Prior to Exceeding 1% Full Power	Yes
Phase D	High power testing and power escalation to full power	RCHP 7	Prior to Turbine Testing & First Synchronization	No
		RCHP 8	Prior to Exceeding 35% Full Power	Yes
		RCHP 9	Prior to Unit Available for Commercial Operation	No

Criteria for release of a hold point are described in Nuclear Refurbishment Unit Readiness for Service, NK38-INS-09701-10006, and written confirmation for regulatory hold points will be provided to the CNSC identifying the following:

- All related project commitments tied to the hold point, as identified in the return to service plan have been completed
- All systems required for safe operation beyond the hold point are available
- All specified operating procedures have been formally validated
- Specified training has been completed and staff qualified
- All non-conformances and unexpected results identified leading up to the end of the phase are addressed
- All SSCs being returned to service meet the quality and completion requirements of N286-05 clause 6.9 and Annex D.3 through completion of CCD, MAFS and SAFS
- Other information as appropriate

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#### **2.3.1.2 System Restart Plans (SRPs)**

System Restart Plans (SRPs) will be prepared for field execution to satisfy the requirements of the detailed restart specification. System Engineers will be responsible for the preparation of restart instructions.

The SRPs will be prepared in three levels of detail:

- (1) SRP2- provide a Level 2 logic overview of the test activities, durations and manpower required to commission or test each SSC. It integrates commissioning of modified equipment and testing of shutdown/laid up or normal operating equipment, identifies major prerequisites and provides the interfaces to other systems required to support system restart. SRP2s are flowchart format logic diagrams.
- (2) SRP3 - provide a more detailed Level 3 logic of the SRP2 test activities, sequence, durations and manpower required to commission or test each SSC or group of systems. SRP3s are flowchart format logic diagrams with a greater level of detail than a SRP2.
- (3) SRP4 (or coordination work plan) - written for a step or a group of steps in a SRP3. SRP4s provide the field executable details required by Operations, Maintenance and other staff to perform the modification commissioning or testing activities for each SSC. For simple modification commissioning/tests, work order task instructions may be used.

#### **2.3.2 Construction Check Out and Test**

At the completion of modification activities by a contractor and prior to acceptance by OPG, the contractor will perform a suite of "check-out & test" (COAT) activities on the SSC. The intent is to confirm that equipment has been installed as per the design requirements. COAT activities are generally static in nature, demonstrate the adequacy of the installation and workmanship, and are performed prior to placing the equipment in service. They are completed as a pre-requisite to the commissioning of modifications and are generally identified and verified in an Inspection and Test Plan (ITP).

The COAT process is described in N-GUID-09701-10019, Nuclear Refurbishment Construction Check and Test Requirements. It identifies a suite of COAT requirements for various types of equipment. The contractor produces the COAT requirements, instructions, and acceptance criteria in accordance with the contractor's quality assurance program.

#### **2.3.3 Construction Completion Declaration**

The Nuclear Refurbishment Construction Completion Declaration, N-GUID-09701-10021, process describes the requirements to be followed during the refurbishment of each Darlington unit following the completion of construction/installation activities performed on a given SSC. The Construction Completion Declaration (CCD) is

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confirmation that construction and installation activities are sufficiently complete and that it is safe to proceed with modification commissioning and restart testing on affected SSCs. Included in the CCD package is documentation on the boundaries and contents of the work, status of the work, field changes, non-conformance reports, marked-up drawings, and so on. OPG provides oversight in the preparation of the CCD package. The package will be reviewed and accepted by the Nuclear Refurbishment Project Manager and in turn the Return to Service Manager as a pre-requisite to initiating modification commissioning and RTS activities. The CCD includes non-modification work through references to work orders completed in Asset Suite 7 in order for the RTS organization to integrate both the non-modification work completed on a SSC and the modification work completed on a SSC into modification commissioning or restart plans. The contractor is expected to follow all OPG nuclear processes and procedures when performing non-modification work including post maintenance testing.

#### **2.3.4 Detailed Commissioning Specifications and Commissioning Reports**

All new or modified SSCs will be commissioned to confirm that the SSC meets the design specifications and performance criteria. The basis for the modification commissioning will be a Detailed Commissioning Specifications (DCS). The DCS will specify the critical parameters to be proven during modification commissioning and will include the acceptance criteria. Modification commissioning results will be documented in a Commissioning Report (CR) as per the Modification Process, N-PROC-MP-0090. The CR will record any non-conformances identified during modification commissioning and address these to ensure safety analysis assumptions and safe operating envelope margin impact is known and dispositioned or updated as required.

A DCS will not be prepared for an SSC that was not modified, since this equipment would have been commissioned during original unit start-up, this equipment will be subjected to a Detailed Restart Specification (DRS) as per Section 2.3.6.

#### **2.3.5 Commissioning and Modification Available for Service**

Commissioning is the process during which SSC of a facility, having been constructed or modified, are made operational and verified to be in accordance with design specifications and to have met the performance criteria. Commissioning of new or modified equipment is performed as per OPG's existing Modification Process, N-PROC-MP-0090. Temporary modifications will be controlled as per N-PROC-MP-0090, Modification Process.

Modification commissioning will be executed by Nuclear Refurbishment Operations & Maintenance staff and Engineering, with support from the Contractor. Some modification commissioning activities may be deferred until the required system conditions have been established. In those circumstances, the outstanding modification commissioning activities will be integrated with restart testing described in Section 2.4. Modification commissioning activities are performed per unit and tracked on a per unit basis. The modification commissioning documentation shall be compliant with the applicable requirements specified in Annex D.2 to the CSA N286-05 standard.

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After completion of modification commissioning, the OPG Project Team will prepare a Modification Available for Service Package (MAFS) for each modification for acceptance by the Refurbishment Operations Manager. Generally, a MAFS meeting will be held with the stakeholders to review the MAFS package and confirm the modification has been installed and commissioned to meet the design and performance requirements and is available to be placed in service. In some instances, the MAFS meeting may be waived by the Nuclear Refurbishment Director of Operations and Maintenance, but the MAFS must still be signed off. Darlington Refurbishment will follow the existing MAFS process as detailed in N-PROC-MP-0090, Modification Process.

#### **2.3.6 Detailed Restart Specifications and Restart Reports**

Many SSCs will not be modified during the Refurbishment outage, but may not have operated in a normal configuration for a significant period of time. A Detailed Restart Specification (DRS) will be prepared as per Nuclear Refurbishment Preparation of Detailed Restart Specifications and Restart Reports, NK38-INS-09701-10002, for all systems to identify equipment functional tests and system level tests that will confirm the normal operation of the system. These tests may be specified as routine Safety Related System Tests or operating manual procedures. In some cases, the tests will require development of non-routine instructions.(e.g. confirm logic functions, operate handswitches, test run pumps, stroke/exercise valves, system fill and flush and verification of system chemistry).

Refurbishment System Engineers will be responsible for preparation of the DRS and associated execution instructions. For maintenance activities included as part of refurbishment scope, the components will generally be returned to service using normal station processes such as post maintenance testing.

Refurbishment System Engineers will be responsible for preparation of a Restart Report as per Nuclear Refurbishment Preparation of Detailed Restart Specifications and Restart Reports, NK38-INS-09701-10002, to document results of detailed restart testing activities performed to meet the DRS. The reports will record the results of the tests, identify and adequately disposition any non-conformances identified during execution of the Restart testing. The reports will be incorporated into the System Available for Service package and referenced in the Completion Assurance Document (CAD) as described in Section 2.6.3.

#### **2.3.7 System Available for Service**

A System Available for Service (SAFS) process will be followed to restart systems when unit conditions are appropriate. The restarting of systems will integrate with modification commissioning when applicable. Restart of systems means returning them to the normal operating condition – removing lay-up, realigning valves, filling pipework, performing normal start-up testing, etc. The SAFS Declaration means that individual systems, or group of systems, can be credited to safely and reliably perform their design functions for continued unit operation. The SAFS will include a review of items such as backlogs, pre-defines, system health, scope of work completed, regulatory commitments, aging management, training, procedures, design basis (i.e.

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Environmental Qualification, Seismic Qualification, Fire Safe Shutdown Program, etc.), OP&Ps and Safety Report. The Director Operations & Maintenance, Nuclear Refurbishment, as the senior unit licensee, provides final overall approval of the SAFS declaration as per Nuclear Refurbishment System Available for Service Process, NK38-INS-09701-10005.

### **2.3.8 Unit Readiness for Service**

A Unit Readiness for Service (RFS) process will be used to document and control how the unit is restarted as per Nuclear Refurbishment Readiness for Service Process, NK38-INS-09701-10006. The RFS process will provide assurance at identified restart milestones that integrated system testing is complete and that systems, conditions and pre-requisites are acceptable to progress past the milestone. There will be a number of RFS meetings scheduled as the unit progresses through the restart phases. For example, RFS meetings will be held prior to loading fuel, prior to removing the containment bulkhead and prior to approach to critical. This process and meetings will be similar to the RFS process used for a normal planned outage, but will also consider the readiness to execute unique requirements of a refurbishment outage, such as on-power tests, non-standard start-up tests and required approvals.

### **2.3.9 Return to Service Performance Indicators**

RTS performance indicators are in the table below.

Process	Indicator	Measure
Construction Completion Declaration	CCD open items	Number of CCD open items
	CCD rejections	Number of CCD rejections
System AFS	System AFS open items	Number of System AFS open items
	System AFS rejections	Number of System AFS rejections

## **2.4 Restart Testing During Start-up**

A full suite of restart tests will be executed through the return to service phases. The tests will consist of existing Station tests/procedures and a set of non-standard test workplans used to prove the design basis and license requirements have been met. A comprehensive restart testing plan will be developed. Any outstanding modification commissioning tests will be integrated with the restart testing and scheduled for execution when the appropriate unit conditions are established. Additional restart testing guidance will be provided to document detailed processes for items such as; non-conformances, contingency planning (i.e. emergency response, backouts etc.), control of workplan changes, design changes as a result of restart testing, training, re-test and impact to operating units. Restart testing activities are performed per unit and tracked on a per unit basis.

A detailed reactor physics plan will be developed for restart Phases A, B, C and D, as defined in Section 2.1, the plan will include a review of procedures and OPEX from other recent CANDU refurbishment projects.

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### **2.4.1.1 Safety Analysis**

Safety analysis will be required to assist in validating design basis and the DNGS Safe Operating Envelope. It will also support Refurbishment modifications to confirm safety, design and operating margins. OPG will develop a process for addressing any nonconformity between the safety analysis assumptions and the modification commissioning results. OPG will update the Probabilistic Risk Assessment to incorporate any major changes to the plant configuration. Reliability models will be updated utilizing system baseline data obtained as per Section 2.4.1.3.

### **2.4.1.2 Operating Policies and Principles Strategy**

Operating Policies and Principles (OP&P) revisions will reflect the applicable boundaries of the Safe Operating Envelope. OP&P revisions are expected in three basic areas: Organization and Authority, Conduct of Operations (including Maintenance and Engineering), and Technical Specifications. The changes will be made to incorporate the expected roles and responsibilities of the Nuclear Refurbishment organization and its interface with the authorities of the operating plant, and to revise conduct requirements and technical specifications as appropriate with the various evolutions, configurations, and refurbishment states such as unit defueling evolution, unit defueled state, changes to the station containment envelope, non-irradiated fuel condition, pre-equilibrium core condition, and return to service activities as required. This work is being coordinated by Nuclear Safety, with input from Nuclear Refurbishment Operations and Maintenance, Engineering, Licensing, and Darlington Station.

### **2.4.1.3 System Baseline Data**

System baseline data will be established as follows:

#### Modified Equipment

- Modification commissioning activities will obtain baseline data through testing or inaugural inspections

#### Non-Modified equipment

- Existing baseline data will be reviewed and compared to the testing results obtained through execution of the DRS. If required, new baseline data will be obtained or inspections performed to re-baseline the SSCs.

### **2.4.1.4 Aging Management Reviews**

Darlington Refurbishment will layup certain systems to maintain the asset during the Refurbishment outage work. Layup technical requirements will be prepared for each laid up system and these layup technical requirements will address aging management as per RD-334, Aging Management for Nuclear Power Plants.

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### **2.4.1.5 Open Item Management**

During execution of the RTS process open items will be identified in the preparation of the RTS documentation (CCD, MAFS, SAFS, and RFS). Rigorous tracking and completion of open items is necessary to ensure the safe operation of the reactor following return to service. During preparation of each of the RTS documents open items are documented, evaluated and actioned or dispositioned appropriately prior to acceptance of the documents and prior to proceeding with operation of the SSCs.

## **2.5 Return to Service Program Management Approach**

### **2.5.1 Site Transition and Department Transfer Plans**

The effectiveness of transitioning between Station Operations and Refurbishment Operations - and subsequently from Refurbishment to Station operations - is critical to the overall success of the Darlington Refurbishment. Transition planning for Darlington Refurbishment is described in the following document:

- NK38-PLAN-09701-10097, Interface Agreement Between Nuclear Refurbishment and Darlington Nuclear

The Interface Agreement clarifies overall roles and responsibilities that are required to achieve the Refurbishment Program objectives, which includes the completion of all identified scope. It also identifies the need for a comprehensive Site Integrated Transition Plan and for Departmental Ownership Transfer Plans.

The Site Integrated Transition Plan will be developed. It will ensure that all the Station and Refurbishment staff are aligned and have a clear understanding of the specific deliverables required to support the transition to Refurbishment and back to Station Operations.

Department Ownership Transfer Plans have been prepared. They ensure that personnel in a department have a clear understanding of specific activities and responsibilities associated with the transition to Refurbishment and back to Station Operations.

### **2.5.2 Records Management**

A large volume of records will be produced during RTS. A process will be developed to manage the volume and processing time with the accuracy needed in order that the records are correct, complete, traceable, and retrievable. Records will be available for the following step of return to service process so that staff can make accurate assessments of the readiness of the equipment and where applicable, support the release of hold points.

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### **2.6 Regulatory Interface**

#### **2.6.1 Regulatory Scope**

In accordance with N-PROC-LE-0007, Nuclear Refurbishment – Global Assessment Report and Integrated Implementation Plan, Darlington, and as per RD-360, Life Extension of Nuclear Power Plants, the Integrated Implementation Plan (IIP) will identify the regulatory scope and implementation schedule.

The IIP scope includes actions to address Component Condition Assessment recommendations and issues requiring resolution from the Integrated Safety Review as well as mitigating measures from the Environmental Assessment. The activities identified in the IIP will bring the plant into closer alignment with modern codes, standards, and practices, and to further ensure that operation of the facility continues to pose minimal risk to the health and safety of persons, to the environment, to national security.

OPG will monitor the project for progress, safety, and quality at all phases of execution and shall provide the CNSC with updates at a mutually agreed frequency regarding the progress of refurbishment. Progress updates may include such information as:

- A listing of IIP items that have been completed;
- Documentary evidence that these items have been closed; and
- Proposed changes to the scope or implementation schedule for open IIP commitments.

As commitments are completed, formal correspondence will be submitted to the CNSC documenting the information required to demonstrate compliance and seeking CNSC concurrence. Any changes to the IIP scope or implementation schedule will follow the change control process to be developed and submitted to the CNSC, NK38-CORR-00531-16568 "Request for CNSC Acceptance of the Darlington NGS Global Assessment Report (GAR) and Integrated Implementation Plan (IIP)".

#### **2.6.2 Regulatory Commitments**

Refurbishment regulatory commitments will be monitored and tracked in accordance with N-PROC-RA-0006, Regulatory Action Management.

Regulatory commitments include:

- Regulatory Scope
- Any other refurbishment-related commitment made by OPG through formal correspondence.

Refurbishment regulatory commitments will be linked to Restart Control Hold Points (RCHP) as appropriate.



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Removal of Regulatory Hold Points will be contingent on having received CNSC approval following submission to the CNSC of the information required to demonstrate that all related regulatory commitments have been met up to that hold point.

### **2.6.3 Completion Assurance Documents**

As per Regulatory Document RD-360, completion assurance documents (CADs) will be submitted to the CNSC in support of a request to remove the hold points identified as regulatory. The CAD will contain references to the documentation that provides confirmation that all pre-requisites, modification commissioning, testing, system restart activities and commitments have been completed to allow release of the specific hold point. It is expected that OPG will prepare several CAD documents to support removal of a regulatory hold point and these documents will be submitted to the CNSC for review and acceptance as work is completed throughout the various phases of the refurbishment outage. The CAD provides confirmation to the CNSC that refurbishment activities required for a specified hold point have been successfully completed (design, installation, maintenance, testing, modification commissioning).

Acceptance of the CADs will be tracked and once all CADs associated with a particular regulatory hold point have been completed OPG will request final approval to proceed past the hold point. It is expected that OPG regularly update the CNSC on the outage progress and status of CADs in order to reduce the time required to receive final regulatory hold point release.

The CAD will include reference to the following reports with detail applicable to the specific activities associated with the milestone:

- Construction Completion Declarations
- Modification Commissioning Reports
- System Available for Service Packages
- Restart Reports

In addition, CNSC Regulatory Document RD-360, Section 8.0 requires the licensee to submit design completion assurance reports. The design completion assurance reports for modifications identified in the Integrated Implementation Plan will be prepared per NK38-GUID-01900-10001, "Darlington Refurbishment: Design Completion Assurance" and submitted to the CNSC by Darlington Refurbishment Engineering well in advance of the Construction Completion Declaration.

OPG will perform a safety assessment for any remaining unknown conditions or outstanding deficiencies related to the Component Condition Assessments of safety related SSCs. These assessments will be submitted to the CNSC for acceptance as a prerequisite to removing regulatory hold point for progression past Phase A (prior to fuel load) RTS activities.

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## **3.0 ROLES AND ACCOUNTABILITIES**

### **3.1 Director, Refurbishment Operations and Maintenance**

The Director, Refurbishment Operations and Maintenance, is the document owner and is accountable for its definition and implementation.

### **3.2 Manager, Return to Service**

The Manager, Return to Service, is accountable for oversight and coordination of commissioning and return to service activities.

The mature RTS organization, led by the manager, will consist of the following three sections.

#### **3.2.1.1 Return to Service: Preparation Section**

The RTS Preparation Section will develop RTS processes and procedures. It will also oversee the preparation of execution plans for modification commissioning and return to service activities.

#### **3.2.1.2 Return to Service: Execution Section**

This section will be staffed for the Execution Phase and be responsible for coordinating the execution of the modification commissioning and return to service activities.

#### **3.2.1.3 Return to Service: Completion Assurance Section**

As each project progresses during the Execution Phase, this section will coordinate MAFS and SAFS preparation. It will assemble system available for service documentation in support of Unit readiness for service. This section will also interface with the contractor for system turnover for modification commissioning.

## **4.0 DEFINITIONS AND ACRONYMS**

### **4.1 Definitions**

***Aging Management*** – refers to the process of ensuring that SSC continue to function as per design given that, with time or use, their characteristics can change or their performance can degrade.

***Commissioning*** – refers to the process during which SSC of a facility, having been constructed or modified, are made operational and verified to be in accordance with design specifications and to have met the performance criteria.

***Contractor*** – refers to non-OPG personnel assigned to perform work on the refurbishment project.

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**Functional Testing** – refers to equipment testing performed as per restart specifications to confirm equipment operation as per design.

**Inspection and Test Plan** – refers to instructions prepared for the execution of check out and test activities.

**Islanding** – refers to a process of isolating the refurbished unit as much as possible and identifying out of service equipment boundaries to reduce any impact to the operating units and to provide a safe work area for refurbishment contractors and OPG workers.

**Modification** – refers to temporary and permanent changes to any SSC in the plant, all modifications are performed as per OPG's current Risk Based Modification Process N-PROC-MP-0090.

**Open Items** – refers to items which are identified as required for completion of a completion assurance package (CCD, MAFS, SAFS, RFS) but have been evaluated and accepted as items that can be done at a later date and tied to a future milestone. Open item management is a key process for return to service and open items need to be tracked and monitored with rigour to ensure that they do not impact safe operation of the unit.

**Reactor Physics Plan** – refers to a detailed plan prepared to identify testing required for confirmation of reactor core configuration post-refurbishment, includes checks and tests to confirm reactor physics and neutronic instrumentation prior to and after approach to critical.

**Restart** – refers to process established for returning systems back to service after system layup or shutdown, in general normal station processes would be used to restart equipment however due to extended layup/shutdown additional testing may be required to confirm systems operate as designed. Specifications are prepared for each system requiring restart and restart testing plan is developed to meet the specifications.

**Return to Service** – refers to the process of restarting the refurbished unit and covers the range of activities from completion of installation work by the contractor to reactor power at 100%, including modification commissioning and restart activities. The process also includes confirmation of physical work completed, configuration management confirmed and safety analysis/assessments completed as per N286-05.

**System Baseline** – refers to established operating characteristics, design specifications and operating performance of a system that is used to monitor the performance of the system and monitor for degradation in system components. This is generally established through routine testing, inspections and pre-defined maintenance of the system and may require non-routine testing or modification commissioning to establish new baseline data.

**System Testing** – refers to integrated restart testing used to confirm operation of a system as per the restart specifications.

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### 4.2 Acronyms

ATC – Approach to Critical  
 CAD – Completion Assurance Document  
 CCD – Construction Completion Declaration  
 CNSC – Canadian Nuclear Safety Commission  
 COAT –Check Out and Test  
 CR – Commissioning Report  
 DCS – Detailed Commissioning Specifications  
 DRS – Detailed Restart Specification  
 GSS – Guaranteed Shutdown State  
 IIP – Integrated Implementation Plan  
 ITP – Inspection and Test Plan  
 MAFS – Modification Available for Service  
 OPEX – Operating Experience  
 OP&P – Operating Policies and Principles  
 RFS – Readiness for Service  
 RCHP – Restart Control Hold Point  
 RTS – Return to Service  
 SAFS – System Available for Service  
 SRP2 – System Restart Plan Level 2  
 SRP3 – System Restart Plan Level 3  
 SRP4 – Coordination Workplans  
 SSC – System, Structure or Component

### 5.0 REFERENCES

CNSC RD-360, Life Extension of Nuclear Power Plants  
 CNSC RD-334, Aging Management for Nuclear Power Plants  
 CSA N286-05, Management System Requirements for Nuclear Power Plants  
 N-GUID-09701-10019, Nuclear Refurbishment Construction Check and Test Requirements  
 N-GUID-09701-10020, Nuclear Refurbishment Return to Service Process Overview  
 N-GUID-09701-10021, Nuclear Refurbishment Construction Completion Declaration

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N-INS-00960-10000, Detailed Commissioning Specifications and Commissioning Reports

N-LIST-08130-10023, CSA N286-05 to OPGN Governance Cross Matrix

N-PROC-LE-0007, Nuclear Refurbishment – Global Assessment Report and Integrated Implementation Plan, Darlington

N-PROC-MA-0013, Planned Outage Management

N-PROC-MP-0090, Modification Process

N-PROC-RA-0006, Regulatory Action Management

N-PROC-MP-0001, Engineering Change Control

NK38-CORR-00531-16568, OPG Letter, Dietmar Reiner and Brian Duncan to F. Rinfert, "Request for CNSC Acceptance of the Darlington NGS Global Assessment Report (GAR) and Integrated Implementation Plan (IIP)", November 15, 2013

NK38-GUID-01900-10001, Darlington Refurbishment: Design Completion Assurance

NK38-INS-09701-10002, Nuclear Refurbishment Preparation of Detailed Restart Specifications and Restart Reports

NK38-INS-09701-10005, Nuclear Refurbishment System Available for Service Process

NK38-INS-09701-10006, Nuclear Refurbishment Unit Readiness for Service Process

NK38-PLAN-09701-10097, Interface Agreement Between Nuclear Refurbishment and Darlington Nuclear

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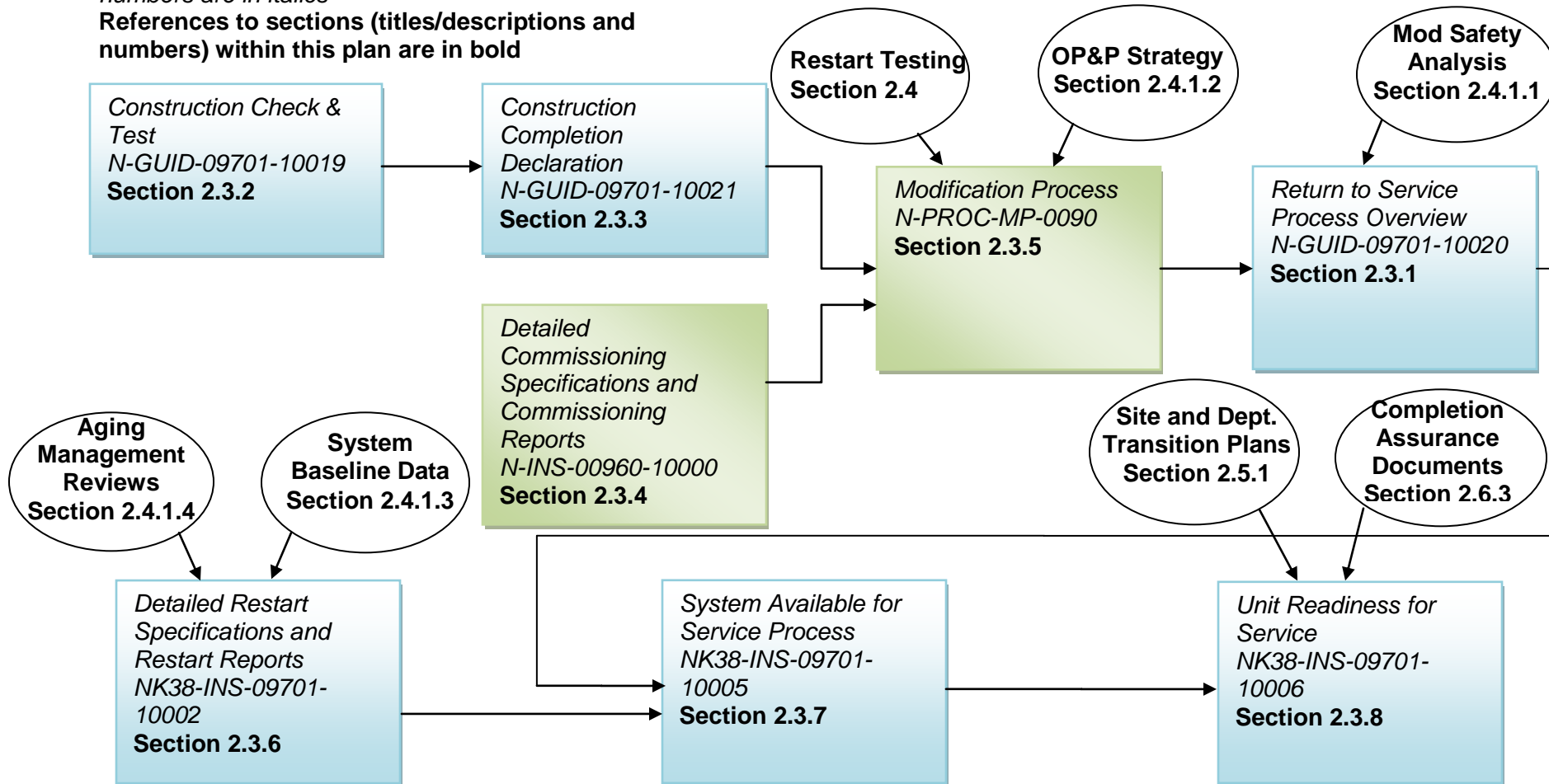
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### Appendix A: RTS Processes/Procedures

#### LEGEND

*References to process/procedure titles and document numbers are in italics*

**References to sections (titles/descriptions and numbers) within this plan are in bold**



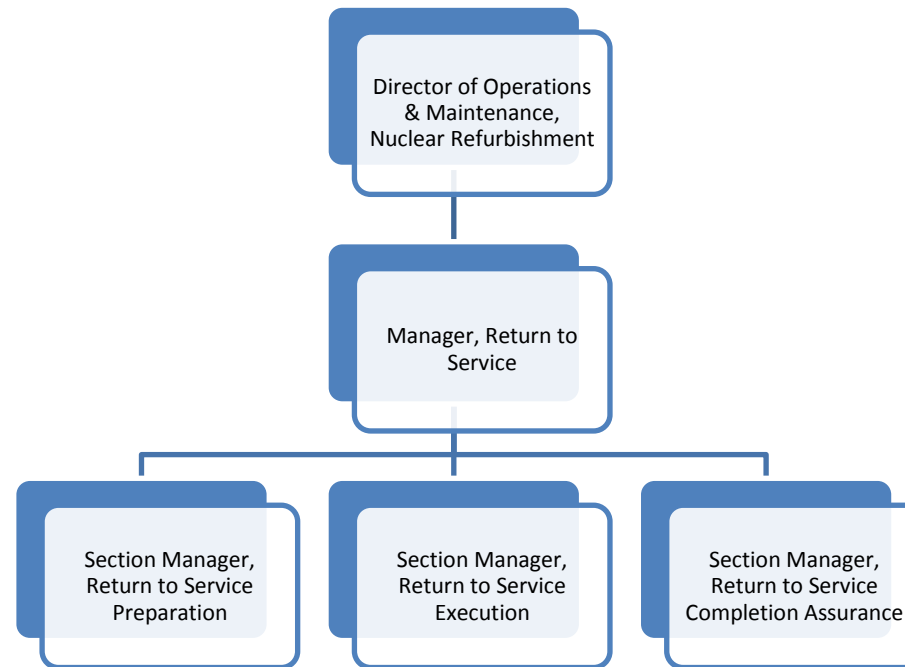
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#### **Appendix B: Darlington Refurbishment – Return to Service Organization (mature)**



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# DARLINGTON REFURBISHMENT - ENVIRONMENTAL PROGRAM MANAGEMENT PLAN

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# Darlington Refurbishment - Environmental Program Management Plan

**NK38-NR-PLAN-09701-10001-0004-R002**  
2016-10-07

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### Revision Summary

Revision Number	Date	Comments
R002	2016-10-07	Major revision to include Project Focus Areas and the Environmental Interface Process. Added reference to Environmental Tactical Plan

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## 1.0 PURPOSE

The Nuclear Refurbishment (NR) Environmental Program Management Plan (EMP) describes how environmental issues will be managed for the NR Program. It establishes a framework for the Environmental Management System (EMS) for NR Projects, Departments and Vendors/Contractors in accordance to defined goals, objectives and expectations for the NR Program.

The *Environmental Mission* is to effectively manage all Environmental Aspects during the NR project, in accordance with the EMS.

## 2.0 PROGRAM REQUIREMENTS

This plan will provide NR and other business unit support staff with clear understanding of the environmental management requirements for the NR Program including:

- Environmental Goals and Objectives
- Environmental Management System Framework
- Significant Environmental Aspects
- Roles and Responsibilities

The changes that will occur as a result of the NR project have the potential to cause Environmental Impacts.

### 2.1 Goals

To effectively manage environmental performance during the Refurbishment Project. Specific goals include:

- Operate **As Low As Reasonably Achievable** (ALARA) to minimize radiation exposure of the **Public** and the **Environment** (PE-ALARA);
- Zero reportable spills and Environmental Infractions;
- Maximize landfill diversion of conventional waste in alignment with regional objectives; and,
- Maintain top quartile performance for the generation of **Low and Intermediate Level Radioactive Waste** (LILRW) during the NR Project and sustain top decile performance following the project.

#### 2.1.1 Objectives

To provide Environmental Oversight for the NR Project by:

1. Identifying potential environmental impacts that are related to Significant Environmental Aspects (SEA) within a project;
2. Maintaining compliance with all legal and other requirements;

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3. Monitoring the performance of a project against specific environmental objectives and targets; and,
4. Reviewing and participating in the modification process during a project.

## 2.2 Strategy

Due to the unique requirements associated with the large scope and duration of the NR Project, and the multi-employer configuration, it is recognized that an environmental program must be in place to ensure that the Significant Environmental Aspects are project focus areas and are managed appropriately.

The *Environmental Policy* [R-1] and *Environmental Management System* [R-2] ensure that Significant Environmental Aspects are identified within OPG (*Environmental Aspects Identification and Significance* [R-3]). These Significant Environmental Aspects are reviewed and ranked across OPG.

The Significant Environmental Aspects that are focus areas for Nuclear Refurbishment include tritium emissions, spills, and radioactive and conventional waste. In addition, OPEX has identified contractor oversight as another key focus area. A summary of these aspects and the management of them are found in Table 1.

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Table 1: Summary of Environmental Focus Areas				
Environment Involvement \ Project Focus Area	Contractor Management Oversight	Tritium Emissions Management (air and waterborne)	Spill Prevention and Management	Radioactive and Conventional Waste Minimization
<b>Governance</b>	<ul style="list-style-type: none"> <li>• OPG-PROG-0005 [R-2]</li> <li>• N-GUID-09701-10013 [R-4]</li> </ul>	<ul style="list-style-type: none"> <li>• N-STD-OP-0031 [R-5]</li> </ul>	<ul style="list-style-type: none"> <li>• N-STD-OP-0026 [R-6]</li> <li>• D-INS-07290-10000 [R-7]</li> </ul>	<ul style="list-style-type: none"> <li>• NK38-NR-INS-79000-10001 [R-8]</li> <li>• W-PROC-WM-0025 [R-9]</li> </ul>
<b>Requirement</b>	<ul style="list-style-type: none"> <li>• Centre- led EMS<sup>(1)</sup> process based on Significant Environmental Aspects</li> </ul>	<ul style="list-style-type: none"> <li>• NR<sup>(2)</sup> Environmental Requirements and Targets outlined in N-PLAN-09701-0584381 [R-17]</li> <li>• Contractor Environmental Management Plans</li> <li>• MPER calculations for impact of all changes</li> </ul>	<ul style="list-style-type: none"> <li>• NR Environmental Requirements and Targets outlined in N-PLAN-09701-0584381 [R-17]</li> <li>• Contractor Spill Prevention and Contingency Plan</li> </ul>	<ul style="list-style-type: none"> <li>• NR Environmental Requirements and Targets outlined in N-PLAN-09701-0584381 [R-17]</li> <li>• Contractor Waste Plan</li> </ul>
<b>Scoping/Planning</b>	<ul style="list-style-type: none"> <li>• Environmental Approval commitments</li> <li>• Environmental Impact Worksheet</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental Impact Worksheet</li> <li>• Master Engineering Change</li> <li>• COIR<sup>(3)</sup></li> <li>• Design Scoping Checklist</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental Impact Worksheet</li> <li>• Master Engineering Change</li> <li>• COIR</li> <li>• Design Scoping Checklist</li> <li>• Site spills risk assessment</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental Impact Worksheet</li> <li>• Master Engineering Change</li> <li>• COIR</li> <li>• Design Scoping Checklist</li> </ul>
<b>Plan Review</b>	<ul style="list-style-type: none"> <li>• External approvals and permits</li> </ul>	<ul style="list-style-type: none"> <li>• Work plans</li> <li>• CWP<sup>(4)</sup>s</li> <li>• Commissioning and Test Plans</li> </ul>	<ul style="list-style-type: none"> <li>• Work plans</li> <li>• CWP<sup>(4)</sup>s</li> <li>• Commissioning and Test Plans</li> </ul>	<ul style="list-style-type: none"> <li>• Work plans</li> <li>• CWP<sup>(4)</sup>s</li> <li>• Commissioning and Test Plans</li> </ul>
<b>Field Oversight</b>	<ul style="list-style-type: none"> <li>• Annual EMS and Compliance Audit</li> <li>• Annual third party EMS audit</li> </ul>	<ul style="list-style-type: none"> <li>• DNGS CA<sup>(5)</sup>/CM<sup>(6)</sup> in field</li> <li>• Project superintendent in field</li> <li>• NR Environment as required</li> </ul>	<ul style="list-style-type: none"> <li>• DNGS CA/CM in field</li> <li>• Project superintendent in field</li> <li>• NR Environment as required</li> </ul>	<ul style="list-style-type: none"> <li>• DNGS CA/CM in field</li> <li>• Project superintendent in field</li> <li>• NR Environment as required</li> </ul>
<b>Monitor/Measure/Report</b>	<ul style="list-style-type: none"> <li>• Centre-led management review to ensure suitability, adequacy and effectiveness</li> <li>• Opportunities to improve</li> </ul>	<ul style="list-style-type: none"> <li>• Performance Objectives</li> <li>• Targets</li> <li>• Measures</li> <li>• Contribution to site emissions reported monthly in terms of annual targets</li> </ul>	<ul style="list-style-type: none"> <li>• Spills reported within required timeline</li> <li>• Monthly reporting by class of spills against targets</li> <li>• Clean up as required in Standard</li> </ul>	<ul style="list-style-type: none"> <li>• Contractor Waste Management Plan describe any monitoring and reporting (as per NR requirements)</li> </ul>
<b>Further Actions</b>	<ul style="list-style-type: none"> <li>• SCRs, self assessments, and audits used to identify trends and areas for improvement</li> </ul>	<ul style="list-style-type: none"> <li>• COIR Assigns responsibility to contractor to prepare plans</li> <li>• NR Environment reviews</li> </ul>	<ul style="list-style-type: none"> <li>• COIR Assigns responsibility to contractor to prepare plans</li> <li>• NR Environment reviews</li> </ul>	<ul style="list-style-type: none"> <li>• COIR Assigns responsibility to contractor to prepare plans</li> <li>• NR Environment reviews</li> </ul>

**Notes:**

(1) EMS = Environmental Management System  
(2) NR = Nuclear Refurbishment

(3) COIR = Contractor/Owner Interface Requirements [R-10]  
(4) CWP = Comprehensive Work Packages

(5) CA = Contract Administrator  
(6) CM = Contract Monitor

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## 2.3 Environmental Management System (EMS) Framework

OPG's Environmental Policy includes a commitment to register the Environmental Management System under the ISO 14001 Standard. Accordingly, OPG is committed to establish, implement, maintain, and continually improve this EMS in accordance with the Standard. In addition to the standard, the CNSC Regulatory Standard (S-296) applies.

The scope of the EMS includes activities associated with the construction, operation, emissions, effluent and waste management, decommissioning and demolition of associated buildings and structures solely owned by OPG and operated by OPG or sites operated by OPG on behalf of OPG's partner owners.

In order to ensure the EMS is maintained, Nuclear Refurbishment Environment will follow a Centre Led single EMS and embody the principles through the use of the Environmental Framework Documents (outlined in Appendices B and C, accordingly). These principles are implemented through the Environmental Interface Process (Appendix D).

## 2.4 Requirements for Environmental Management

It must be demonstrated that an Environmental Management System is able to meet the OPG EMS standard (ISO 14001). With respect to the NR Project, the standard requires that any person performing work or services on a site, which has the potential to cause a significant environmental impact, should be aware of the requirements and importance of the EMS and are competent to perform the job assigned. In addition, any operation or activity that has potential environmental impacts that are significant is to be controlled using documented procedures. Regardless of whom performs the work (e.g., OPG staff, contractors, subcontractors, etc.), compliance is required.

Whether or not OPG is the Constructor of a project or the project is an Owner only project, OPG can be found liable for environmental regulatory infractions. The Project Manager is responsible for ensuring environmental requirement specifications are prepared, approved and followed. This must be done with full knowledge of the degree of environmental risk inherent to the construction or maintenance activities involved in the project (including environmental impact risks, stakeholder risks and legal risks).

The Project Manager's assessment of the *Environmental Aspects* and potential *Environmental Impacts* will be unique to their project. This assessment will be integrated into the Contractor's Environmental Management Program (CEMP). The assessment provides assurance to the workplace parties that the environmental risks unique to the project have been identified and that adequate controls to eliminate or mitigate the risks are in place before work commences.

This Program Management Plan provides the Project Manager with an understanding of the environmental risks of the project and in conjunction with the *Nuclear Projects – Environmental Requirements Guideline* [R-4], which provides expectations and specific requirements for the CEMP.

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## 2.5 Risk Management

Environmental risks are proactively identified and managed in order to ensure environmental safety during a project. Once a risk is identified, it is assessed and maintained in the Risk Management Oversight (RMO) Tool as per the *Nuclear Projects Risk Management* [R-11] process. This tool is well aligned with the requirements of the recently revised ISO 14001:2015 standards, which emphasize an alignment between significant environmental aspects and the environmental risks associated with threats and obligations. Appendix A provides a snapshot of the entries in the Risk Management Oversight Tool at the time of this document update.

### 2.5.1 Risk Identification and Analysis

Environmental risks to a project can be identified from a number of sources. Information gathering for input to the risk register is taken from issues arising from Darlington Environmental Review Team meetings, OPEX, Contractor risk identification, as well as other appropriate sources.

The significance of each risk is the product of its impact and probability. These factors are assessed by NR Environment, the appropriate stakeholders for each risk and when needed with help from expert advice.

Environmental risks which have been identified are managed through the RMO tool. Emerging risks are added to the RMO tool, as required. Currently, the largest risks to the ensuring all environmental requirements are met include:

- Frequent turnover of contractor staff challenge the completion of work consistently meeting environmental requirements of the work as described in Environmental Management Plans;
- Oversight of contractors and their subcontractors is inconsistent when compared to OPG expectations particularly with respect to timely notification of events and response; and
- Processes described in OPG EMS are not mature in terms of environmental performance of contract staff.

A snapshot of Environmental risks is included in Appendix A. The identified risks have associated actions in order to manage the risks. Risks that are not unique to NR Environment include OPG and contractor staff retention, qualifications, and engagement.

### 2.5.2 OPEX

The amount of OPEX from major construction projects and the resulting mitigation of their environmental effects are assessed as part of risk identification and work planning processes. Recent and applicable OPG OPEX that are readily transferrable to the Project include:

- D-2009-14668 – HP Event - ECI IWST overfilled with ESW Water causing spill to environment

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- N-2015-25855 – Lessons Learned Arising from Darlington Vacuum Building Outage (VBO) Execution Issues
- Niagara Tunnel and Lower Mattagami River Projects – Lesson Learned (file NAW130-00120 TS)
- NR Risk Management and Oversight tool – OPEX Log 00002539 HTO Niagara Tunnel and Lower Matagami River Projects – Environment

In order to benefit from lessons learned, events will be documented in the SCR database. SCRs are reviewed, typically twice per week, with the senior manager to identify adverse trends and areas for improvement.

## 2.6 Environmental Performance Metrics and Targets

A single, consistent set of Environmental Metrics (measures and targets) for Nuclear Refurbishment and Contractors at the Program and Project levels is provided in the *Darlington Refurbishment - Chemistry & Environment Metrics* [R-12].

NR Senior Line Management, NR Project Teams and Contractors will use the metrics to identify unsatisfactory performance against prescribed targets and identify methods to eliminate causes for unsatisfactory safety performance.

Program and Project Environment metrics will be tracked on a prescribed frequency and reported graphically, or otherwise, through the NR Program Monthly Status Report and Project Manager Status Reports.

## 2.7 Environmental Oversight and Monitoring

Environmental oversight and monitoring requirements for Nuclear Projects will be established under direction of the *Project Oversight Standard* [R-13]. Environmental oversight criteria are identified in the *Nuclear Refurbishment – Environmental Requirements Guideline* [R-4]. Environmental oversight focus areas are outlined in the *Guideline for Chemistry & Environment Oversight* [R-14] and will be included in the Project Oversight Plans (POPs).

A Darlington Environmental Review Team (DERT) has been established and will be a key environmental compliance oversight mechanism for the Program Roles & Accountabilities (*DERT – Terms of Reference* [R-15]).

## 2.8 Project Focus Areas

### 2.8.1 Environmental Interface

On a project by project basis, Significant Environmental Aspects are identified during various phases of a project (note: some work, e.g., soil management, although not a project, is benefiting from this approach). NR Environment is involved throughout a project, as illustrated in Appendix D. These general phases include Scoping/Planning, Plan Reviews, Field Oversight, and Monitor/Measure/Report. All of these phases



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support the Requirements [e.g., Environmental Management System, Environmental Policy, requirements from external regulatory agencies (e.g., Ministry of Environment and Climate Change)].

Once the aspects have been identified, the project is required to determine methods of minimizing the impact and managing the aspect. Nuclear Refurbishment Environment provides support to the project to determine a method for managing the aspect based on extensive knowledge and dedication to excellence.

During a project, the *Modification Process* [R-16] is followed. Within the process there are steps must be completed and requirements fulfilled, which initiate review of a project by Nuclear Refurbishment Environment. These include, but are not limited to: Environmental Impact Worksheets, Contractor/Owner Interface Requirements [R-10], Master Engineering Changes, and Design Scoping Checklists.

Plans that are prepared as part of a project may include Work Plans, Comprehensive Work Packages, Commissioning and Test Plans, in addition to the Contractor Environmental Management Plans (CEMP) (this is a requirement of the COIR). If, during the preparation of the CEMP, it is noted that a specific environmental aspect needs further oversight, a more specific plan will be developed and reviewed by Nuclear Refurbishment Environment (e.g., soil management plan, spills prevention and contingency plan, waste management plan, water management plan). If required, Centre Led Environment may provide additional expertise.

## 2.8.2 Tritium Emissions Management (Air and Water)

*Monitoring Of Nuclear And Hazardous Substances In Effluents* [R-4] establishes minimum requirements for the monitoring of nuclear and hazardous substances in airborne and waterborne effluents from OPGN facilities operating under normal and abnormal operating conditions.

The requirement to review and determine the potential to impact or change radioactive emissions is captured throughout a project. These requirements that cause the investigation into radioactive emissions include: *Nuclear Projects - Environmental Requirements Guideline* [R-4], Contractor Environmental Management Plans, and MPER calculations review.

Once an impact or change to radioactive emissions has been determined, performance objectives, targets, and measures are developed and incorporated into Darlington's metrics. These are reviewed by upper management to ensure that the overall emissions profile for OPGN meet the commitment to the community. The contribution to site emissions is included in a monthly report.

A Tritium Emission Mitigation Strategy has been incorporated in the Darlington Refurbishment – Environmental Tactical Plan[R-17].

This strategy will describe elements and processes which will be used to manage tritium emissions. These elements include the following:

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1. Moderator flushing: three system flushes are expected to reduce contaminant concentrations by more than 70 times, reducing the amount of tritium in the water from 12 Ci to 0.3 Ci;
2. Drying skids: newly designed skids for drying the drained primary side systems are being developed to condense and capture tritium from the system and to minimize the amount that is being released as airborne emissions (MEC 118767 for PHT, MEC 118768 for Moderator);
3. Spill carts: new spill carts based on Bruce OPEX (Bruce encountered 3 heavy water spills) are being designed and will be available for any heavy water spills, including larger spills, or to house equipment to contain smaller spills;
4. Fuel End Cap Fittings: plastic end caps will be used to reduce leakage or air ingress into the PHT system over the range of design conditions until retubing activities commence;
5. Vault Vapour Recovery System (VVRS): dryer 5 (DR5) will be bypassed due to increased breathing air load. Aggressive leak control will be required and dryers (i.e., Munter-type dryers) will need to function at a high efficiency and reliability;
6. Temporary Heavy Water Storage Facility: the design requirements of this facility include methods to minimize emissions. MPER calculations determined that any off-gassing of the temporary tanks would not significantly impact the station's tritium emissions minimization plan; and
7. Human Performance: HU tools will be used throughout planning and execution phases, which will include checking execution plans, surveillance, response procedures and proper training.

### 2.8.3 Spill Prevention and Management

*Spill Management* [R-6] provides directions to manage spills to land, air and water at OPGN facilities in accordance with Ontario Regulations. Nuclear Refurbishment follows the *Darlington Spill Prevention and Contingency Plan* [R-7] to monitor and report spills. Spill Management is also discussed in the Darlington Refurbishment – Environmental Tactical Plan [R-17].

The requirement to review and determine the potential impact to the environment due to spills and the likelihood of a spill is determined as part of the Contractor Environmental Spill Plan. This plan is developed by the Contractor with reviews by Nuclear Refurbishment Environment. Once the plan has been accepted by the project, the prevention measures are put in place prior to beginning work and walk downs performed on a predetermined basis to ensure that the work area is in good repair.

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The DNGS Projects Contract Management Office, DNGS Maintenance Contract Management Office, and Construction Oversight provides a day-to-day liaison with the contractor in the field. If there are any events, the contractor contacts their respective (either Projects or Maintenance) DNGS Contract Administrator, who then contacts Nuclear Refurbishment Environment. Construction Oversight would also contact Nuclear Refurbishment Environment if an event is observed. The event is reviewed and recorded, and, if required, reported. Monthly, the spills are reviewed and input into the Electronic Performance Report. Any trends or anomalies in either the numbers or types of spills are reviewed for further investigation. Opportunities for improvement are sought and implemented where feasible.

#### 2.8.4 Radioactive and Conventional Waste Minimization

*The Darlington Refurbishment Waste Plan, Logistics and Guidelines [R-8]* was developed to integrate waste minimization strategies and plans for waste generation, processing and shipping. Radioactive waste can have negative impacts on the environment, presents a significant legacy issue for future generations, and can be challenging financially and from a human resource perspective. In addition, Low and Intermediate Level Radioactive Waste is a Significant Environmental Aspect in OPG's Environmental Management System.<sup>1</sup>

Waste minimization initiatives are in development and will be implemented to support the Nuclear Refurbishment in order to reduce the potential for Low Level Waste associated with the Project including, de-packaging in the Darlington East Warehouse, a de-packaging area in the powerhouse, and the use re-washable PPE.

The majority of the Nuclear Refurbishment Radioactive Personnel Protective Equipment, supplied by OPG, will be re-washable including plastic suits, gloves, booties and Anti-Cs. All of these washable products will be made available at specially marked laundry silos at the airlocks and at various locations throughout the islanded unit. The use of these re-washable products will minimize the amount of radioactive waste generated. The expectation for these products is that they will be placed in the specially marked laundry bins at the airlocks and rubber areas after use (regardless of their condition), and NOT in the Active Waste Collection Area.

To assist with these processes, job aids will be available, as well as assistance from trained and knowledgeable Field Supervisors, Radiation Protection Coordinators, Nuclear Refurbishment Civil Maintenance, and the Nuclear Refurbishment Waste SPOC.

The Retube and Feeder Replacement (RFR) project is a major contributor to the amount of waste generated during the Project. A Volume Reduction System is an initiative to minimize the amount of waste using the Retube Waste Processing Building (RWPB). This building will reduce and compact Intermediate Level Waste (ILW) produced from the removal of reactor core components. This building will also be used to store contaminated tooling (on an interim basis) after the first unit

<sup>1</sup> N.B. There are Maintenance Milestones in place to develop and implement a process for managing LILRW (Milestones DNRU2B2020 and DNRU2B2023).

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refurbishment. This tooling will be reused on subsequent unit refurbishments, diverting potential radioactive waste until the end of the Project.

In addition, a new waste collection process will be implemented for the islanded unit (Breaker Open – Return to Service) to promote a pro-active approach to segregation and waste minimization, by utilizing a central Active Waste Collection Area that contractors and staff will bring their waste to for disposal. The expectation is that personnel segregate waste (incinerable, compactable, non-processible, laundry) at the source and dispose of it at the central location. Solid Active Waste will be processed and shipped through the RWPB, which will not be available until after Unit 2 is defueled and dewatered. As a result, waste will continue to be staged and shipped at the Common Services Area (Unit 0) Waste Handling Facility until the commissioning of the RWPB.

Targets and projections for waste are incorporated in the Darlington Refurbishment – Environmental Tactical Plan [R-17].

### 3.0 ROLES & ACCOUNTABILITIES

For the Nuclear Refurbishment Program, safety is a shared responsibility.

#### 3.1 All OPG and Contractor employees:

- Have accountability for safety. This includes making conservative decisions regarding refurbishment operation and construction activities as they relate to the health and safety of our employees and the environment.
- Are accountable for performing work safely and for identifying, communicating and, where appropriate, correcting workplace hazards in order to protect themselves, their co-workers, other contractors or the environment from harm.

#### 3.2 OPG Nuclear Refurbishment is accountable for:

The role and responsibility of the *Owner/Constructor*:

#### 3.3 All OPG and Contractor line management are accountable for:

- The safety of their employees at OPG workplaces and ensuring their activities do not harm any employees or the environment.
- Ensuring the work environment is designed to protect workers and the environment.
- Ensuring that work is planned and performed to protect workers and the environment.
- Providing employees with the information, training, tools, procedures and support required to do their job safely and without harming other workers or the environment.

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### 3.4 Requirements for Environmental Management

OPG expects that all operations are conducted in order to protect the welfare of site staff and the environment. The processes and procedures shall be subject to competent scrutiny through the supply chain. Environmental programs and/or operations that do not meet these expectations, and in particular where there are opportunities that have not been utilized to improve the use of good environmental practice and/or eliminate/reduce significant risks, shall not be deemed acceptable (subject to assessments of reasonable practicability).

Where design is part of the works, the following list of requirements shall be considered:

- All environmental requirements are fully incorporated into the Engineering, Procurement and Construction (EPC) process;
- There is clear allocation of responsibility and authority for environmental management matters;
- There is an effective interface with regulators, including obtaining relevant licences, consents and permits;
- These requirements are clearly communicated through their supply chain, and reflected in the Contractor Environmental Management Program (CEMP);
- Ensure that all personnel are competent and sufficiently resourced to work to the required standards;
- Ensure compliance with site as well as their own requirements by their personnel, subcontractors personnel and visitors;
- There is cooperation with the Project Manager and Environment Advisor;
- There is cooperation and participation in environmental programs for contractors;
- There are mechanisms in place to ensure cooperation and exchange of information on neighbouring/shared risks and logistics;
- Ensure that relevant information on work in the area designated as under their control is provided to OPG to facilitate coordination, so that the activity of any party does not result in undue risk;
- Members of the team have access to appropriate, competent environmental management advice and support; and
- Monitoring and reporting including the completion of the monthly Environment Scorecard and reporting of incidents and accidents.

### 4.0 DEFINITIONS & ACRONYMS

Below is a list of definitions and acronyms

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#### 4.1 Definitions

- **Environment Aspect:** Element of an organization's activities, products or services that can interact with the environment
- **Environmental Impact:** A change in the environment that could have a negative effect on the ecosystem.
- **EMS:** Management of an organization's environmental programs in a comprehensive, systematic, planned and documented manner. It includes the organization structure, planning and resources for developing, implementing and maintaining policy for environmental protection. See Appendix B for a model schematic.
- **Environment Policy:** refers to the commitment of an organization to the laws, regulations and other policy mechanisms concerning environmental issues and sustainability

#### 4.2 Acronyms

- **ALARA** – As low As Reasonable Achievable
- **CEMP** – Contractor Environmental Management Program
- **COIR** – Contractor/Owner Interface Requirements
- **DETR** – Darlington Environmental Review Team
- **EMP** – Environment Management Plan
- **EMS** – Environment Management System
- **EPC** – Engineering, Procurement and Construction
- **ILW** – Intermediate Level Waste
- **LILRW** – Low and Intermediate Level Radioactive Waste
- **NR** – Nuclear Refurbishment
- **POP** – Project Oversight Plans
- **RFR** – Retube and Feeder Replacement
- **RWPB** – Retube Waste Processing Building

#### 5.0 REFERENCES

- [R-1] The *Environmental Policy*, OPG-POL-0021
- [R-2] *Environmental Management System*, OPG-PROG-0005
- [R-3] *Environmental Aspects Identification and Significance Rating*, OPG-PROC-0036
- [R-4] *Nuclear Projects - Environmental Requirements Guideline*, N-GUID-09701-10013

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- [R-5] *Monitoring Of Nuclear And Hazardous Substances In Effluents*, N-STD-OP-0031
- [R-6] *Spill Management*, N-STD-OP-0026
- [R-7] *Darlington Spill Prevention and Contingency Plan*, D-INS-07290-10000
- [R-8] *The Darlington Refurbishment Waste Plan, Logistics and Guidelines*, NK38-NR-INS-79000-10001
- [R-9] *Waste Acceptance Criteria for Low and Intermediate Level Radioactive Waste*, W-PROC-WM-0025
- [R-10] *Contractor\Owner Interface Requirements (COIR)*, N-COI-00120-00001
- [R-11] *Nuclear Projects Risk Management Process*, N-MAN-00120-10001-RISK
- [R-12] *Refurbishment Chemistry & Environment Metrics*, NK38-REP-09701-10185
- [R-13] *Project Oversight Standard*, N-STD-AS-0030
- [R-14] *Guideline for Chemistry & Environment Oversight*, NK38-GUID-09701-10029
- [R-15] *DETR – Darlington Refurbishment – Darlington Environmental Review Team (DETR) Terms of Reference*, NK38-PLAN-09701-10121
- [R-16] *Modification Process*, N-PROC-MP-0090
- [R-17] *Darlington Refurbishment – Environmental Tactical Plan*, N-PLAN-09701-0584381

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### Appendix A: Risk Management Oversight Tool Snapshot

Risk Identification	Title	Description
00005847	Business Case – Decommissioning of two deep exploratory wells – UN1 and UN2	Environment Services assisting with preparation of a detailed business case for the decommissioning of two deep exploratory wells – UN1 and UN2 per O. Reg. 903 requirements.
00005958	Communicate success of soil placement as land-cover layer to the broader organization	Communication completed. This Risk is in the process of being closed off in Risk Management Oversight Tool database.
00006321	Environmental Contractor Management	<ol style="list-style-type: none"> <li>1. Frequent turnover of contractor staff challenge the completion of work consistently meeting environmental requirements of the work as described in Environmental Management Plans</li> <li>2. Oversight of contractors and their subcontractors is inconsistent when compared to OPG expectations particularly with respect to timely notification of events and response</li> <li>3. Processes described in the OPG EMS are not mature in terms of environmental performance of contract staff</li> </ol>



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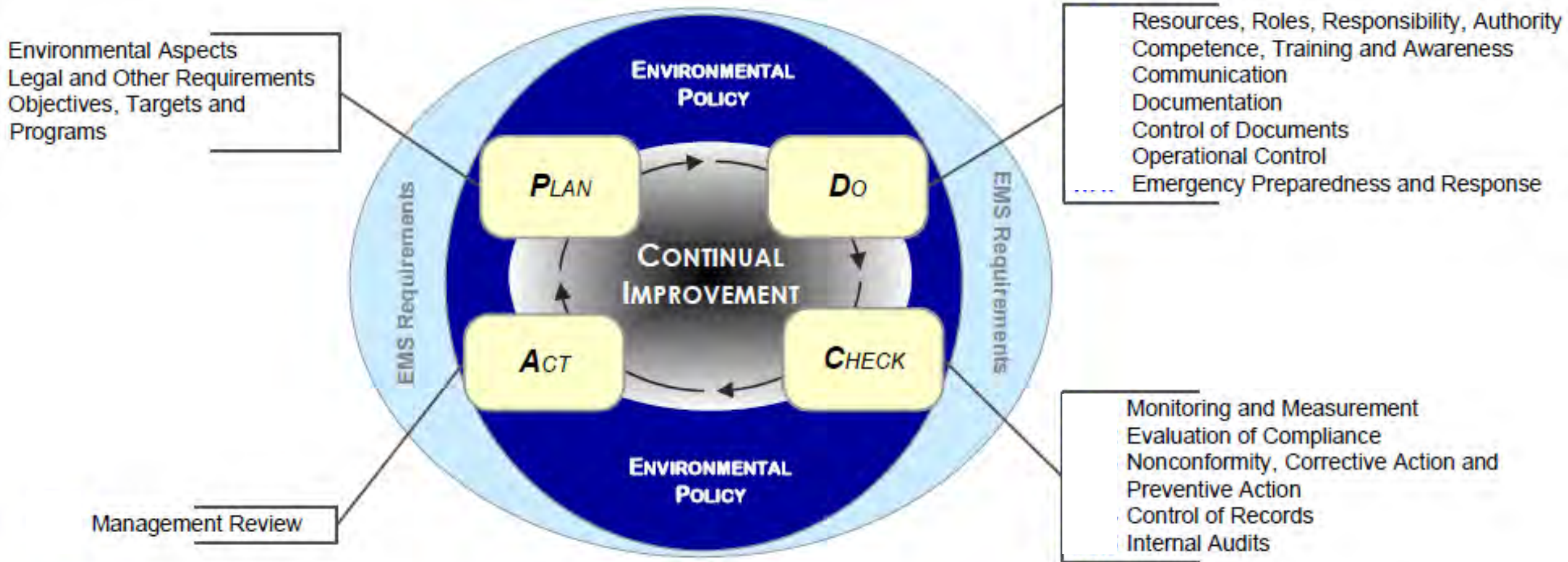
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Appendix B: Environmental Management System Model



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**Appendix C: Environmental Framework Documents**

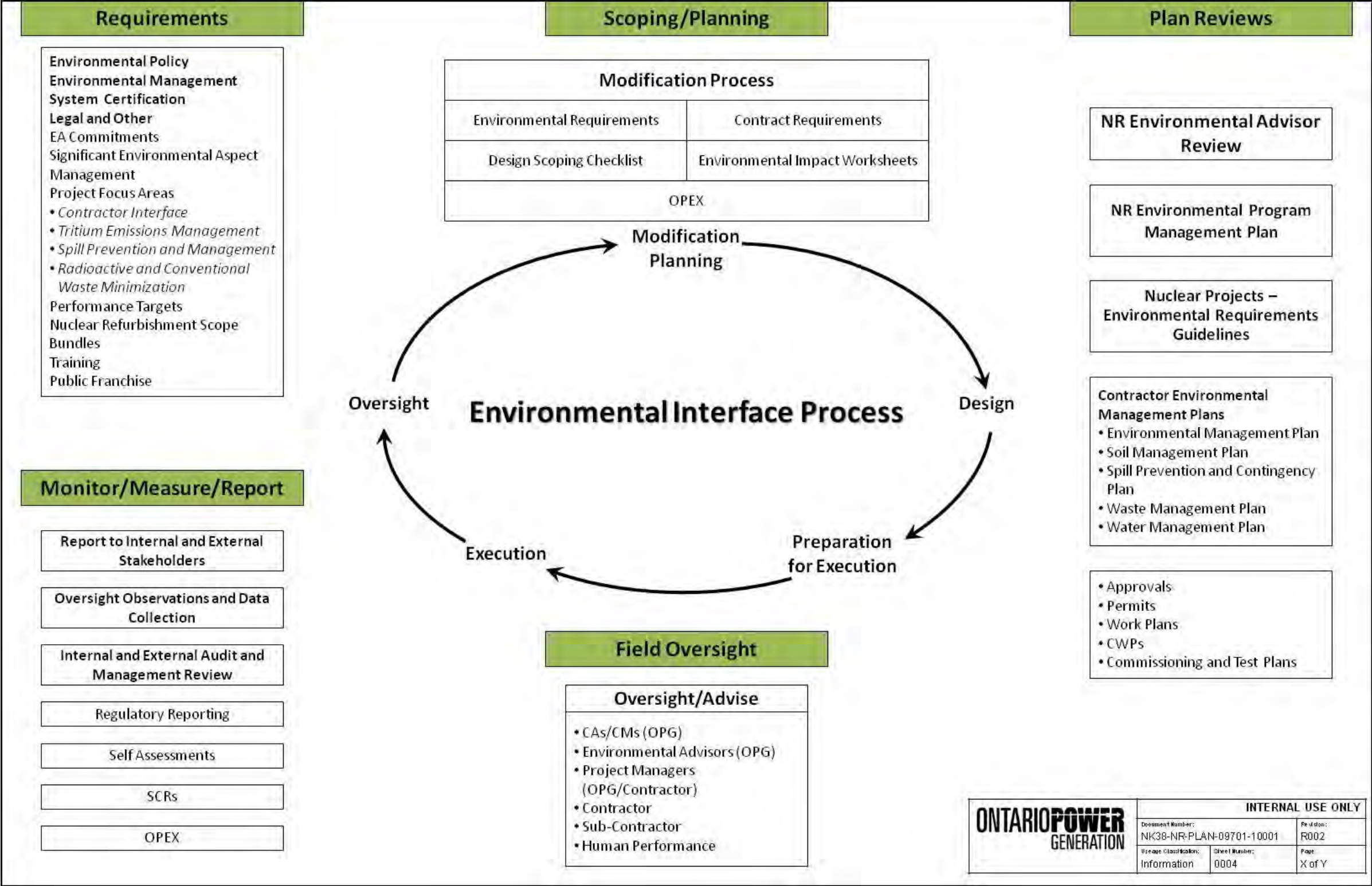
CORPORATE ENVIRONMENT	NUCLEAR ENVIRONMENT	NR ENVIRONMENTAL MANAGEMENT	PROJECTS AND MODIFICATIONS	NR INTERFACE WITH DNGS SITE ENVIRONMENT
OPG-POL-0021 <i>Environmental Policy</i>	CNSC Regulatory Standard S-296 <i>Environmental Protection Policies, Programs and Procedures at Class I Nuclear Facilities and Uranium Mines and Mills</i>	NK38-NR-PLAN-09701-10001 <i>Darlington Refurbishment- Environmental Program Management Plan</i>	N-COI-00120-00001 <i>Contractor\Owner Interface Requirements for Nuclear</i>	NK38-PLAN-09701-10156 <i>Environmental Interface Agreement Darlington Nuclear</i>
OPG-PROG-0005 <i>Environmental Management System</i>	ISO 14001:2004 <i>Environmental management systems</i>	N-GUID-09701-10013-004 <i>Nuclear Projects- Environmental Requirements Guideline</i>	N-FORM-10422 <i>Environmental Impact Worksheet</i>	NK38-PLAN-09701-10113-CHE-01 <i>Chemistry &amp; Environment – Ownership Transfer Plan</i>
OPG-PROC-0036 <i>Environmental Aspects Identification And Significance Rating</i>	CSA Standard N286-05 <i>Management system requirements for nuclear power plants, Section 6.29, Effluent control</i>	NK38-REP-09701-10185 <i>Darlington Refurbishment- Chemistry &amp; Environment Metrics</i>		NK38-PLAN-09701-10121 <i>Darlington Refurbishment Environmental Review Team (DERT) Terms of Reference</i>
OPG-PROC-0041 <i>Significant Environmental Event Identification and Reporting Procedure</i>	N-PROG-OP-0006 <i>Environmental Management</i>	NK38-REP-09701-10031 <i>Guideline for Chemistry &amp; Environment Oversight</i>		
OPG-PROC-0044 <i>Environmental Internal Audit and Compliance Audit</i>	<b>SIGNIFICANT ENVIRONMENTAL ASPECTS</b> <b>Tritium Emissions</b> <ul style="list-style-type: none"><li>•N-STD-OP-0031, <i>Monitoring Of Nuclear And Hazardous Substances In Effluents</i></li></ul> <b>Spills</b> <ul style="list-style-type: none"><li>•N-STD-OP-0026, <i>Spill Management</i></li></ul> <b>Low &amp; Intermediate Level Radioactive Waste</b> <ul style="list-style-type: none"><li>•W-PROC-WM-0025, <i>Waste Acceptance Criteria for Low &amp; Intermediate Level Radioactive Waste</i></li><li>•NK38-NR-INS-79000-10001, <i>Darlington Refurbishment Waste Plan Logistics And Guidelines</i></li></ul>	NK38-PLAN-09701-0477676 <i>Nuclear Projects Environmental Management Alignment Plan</i>		
OPG-PROC-0049 <i>Identification of Environmental Legal and Other Requirements</i>				



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Appendix D: Environmental Interface Process





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**DARLINGTON REFURBISHMENT HEALTH AND SAFETY PROGRAM MANAGEMENT**

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**Darlington Refurbishment Health And  
Safety Program Management**

**NK38-NR-PLAN-09701-10001-0005-R002**  
2016-05-02

Order Number: N/A  
Other Reference Number:

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### Revision Summary

Revision Number	Date	Comments
R00021	2014-01-31	<p>This document supersedes NK38-PLAN-09701-10067 Sheet 0016. The changes between NK38-PLAN-09701-10067 Sheet 0016 and this document are as follows:</p> <ul style="list-style-type: none"> <li>• The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001,</li> <li>• The security classification has been removed so that the document can be submitted to the CNSC, and</li> <li>• References have been updated.</li> </ul>
R002	2016-05-02	<ul style="list-style-type: none"> <li>• Incorporated comments from AR 28184669 action 5</li> <li>• Added NR Support Functions and Services to Section 2.1.2.6</li> <li>• Added Vendor Health and Safety Representative – Section 2.1.2.7</li> <li>• Added details to section 2.1.2.8 H&amp;S Oversight and Monitoring including references to NK38-PLAN-09701-10269-R000 - Darlington Refurbishment Conventional Safety Oversight Plan</li> <li>• Update H&amp;S Communications Section 2.1.2.9</li> <li>• Added description of NR JHSC Section – Section 2.1.2.10</li> <li>• Added Appendices A and B</li> <li>• References have been update</li> </ul>

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## 1.0 PURPOSE

The Darlington Refurbishment Health & Safety Program Management Plan describes how OPG and Contractors will manage the health and safety of all workers associated with the Nuclear Refurbishment Project. It establishes an integrated framework for the management of worker health and safety in accordance with defined health and safety values, goals, objectives and expectations for the Nuclear Refurbishment Project.

## 2.0 PROGRAM REQUIREMENTS

The over-arching Nuclear Refurbishment Health and Safety Program Management Plan provides NR and other business unit support staff with a clear understanding of the H&S management requirements for the entire Nuclear Refurbishment Project including:

- H&S Management Framework and Processes
- Program Plan and Key Deliverables

### 2.1 H&S Management Framework and Processes

#### 2.1.1 H&S Management Framework

To define and articulate the joint commitment and responsibility for health and safety within the project, all parties require a common framework that provides everyone with what effective H&S management looks like before refurbishment work even begins. See Appendix A for a flow chart of the framework of the NR H&S Program.

This framework provides each NR Project with one common core value for safety, one common safety policy, one set of common safety rules, a single set of integrated, specific safety principles, objectives, responsibilities, expectations, performance measures, evaluations and verifications for the management of H&S by OPG and its Contractors.

Nuclear Refurbishment has specified the framework for health and safety in standard contract Safety Exhibit clauses and ES MSA worksheets that include reference to N-GUID-09701-10011 (Safety Management Essentials for DN Refurbishment). This guide is intended to serve as OPG's H&S performance measure for all Contractors providing the basis for the health & safety requirements that the Contractor Safety Program and Project Specific Safety Plans are to demonstrate equivalency to.

This guide applies to OPG EPC/ES MSA Contractors and its requirements will be integrated into their Health & Safety Programs and Project Specific Safety Plans. The EPC/ES MSA Program shall include specific EPC Contractor developed safety plans associated with managing safety risk for every major project phase and associated work tasks. The Contractor Health and Safety Programs (including Project Specific



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Safety Plans) will be reviewed by NR Health and Safety for compliance with N-GUID-09701-10011 using N-FORM-11623 (Gap Analysis Sheets).

In addition, this guide provides a framework of OPG's expectations for project H&S field oversight and evaluation of the quality of the Contractor's H&S Program, Project Specific Safety Plans and safe work practices. This is an integral part of the Project Oversight Plans for each project. Contractors are also expected to apply the N-GUID-09701-10011 as part of their own H&S oversight program and plans.

Together, the Contract (including N-GUID-09701-10011), the Project Safety Management Plan and the EPC/ES MSA Contractor's Safety Program (including Project Specific Safety Plans) form the basis of the Health and Safety Management framework for the Nuclear Refurbishment Program.

## 2.1.2 Health and Safety Management Processes

The processes within OPG that Health and Safety Management will establish for the Nuclear Refurbishment Program are described in the following sections.

### 2.1.2.1 Contracting Requirements for H&S Management

- Standard Project contract clauses (Safety Exhibit) and supporting documents (addendums) identifying OPG's expectations for H&S management by Contractors. Current H&S policy and program standards will apply to all contractors to ensure the same level of H&S quality is maintained throughout the refurbishment.
- Performance based H&S specification (N-GUID-09701-10011) included as a contract addendum that will identify the H&S management requirements and safety outcomes that must be satisfied by the contractors on the project. For example, the performance-based specification will be the basis document for the contractors' H&S programs, (e.g. regulatory basis and standards to which the project will subscribe (CSA, CAN/ULC, etc.), and will outline training basis, safety performance reporting standards, incident/accident investigation, hazard specific performance specifications, prescribed OPG governance, and Industry OPEX Focus Areas (e.g. Falling Objects).
- Contractors (employers as defined by OH&SA) are pre-qualified using stringent Health and Safety criteria. This pre-qualification will demonstrate the contractor's commitment to safety as well as their senior management's commitment to safety. All Contractors and Subcontractors will be pre-qualified in ISNetworld prior to executing work on NR, unless specific exemption criteria have been met.
- Contractor H&S management system programs are reviewed as part of the bidding process and constructive feedback on areas for improvement is provided.
- Post Bid/Award of Contract includes the requirement for contractors to develop and implement integrated plan(s) to incorporate OPG NR Safety Management Essentials and Project Safety Management Plans into their H&S Program and Project Specific Safety Plans which will be reviewed by NR Health and Safety

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### 2.1.2.2 Program & Project/Departmental H&S Risks

Program and Project H&S risk information is input into the Refurbishment Program Risk Register (PROGRAM RADAR) and the Refurbishment Project/Departmental Risk Register (PROJECTRADAR) in the Risk Management and Oversight (RMO) Tool.

### 2.1.2.3 H&S Performance Metrics and Targets

A single, consistent set of H&S Performance Metrics (measures and targets) for Nuclear Refurbishment Contractors at the Program and Project levels have been approved for use. These metrics are established in NK38-REP-09701-10127 (Darlington Refurbishment Program - Health and Safety Metrics) and are included in N-GUID-09701-10011. NR H&S metrics will be tracked on a prescribed frequency and reported graphically, or otherwise, through the Refurbishment Program Monthly Status Report, Project Manager Status Reports and the MSO Oversight Trend Report.

NR Senior Line Management, Project Teams, Safety Group and Contractors will compare the metrics to prescribed targets to determine the safety performance of the project. These metrics, combined with field observations will be used to identify and eliminate causes for unsatisfactory safety performance and to develop corrective actions, oversight strategies and safety communications.

### 2.1.2.4 NR Design Packages and Field Procedures

H&S requirements will be defined in NR design packages and field procedures.

### 2.1.2.5 H&S Training

Health and Safety training for Nuclear Refurbishment Contractors is defined in NK38-PLAN-09701-10007 (Darlington Refurbishment - Project Training Work Plan) and N-TQD-510-00001 (Supplemental BTU, Direct Hire and Contract Management Training and Qualification Description). Contractors are required to complete all training to comply with their respective safety management systems, as well as any additional training needed to complete a give scope of work safely and ensure their staff has completed all regulatory training requirements.

### 2.1.2.6 NR Conventional Safety Support Function and Services

The activities and accountabilities identified in this plan include support for planned H&S activities identified in NR Operations and Maintenance P6 H&S Plan including (but not limited to):

- Support to NR Project Managers e.g. development of H&S expectations for Contractors, H&S clause for contracts, support for development of Project Managers' Safety Management Plans
- Participate in the review and acceptance of Contractor H&S Program, Project Specific Safety Plans as a pre-qualification to execution of work

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- Review Contractor Safe Work Planning documents as required
- Support to NR Function Managers to develop and issue H&S specifications, provide input into H&S training requirements, produce oversight and surveillance criteria and other H&S standards for the DN Refurbishment project
- Support program and project risk management activities
- Produce and implement H&S oversight and surveillance processes, criteria and job aids for NR Projects
- Conduct Oversight, Surveillance and Inspection of contractor H&S practices to ensure compliance to OPG's expectations for NR Projects. Observations are recorded in the Field Inspections Log.
- Participate in incident investigations and reviews by providing subject matter experts to appropriately assign and track the disposition of corrective actions
- Support to implementation and tracking/reporting of H&S Contractor Performance Metrics and Trends for Nuclear Refurbishment Project
- Analyzing safety input data (from observations log, oversight data, O&C data) to determine emerging safety trends and risk areas to implement corrective actions
- Establishing and supporting the roles and duties of the Darlington JHSC, BTU JHSC and WTC for Nuclear Refurbishment
- Host daily NR alignment call with all NR Contractors to communicate and resolve field safety issues
- Support NR Execution organization, Construction Oversight & Project Field Support, Project Managers and NR Regulatory Affairs with regulatory requirements and interfaces (Notice of Project, MoL investigations and visits, CNSC requests).
- Act as the single point of contact for NR Safety related regulator interfaces (NR H&S Program Manager)
- Develop and implement the Refurbishment Industrial Hygiene (IH) Testing and Sampling Program for NR Projects
- Develop and schedule Safety Communications plans and schedule for NR and NR Contractors
- Participate in delivery of NR Constructor Awareness Sessions and development of continuing training for OPG staff
- Hire and train NR Conventional Safety personnel as required to support the NR Readiness, Execution and Return to Service phases of the program

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- Manage NR Conventional Safety staff personnel performance throughout the duration of the project
- Monitor for regulatory changes, benchmarking information and relevant OPEX

### 2.1.2.7 Contractor Health and Safety Representative

Each contractor will provide a qualified and experienced full time health and safety representative for the NR Project that will act as the single point of contact for the Vendor with respect to health and safety on the NR Project. The H&S representative's responsibilities include:

- Ensuring that the Contractor complies with their H&S Program and all applicable laws and obligations as they relate to the health and safety of their workers
- Training of the Contractor's Personnel and other persons on site
- Maintaining, reviewing and revising the H&S Program and PSSP
- Maintaining and rolling up safety performance metrics and trend data for the Project for all trades

### 2.1.2.8 H&S Oversight and Monitoring

H&S oversight and monitoring requirements for Nuclear Projects will be established under direction of N-STD-AS-0030 Project Oversight Standard. NR H&S oversight activities are described in NK38-PLAN-09701-10269 - Darlington Refurbishment Conventional Safety Oversight Plan and will be included in Project Oversight Plans. H&S Oversight criteria are based on N-GUID-09701-10011 and are included in NK38-LIST-09701-10001 Project Safety Oversight Criteria.

In addition to the NR Conventional Safety department, health and safety oversight will be conducted by Project Management, Construction Oversight and Project Field Support, Operations and Maintenance, Managed Systems Oversight (MSO) and the JHSC.

### 2.1.2.9 H&S Communications

As part of the NR Operations & Maintenance (O&M) H&S P6 Plan, an activity is allocated to implement a joint H&S Communications Plan, where both OPG and Contractors will continually communicate a consistent message to all staff that "Safety is the **CORE** Value of the Darlington Refurbishment Project" ("Safety" includes Nuclear, Conventional, Radiological and Environmental safety).

Issues and trends identified through oversight activities, observation and coaching, and Safety performance metrics will be used to develop communications that will be delivered to NR staff. See Appendix B for Safety Analysis Corrective Action and Feedback flow chart.

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H&S Communications are also shared between OPG and NR Contractors through the daily Project Control Centre (PCC) Meetings and the NR Projects Conventional Safety Alignment Calls.

### 2.1.2.10 Joint Health and Safety Committee

There will not be a NR specific JHSC. Instead, the Darlington Station JHSC will support O&M issues on the islanded units and additional representation is not anticipated to be required. Additional construction regulations training will be sourced and supplied to the Darlington JHSC.

The BTU JHSC will be expanded and will support NR project areas. It will include OPG and BTU co-chairs. This committee will include Contractor Management and BTU voting members.

Additionally, the Worker Trades Committee (WTC) consisting of representatives from all trades on site, with no management representation, will meet a week before the BTU JHSC meetings and will report unresolved issues to BTU JHSC.

The NR H&S department will provide support to all of the JHSC's supporting NR but will not be a member of any of the committees.

### 2.1.2.11 H&S Information Management

Formal H&S Management documentation shall follow OPG-PROG-0001 (Information Management) and N-MAN-00120-10001-RDM (Nuclear Projects Records and Document Management).

### 2.1.3 Health and Safety Management Documents for Program

- Darlington Refurbishment Health and Safety Program Management Plan: NK38-NR-PLAN-09701-10001 Sht: 0005
- Darlington Refurbishment - Safety Management Essentials: N-GUID-09701-10011
- Darlington Refurbishment Program Health and Safety Metrics: NK38-REP-09701-10127
- Conventional Safety - Ownership Transfer Plan: NK38-PLAN-09701-10113 Sht: SFY-01

## 2.2 Program Plan and Key Deliverables

Key dates and deliverables to support the completion of the Program Health and Safety Management Plan are identified in the NR O&M H&S P6 Plan (73018) and include activities that the Program Manager and others will perform to support the plan. The NR O&M H&S P6 Plan is a live plan and is updated on a monthly basis.

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Sheet Number: <b>0005</b>	Revision Number: <b>R002</b>	Page: <b>10 of 14</b>
Title: <b>DARLINGTON REFURBISHMENT HEALTH AND SAFETY PROGRAM MANAGEMENT</b>		

The Nuclear Refurbishment H&S Management System is subject to regular review to ensure compliance with the requirements of NR oversight governance. It is designed to manage, rather than eliminate, the risk of failure to achieve project objectives.

This plan is part of the ongoing process in place to identify, assess, manage, monitor and report health and safety risks.

The Darlington Refurbishment H&S Program Management Plan is a live document, to be maintained by the Program Manager, or delegate. It is to be used as a guideline for reporting to senior management.

### 3.0 ROLES AND ACCOUNTABILITIES

#### 3.1 Director of Corporate Health and Safety

The Director of Corporate Health and Safety is the document owner and is accountable for its definition and implementation.

#### 3.2 Darlington Refurbishment Project Managers

Project Managers are accountable for their project specific Safety Management Plans which will contain the unique requirements for management of H&S risks associated with specific project activities. These plans will provide NR Project Teams and support staff with a clear understanding of the H&S management requirements for the project(s).

#### 3.3 General

All OPG and Contractor employees:

- Have accountability for Health and Safety. This includes making conservative decisions regarding refurbishment operation and construction activities as they relate to the health and safety of our employees and the public.
- Are accountable for performing work safely and for identifying, communicating and, where appropriate, correcting workplace hazards in order to protect themselves, their co-workers and the public from harm.

OPG Nuclear Refurbishment is designated as *Owner/Constructor* and is accountable for the associated roles and responsibilities.

All OPG and Contractor line management are accountable for:

- The health and safety of their employees at OPG workplaces and for ensuring their activities do not harm any employees or the public.
- Ensuring the work environment is designed to protect workers and the public;

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Title: <b>DARLINGTON REFURBISHMENT HEALTH AND SAFETY PROGRAM MANAGEMENT</b>		

- Ensuring that work is planned and performed to protect workers and the public;
- Providing employees with the information, training, tools, procedures and support required to do their job safely and without harming other workers or the public.

Overall, for the Nuclear Refurbishment Program, health and safety is a shared responsibility.

## 4.0 DEFINITIONS AND ACRONYMS

### 4.1 Definitions

*Owner/Constructor* – An Owner is a workplace party who owns a workplace or construction project. Owner/Constructor includes an Owner who undertakes all or part of the project by itself or by more than one employer.

### 4.2 Acronyms

<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>EPC</b>	Engineer, Procure, Construct
<b>ES MSA</b>	Extended Services Master Service Agreement
<b>H&amp;S</b>	Health and Safety
<b>IH</b>	Industrial Hygiene
<b>JHSC</b>	Joint Health and Safety Committee
<b>MoL</b>	Ministry of Labour
<b>NR</b>	Nuclear Refurbishment
<b>OHSA</b>	Ontario Occupational Health & Safety Act and Regulations
<b>O&amp;M</b>	Operations and Maintenance
<b>PCC</b>	Project Control Centre

## 5.0 REFERENCES

NK38-NR-PLAN-09701-10001 Sht 0001: Darlington Refurbishment Program Structure

NK38-PLAN-09701-10269: Darlington Refurbishment Conventional Safety Oversight Plan

NK38-PLAN-09701-10113 Sht SFY-01: Conventional Safety - Ownership Transfer Plan

N-GUID-09701-10011: Darlington Refurbishment - Safety Management Essentials

N-FORM-11623: Safety Management Essentials Gap Analysis Sheets

NK38-PLAN-09701-10007: Darlington Refurbishment - Project Training Work Plan

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N-TQD-510-00001: Supplemental BTU, Direct Hire and Contract Management Training and Qualification Description

N-STD-AS-0030: Project Oversight Standard

NK38-LIST-09701-10001: Project Safety Oversight Criteria

OPG-PROG-0001: Information Management

N-MAN-00120-10001 Sht RMD: Nuclear Projects - Records and Document Management

NR-PLAN-09701-10001 Sht 0005: Darlington Refurbishment Health and Safety Program Management Plan

NK38-REP-09701-10127: Darlington Refurbishment Program Health and Safety Metrics

NR O&M H&S P6 Plan



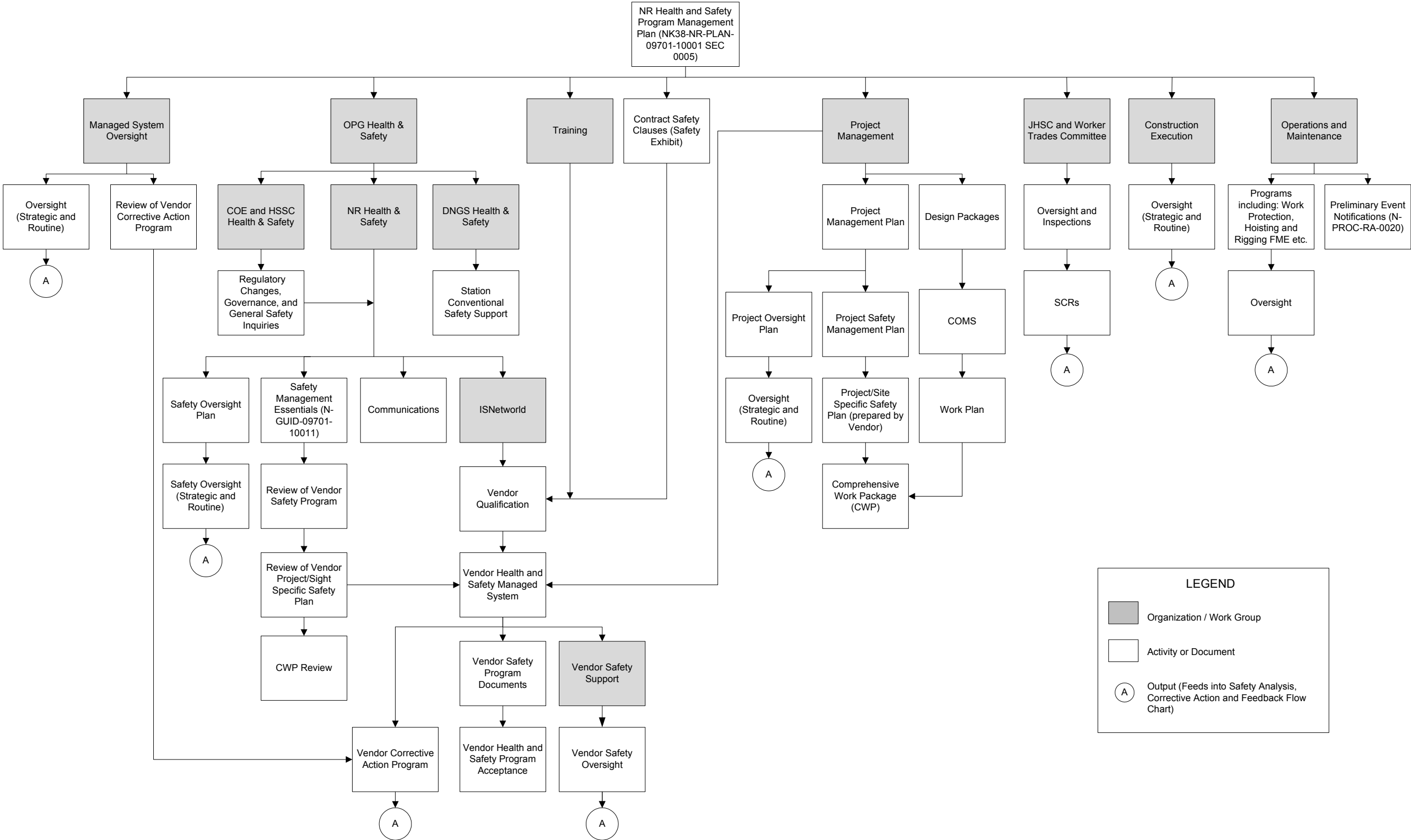


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Appendix A: NR Health and Safety Program Management Plan



LEGEND
 

Organization / Work Group

Activity or Document

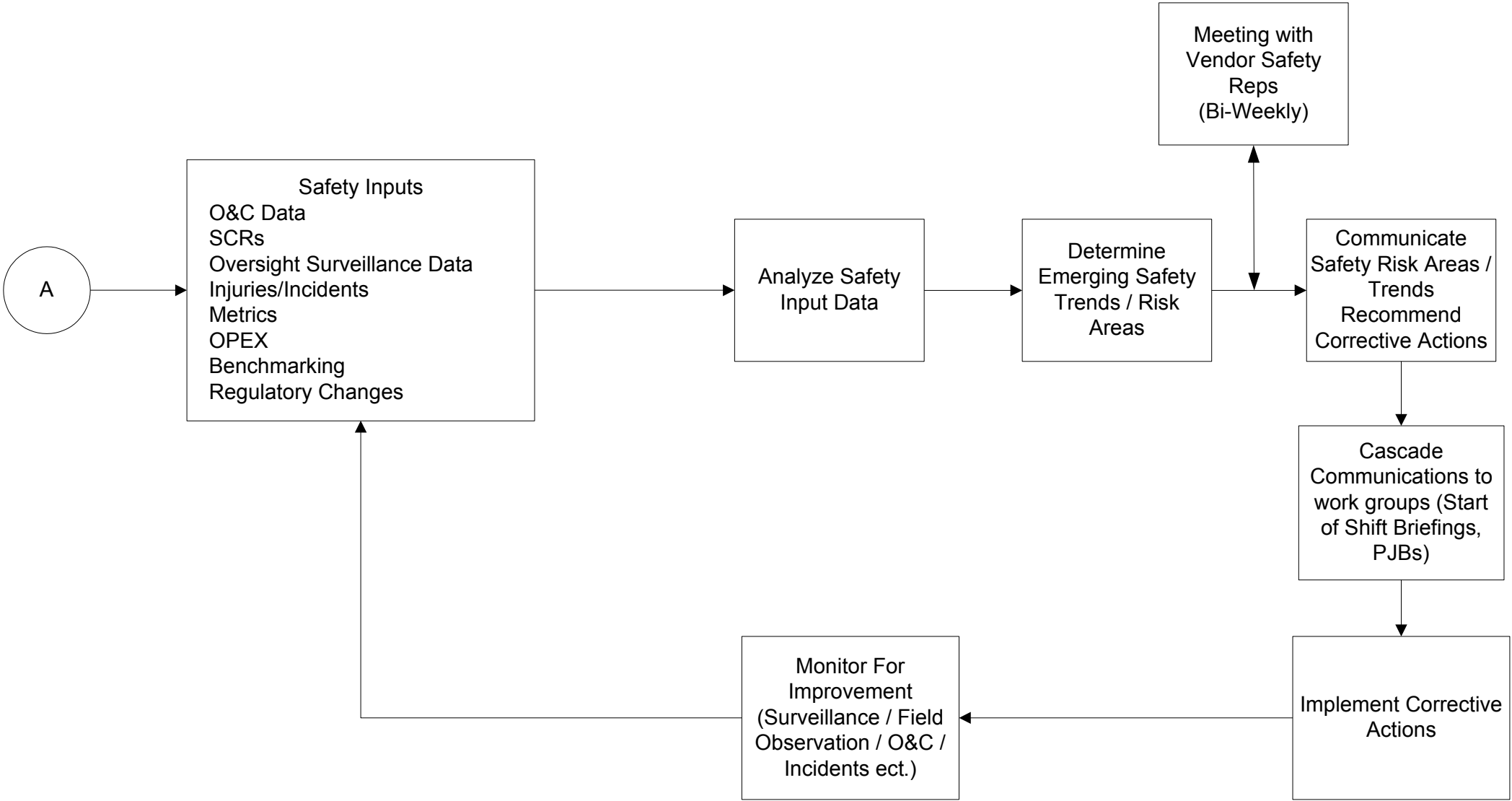
A

 Output (Feeds into Safety Analysis, Corrective Action and Feedback Flow Chart)

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Appendix B: Safety Analysis Corrective Action and Feedback





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Title: <b>DARLINGTON REFURBISHMENT - CHEMISTRY PROGRAM MANAGEMENT PLAN</b>
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**Darlington Refurbishment - Chemistry  
Program Management Plan**

**NK38-NR-PLAN-09701-10001-0006-R003**  
2016-04-04

Order Number: N/A  
Other Reference Number:

**Internal Use Only**

Prepared By: Emily Cornthwaite  
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Concurred By: Roger Daly  
Manager  
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Environment

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Director  
Refurbishment Operations &  
Maintenance

Plan

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**Revision Summary**

Revision Number	Date	Comments
R003	2016-04-04	Update document to address self assessment RF16-000037 finding that there is misalignment in the refurbishment chemistry program documents.

**Records Table**

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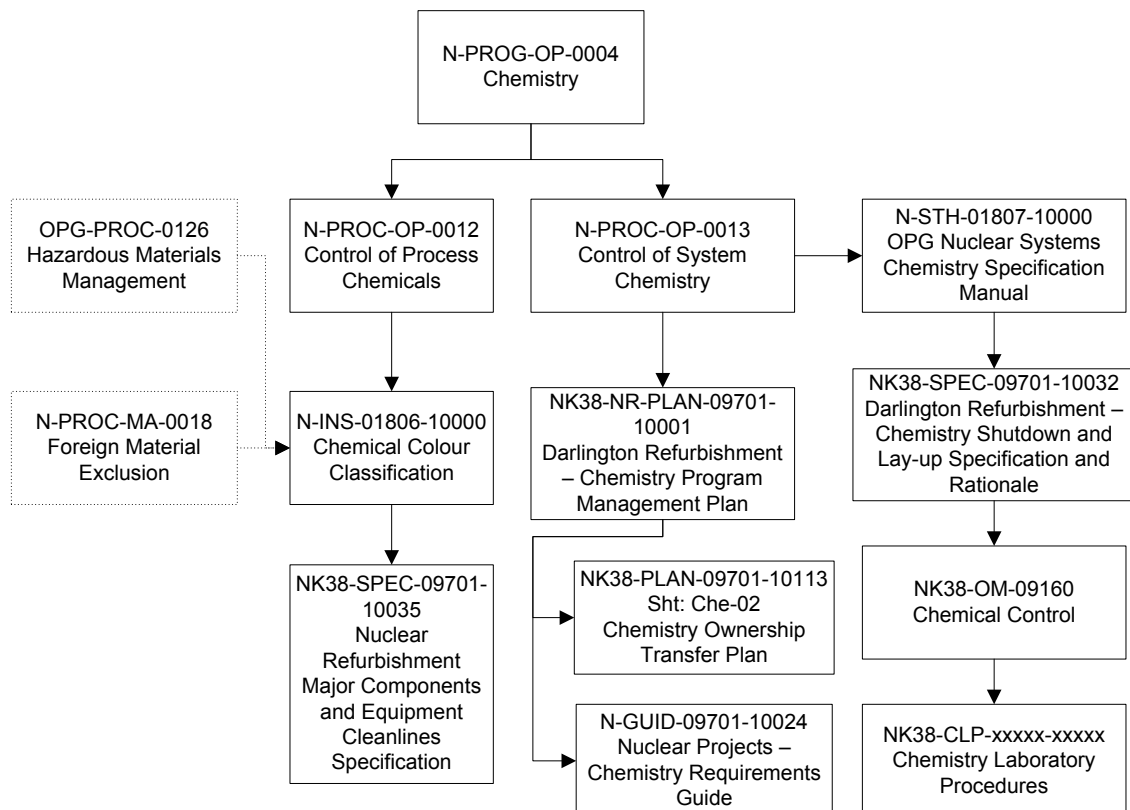
## 1.0 PURPOSE

The NR, Chemistry Program Management Plan (PgMP) confirms that employees working within the Darlington Refurbishment Program will perform their work while conforming to the existing OPG Management System, specifically *Chemistry Program*, N-PROG-OP-0004.

## 2.0 PROGRAM REQUIREMENTS

The NR Chemistry Program will adhere to the Nuclear Chemistry Program (Chemistry Program, N-PROG-OP-0004) which specifies processes, requirements, and staff accountabilities to ensure effective control of plant chemistry, including provision of analytical services and control of chemicals. Furthermore, it is applicable across the OPGN fleet, including the refurbishment units.

NR Technical documentation will require review by NR Chemistry in order to comply with OPG Chemistry Control Program requirements. These document reviews and potential revisions shall follow N-PROG-AS-0001, Managed Systems, N-PROG-AS-0006, Records and Document Control and any other appropriate governance.



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## 2.1 New Governance and supporting documentation specific to the NR Project

The following documents have been prepared or modified to meet the requirements of the NR Chemistry Program.

*Darlington Refurbishment – Chemistry Shutdown and Lay-up Specifications and Rationale*, NK38-SPEC-09701-10032 specifies the shut down and lay-up chemistry specifications, sampling frequencies, and action levels for the refurbishment unit. It is intended to augment specific scenarios / configurations that will occur to support refurbishment activities.

*Darlington Operating Manual Chemistry Control*, NK38-OM-09160 will have refurbishment specific information added to provide decision making criteria to maintain chemistry specifications.<sup>1</sup>

*Nuclear Projects – Chemistry Requirements Guide*, N-GUID-09701-10024 provides an outline of the expectations for NR Project Managers for directing Contractors regarding the Nuclear Chemistry Program. Contractor oversight requirements to meet the objectives of the Project Oversight Plan (POP) are also included in this document.

*Chemistry Ownership Transfer Plan*, NK38-PLAN-09701-10113 Sht: CHE-02 describes the Matrix organization that NR, Chemistry Technical operates within, and how it interfaces with the DNGS Chemistry Laboratory, DNGS Chemistry Technical Department and CWMD.

## 2.2 Goals and Objectives for the NR, Chemistry Technical Department

- Maintain system chemistry during Lay-Up as per OPG NR Specification to ensure the integrity of system components upon RTS by ensuring:
  - Sampling, chemical analysis and data recording are done in a timely manner; and
  - Appropriate Quality Assurance and rigor are applied.
- Prevent a Chemistry Excursion on start-up by ensuring:
  - Cleanliness Specifications are followed during major component maintenance.
- Control the use of consumables and chemical products to ensure;
  - Only approved OPG Chemicals and Chemical Products are used, and
  - Chemical Color Classification requirements are followed to prevent incompatible chemicals from being used on station systems.

<sup>1</sup> Note: this information will be transferred from Refurbishment Chemistry Control, NK38-OM-09701.

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## 2.3 Metrics

The following metrics enable NR Senior Line Management, NR Project Teams and Contractors to identify opportunities for improvement and illustrate successful execution of targets.

- “NR, Chemistry Technical Readiness for Execution Metrics” is used to track the departments’ progress preparing for refurbishment activities. It is updated monthly and is located on the shared drive.
- The “Control of Refurbishment Chemistry Metrics” will be used during the “Execution phase” to track oversight of the NR, Chemistry Program on a system by system basis. It will be updated monthly and is located on the shared drive.
- Additionally NR Chemistry Technical will monitor the WANO CPI for RTS and the hours out of specification will be recorded in EPR.

## 3.0 ROLES & ACCOUNTABILITIES

The Roles and Accountabilities for all NR, Chemistry Program stakeholders are described in detail in the Chemistry Ownership Transfer Plan, NK38-PLAN-09701-10113 CHE-02.

## 4.0 DEFINITIONS & ACRONYMS

### 4.1 Definitions

None

### 4.2 Acronyms

CMWD	Chemistry, Metallurgy and Welding Department
CPI	Chemistry Performance Index
DNGS	Darlington Nuclear Generating Station
EPR	Electronic Performance Reporting
NR	Nuclear Refurbishment
RTS	Return to Service
WANO	World Association of Nuclear Operators



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## **5.0 REFERENCES**

### **5.1 Developmental References**

N-PROG-OP-0004, "Chemistry Program."

N-PROC-OP-0012, "Control of Process Chemicals"

N-PROC-OP-0013, "Control of System Chemistry"

N-PROC-OP-0014, "Chemistry Measurement and Analysis"

N-PROC-OP-0017, "Laboratory Work and Data Management"

N-PROC-MA-0018, "Foreign Material Exclusion"

N-GUID-09701-10024, "Nuclear Projects – Chemistry Requirements Guide"

N-GUID-09701-10011, "Safety Management Essentials"

N-STH-01807-10000 "OPG Nuclear Systems Chemistry Specification Manual"

N-TS-01806.5-100XX (XX = 01 – 42), "Process Chemical Purchase Specifications."

OPG-PROC-0126, "Hazardous Materials Management"

NK38-OM-09160 "Chemical Control"

NK38-OM-09701-R000, "Darlington Operating Manual – Refurbishment: Chemical Control."

NK38-SPEC-09701-10032, "Darlington Refurbishment - Chemistry Shutdown And Lay-up Specifications And Rationale"

NK38-PLAN-09701-10113 CHE-01 R000, "Chemistry & Environment – Ownership Transfer Plan."

NK38-CORR-09701-0466227 T25, "Strategy for Darlington Chemistry Lab Support During Refurbishment",

N-INS-01806-10000, "Chemical Colour Code Classification and Labelling Instruction."

N-INS-07080-10002, "Labelling, Storage, Use and Disposal of Hazardous Materials in the Field."



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Title:

**DARLINGTON REFURBISHMENT LICENSING MANAGEMENT PLAN**

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## **Darlington Refurbishment Licensing Management Plan**

**NK38-NR-PLAN-09701-10001-0007-R002**  
2016-08-30

Order Number: N/A  
Other Reference Number:

**Internal Use Only**

Prepared By:

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Refurbishment Licensing Support

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**DARLINGTON REFURBISHMENT LICENSING MANAGEMENT PLAN**

### Revision Summary

Revision Number	Date	Comments
R002	2016-08-30	Licensing Management Plan was refreshed for minor updates including staffing changes, document updates, etc.
R001	2015-03-06	Licensing Management Plan was revised to incorporate the following: (a) To address observations made in Self Assessment RF14-000625. Section 2 was expanded to incorporate additional specific licensing management requirements and the Licensing process framework.  (b) Additional miscellaneous revisions made to the plan to bring it up to date.
R000	2014-01-29	NK38-PLAN-09701-10067 Sheet 0015 R001 has been superseded by moving its content to this document.  An additional section, Section 2.2, Licensing Basis was added and minor non-intent changes with respect to security classification and document number were made.

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## 1.0 PURPOSE

The purpose of this document is to ensure a clear understanding of the regulatory requirements for the Darlington Refurbishment Program with respect to the Nuclear Safety Control Act and Regulations and the management of the regulatory interface with the Canadian Nuclear Safety Commission (CNSC).

## 2.0 PROGRAM REQUIREMENTS

### 2.1 Nuclear Safety Control Act and Regulations

Under the Nuclear Safety Control Act and Regulations, the Darlington Refurbishment Program is subject to the requirements of all applicable laws and regulations, including the requirements established through the Darlington Nuclear Generating Station (NGS) Power Reactor Operating Licence (PROL).

### 2.2 Licensing Basis

The Refurbishment Licensing Support Department (RLSD) was established within Nuclear Regulatory Affairs to support the definition of the licensing basis specific to refurbishment activities and to ensure communication of the licensing basis such that it is sustained throughout refurbishment. For further information on the current licensing basis for the Darlington station, refer to Part II, Section 1.1 *Licensing Basis for the Licensed Activities*, in the Darlington Licence Conditions Handbook (LCH, [R-1]).

### 2.3 CNSC Communications

All communications with the CNSC, specific to refurbishment, are coordinated by RLSD and reviewed to ensure consistency with the licensing basis and N-PROC-RA-0047. RLSD is also responsible for identifying any requested changes to the licensing basis and confirming that the request is supported by information that meets CNSC expectations.

### 2.4 CNSC Regulatory Approvals and Notifications

RLSD is responsible to support refurbishment project teams in identifying CNSC approvals, acceptances/concurrences and notifications required through all phases of the project. Unit specific approvals, acceptances/concurrences and notifications will be targeted for submission to the CNSC no later than 9 months prior to breaker-open to ensure regulatory certainty for refurbishment activities. It is anticipated that any required approvals would be received 3 months prior to breaker-open. These regulatory milestones are tracked in the Darlington Refurbishment Integrated Master Schedule.

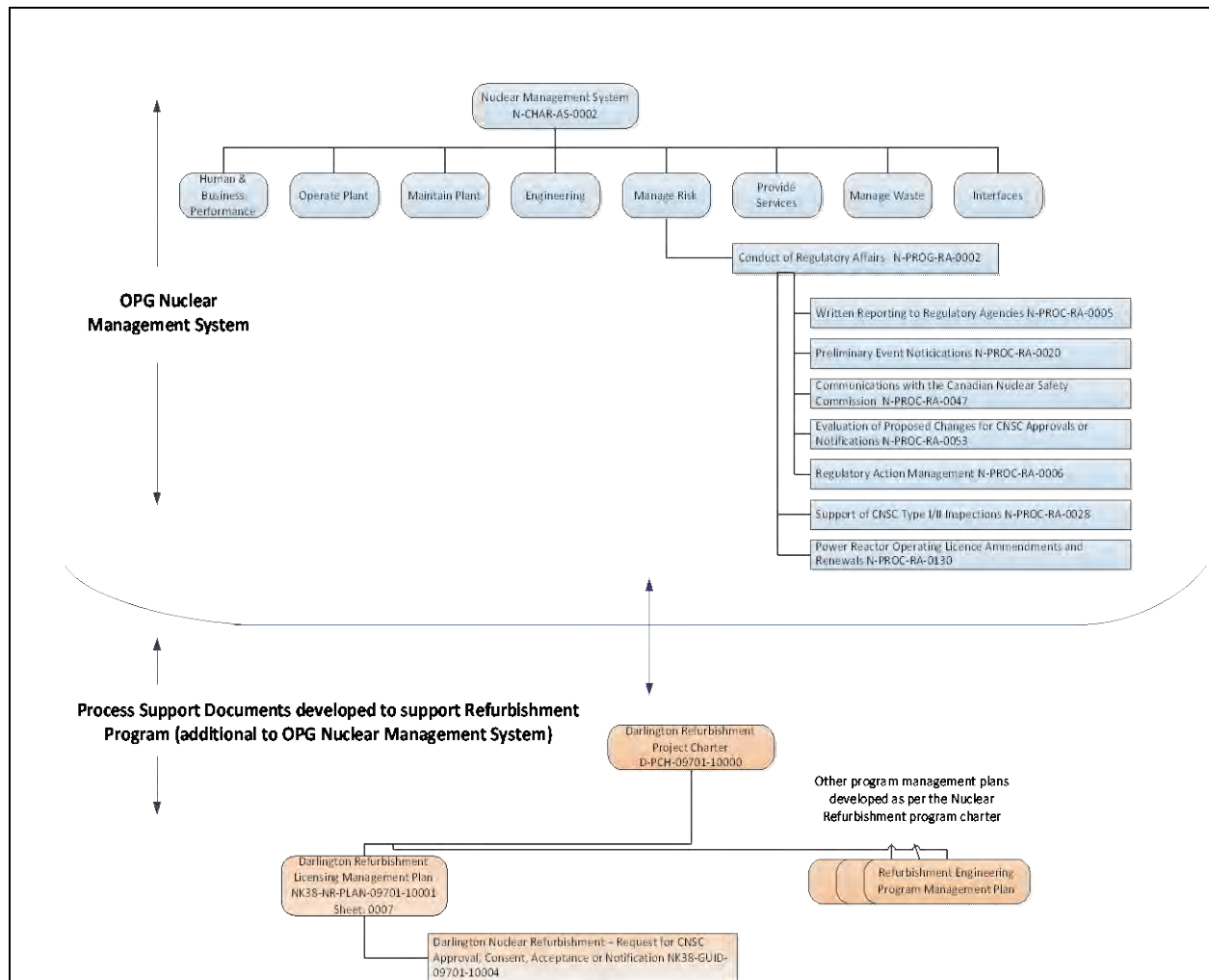
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## 2.5 Licensing Management Plan Process Framework

The Licensing Management Plan process framework, including implementing and interfacing documents, is shown in Figure 1 below.

**Figure 1**  
**Licensing Management Plan Process Framework**



## 2.6 N-PROG-RA-0002, Conduct of Regulatory Affairs

The overall program document governing management of the OPG CNSC interface is N-PROG-RA-0002. This program applies across the OPG Nuclear fleet as well as the Darlington Refurbishment Program. It includes broad guidelines to ensure effective and efficient compliance with regulatory requirements and to ensure open, honest and

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timely communications. This program defines a set of processes to ensure these expectations are met.

**2.7 NK38-GUID-09701-10004, Darlington Nuclear Refurbishment – Request for CNSC Approval, Consent, Acceptance or Notification**

The purpose of this guide is to clarify the requirements for the Darlington Refurbishment Program in determining when CNSC approval, consent, acceptance or notification is required. Guidance is also provided to understand the deliverables needed to support such requests.

This guide is applicable to all changes to the licensing basis, including changes to plant design, the processes used by OPG to operate and maintain the plant, and qualifications and complement of personnel necessary to ensure safe operation of the plant.

**2.8 N-PROG-RA-0015, Nuclear Safeguards**

Safeguards equipment installed in the Darlington NGS is subject to the requirements outlined in N-PROG-RA-0015, Nuclear Safeguards, and its implementing standard N-STD-RA-0024, Nuclear Safeguards Implementation.

**2.9 Performance Indicators**

**2.9.1 Metrics**

In addition to Departmental Event Free Resets, Regulatory Affairs Departments use a consistent set of performance indicators as outlined below as per N-PROG-RA-0002. The metrics are for quality of CNSC submissions and commitment management. They are tracked monthly and are used to identify and correct unsatisfactory performance.

Quality of CNSC Submissions:

- (a) Correspondence errors after submission (error requiring a retraction or correction letter).
- (b) Correspondence near miss errors caught prior to submittal (errors caught during final signatory review that could have required a retraction or correction letter).

Commitment Management:

Missed Regulatory Obligations (REGO) and Regulatory Commitments (REGC).

Number of occasions when the REGO, REGC, or Regulatory Management Action (REGM) committed date required a change.



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### 2.9.2 Metric Development

Additional performance indicators for the Darlington Refurbishment Program are in development and will be in use for refurbishment execution.

## 3.0 ROLES AND ACCOUNTABILITIES

This section briefly and succinctly describes the scope and responsibilities of the Stratum IV and V positions related to the implementation of this document.

### 3.1 Vice President, Nuclear Regulatory Affairs and Stakeholder Relations

The Vice President of Nuclear Regulatory Affairs and Stakeholder Relations performs the following roles and accountabilities specific to the Darlington Refurbishment Program:

- Provides oversight of the regulatory interface, compliance with regulatory requirements and regulatory issue resolution.
- Establishes expectations for all Regulatory Affairs Departments (Pickering, Darlington, Nuclear Waste and Nuclear Refurbishment).
- Coordinates activities for licence amendments and renewals.

### 3.2 Regulatory Affairs Managers

As the *Designated Licensing Authority* (DLA), OPG Regulatory Affairs Managers are responsibilities include:

- Ensure compliance with Nuclear Safety & Control Act and regulatory requirements.
- Identify and report on key regulatory matters to stakeholders.
- Provide advice and support on the management and resolution of regulatory issues.
- Interpret specific regulatory and legislative requirements.
- Ensure regulatory commitments are identified, assigned, and monitored to completion.
- Coordinate OPG appearances at CNSC public meetings and public hearings.
- Manage all verbal and written communications with the CNSC.
- Assess impacts of licence and permit applications and amendments.

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- Manage the interface with the CNSC.
- Coordinate timely receipt for regulatory approvals, concurrences/acceptance and notifications.

### 3.3 Manager, Nuclear Refurbishment Licencing Support

The Manager, Nuclear Refurbishment Licencing Support is the owner of this document and is accountable for its definition and implementation. In addition to the generic accountabilities identified in Section, 3.2, this position is also accountable to:

- Act as the *Designated Licensing Authority (DLA)* for the CNSC for Refurbishment during Refurbishment planning, preparation, and execution on the first unit.
- For Refurbishment submissions requiring signature of the Site Vice President, Darlington Nuclear, prepare and/or review and route submissions to the Darlington Regulatory Affairs Department (DRAD) for processing.
- Support refurbishment project teams in identifying regulatory approvals and notifications required through all phases of the project, developing strategies to obtain the required approvals and coordinate the application for approvals.
- Coordinate with DRAD as required to ensure no negative regulatory impact on Darlington NGS is introduced through refurbishment licensing activities.
- Support DRAD applications for licence renewals or amendments.
- Ensure the CNSC is informed of project status and needs through routine meetings with the CNSC Project Manager and CNSC Senior Management as well as focused meetings with the CNSC specialist organizations.
- Meet with the CNSC site supervisor, as required, to provide updates on project status.

### 3.4 Manager, Darlington Regulatory Affairs

In addition to the generic accountabilities identified in Section 3.2, the Darlington Regulatory Affairs Manager is also accountable to:

- Act as *DLA* for the CNSC for Darlington NGS and, post first unit return to service, for Darlington Refurbishment.
- Complete and issue all unscheduled reports for non-islanded units and scheduled reports to the CNSC in accordance with REGDOC 3.1.1 [R-2]. The responsibility for unscheduled reports on islanded units has been determined and documented in [R-3].

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- Prepare requests for renewal of, and amendments to, the station's operating licence(s).
- Act as the *DLA* for the CNSC for all changes to the LCH except for notifications of changes to nuclear level documents.
- Control revisions to Operating Policies and Principles.

### 3.5 Darlington Refurbishment Function Managers

Function Managers are accountable for understanding and complying with the program requirements as described in Section 2 and providing status updates to CNSC staff, as required.

### 3.6 Darlington Refurbishment Project Managers

Project Managers are accountable for understanding and complying with the program requirements as described in Section 2 and providing status updates to CNSC staff, as required. Project Managers are also responsible for ensuring contractors are aware of these requirements.

### 3.7 Darlington Fuel Handling Manager

The Darlington Fuel Handling Manager ensures the site safeguards program is adhered to and appoints a responsible system engineer as the licensed facility Safeguards Officer. The Safeguards Officer is the single point of contact with the CNSC and the International Atomic Energy Agency on informal communications, and as a minimum, reviews all formal safeguards site communications.

## 4.0 DEFINITIONS & ACRONYMS

### 4.1 Definitions

***Designated Licensing Authority (DLA)*** is the position designated as being accountable for providing licensing support to the Designated Representative of the Licensee.

### 4.2 Acronyms

<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>DLA</b>	Designated Licensing Authority
<b>DRAD</b>	Darlington Regulatory Affairs Department
<b>LCH</b>	Licence Conditions Handbook
<b>NGS</b>	Nuclear Generating Station
<b>OPG</b>	Ontario Power Generation
<b>PROL</b>	Power Reactor Operating Licence
<b>REGDOC</b>	Regulatory Document
<b>RLSD</b>	Refurbishment Licensing Support Department

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## 5.0 REFERENCES

- [R-1] LCH-DNGS-R000, Licence Conditions Handbook, Darlington Nuclear Generating Station, Nuclear Power Reactor Operating Licence PROL 13.00/2025.
- [R-2] Regulatory Document REGDOC 3.1.1, "Reporting Requirements for Nuclear Power Plants", May 2014.
- [R-3] NK38-PLAN-09701-10113-LIC-01, Licensing - Ownership Transfer Plan
- [R-4] NK38-GUID-09701-10004, Darlington Nuclear Refurbishment – Request for CNSC Approval, Consent, Acceptance or Notification
- [R-5] N-PROC-RA-0005, Written Reporting to Regulatory Agencies
- [R-6] N-PROC-RA-0006, Regulatory Action Management
- [R-7] N-PROC-RA-0020, Preliminary Event Notification
- [R-8] N-PROC-RA-0028, Support of Canadian Nuclear Safety Commission Type I/II Inspections
- [R-9] N-PROC-RA-0047, Communications with the Canadian Nuclear Safety Commission
- [R-10] N-PROC-RA-0053, Evaluation of Proposed Changes for Canadian Nuclear Safety Commission Approval or Notification
- [R-11] N-PROC-RA-0130, Power Reactor Operating Licence Amendments and Renewals
- [R-12] N-PROC-RA-0002, Conduct of Regulatory Affairs
- [R-13] N-PROC-RA-0015, Nuclear Safeguards
- [R-14] N-STD-RA-0024, Nuclear Safeguards Implementation



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**ENGINEERING PROGRAM  
MANAGEMENT PLAN**

**NK38-NR-PLAN-09701-10001 SHT-0008-  
R002**  
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### Revision Summary

Revision Number	Date	Comments
R000	2014-01-31	<p>This document supersedes NK38-PLAN-09701-10067 Sheet 0010. The changes between NK38-PLAN-09701-10067 Sheet 0010 and this document are as follows:</p> <ul style="list-style-type: none"> <li>• The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001.</li> <li>• The security classification has been removed so that the document can be submitted to the CNSC, and</li> <li>• References have been updated.</li> </ul>
R001	2015-08-18	<p>This document was substantially updated to align with Nuclear Refurbishment Engineering Functional Management Plan NK38-PLAN-09701-10223 SHT 004 and to meet requirements established in Darlington Refurbishment Program Structure NK38-NR-PLAN-09701-10001 SHT 0001.</p>
R002	2016-09-19	<p>This document was updated to represent the changes in the Engineering organization.</p>

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### 1.0 PURPOSE

The Engineering Program Management Plan (PgMP) describes how Engineering will manage the engineering of Refurbishment projects. It establishes a framework for the management of engineering by Engineering and Contractors in accordance with expectations established by the Chief Nuclear Engineer and defined goals, objectives and expectations for the Nuclear Refurbishment Program.

This PgMP obtains its authority from D-PCH-09701-10000, Darlington Refurbishment Charter, and aligns with Nuclear, Corporate, and other business unit governance. The Engineering PgMP is part of a framework of process support documentation established in NK38-NR-PLAN-09701-10001 SHT 0001, Darlington Refurbishment Program Structure. The Refurbishment Engineering Functional Management Plan NK38-PLAN-09701-10223, sht 004 supports the PgMP and provides additional detail.

### 2.0 PROGRAM REQUIREMENTS

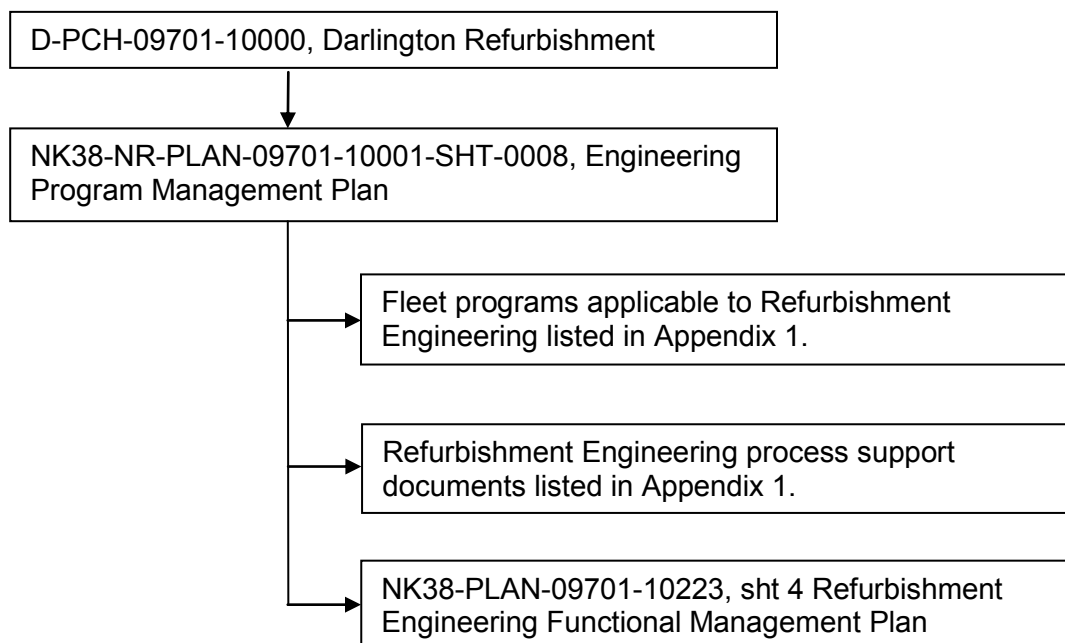
Engineering is governed by requirements established for the OPG Nuclear fleet as defined in the engineering programs specified in Appendix 1. These programs apply to Refurbishment design activities, and to Structures, Systems and Components (SSCs) that have been turned over to Engineering. Engineering also uses process support documents that are specifically created for the Darlington Refurbishment Program (DRP) listed in Appendix 1. NK38-PLAN-09701-10223, sht 004 Refurbishment Engineering Functional Management Plan provides the framework and overall direction for Engineering.



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**Figure 1 Hierarchy of Engineering Governing and Process Support Documentation**



## 2.1 Fleet Engineering Programs Applicable to Engineering

The OPG Nuclear fleet engineering programs that are applicable to Engineering are listed in Appendix 1. The fleet requirements apply to Engineering in two ways as noted in the Appendix.

- Engineering design work in collaboration with Engineer, Procure, Construct (EPC) Contractors
- Engineering support work that occurs on SSCs while they are turned over to the Refurbishment organization

Additional requirements and processes that are unique to Engineering are listed in Appendix 1.

Engineering will execute engineering work within the governance structure and expectations set out by the OPG Chief Nuclear Engineer. Engineering governance may be developed to interpret and apply OPG governance in the refurbishment context. EPC contractor governance will be applied to EPC work only after Engineering has confirmed the Contractor governance meets the requirements of OPG governance as per Contract Owner Interface Requirements (COIR) for Nuclear, N-COI-00120-00001).

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## **2.2 Performance Measurement and Reporting**

Performance measures are used to assess the extent to which performance is achieving the intended targets. If targets are at risk of not being met, corrective action is taken. As defined in NK38-NR-PLAN-09701-10001 sht 0002, Darlington Refurbishment Planning and Controls Program Management Plan, a set of standard reports are produced for communicating program and project level performance to various stakeholders. A project status report provides a visual tool to quickly identify areas of good and poor performance in each focus area.

Engineering has implemented performance measures and reporting for the areas of engineering completion, performance of engineering, project engineering, event free day reset, engineering contractors' performance, and corrective action performance. Details of these performance measures are discussed in NK38-PLAN-09701-10223, sht 004 Nuclear Refurbishment Engineering Functional Management Plan.

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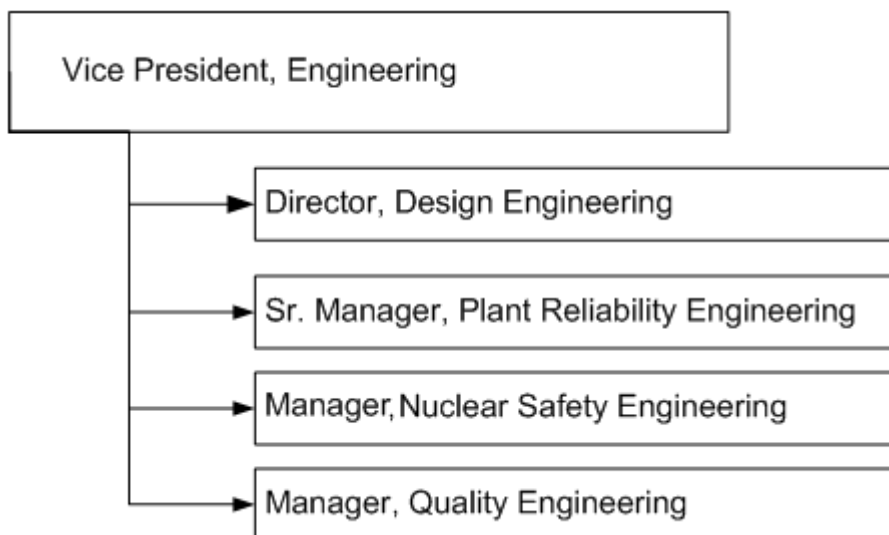
### 3.0 ROLES AND ACCOUNTABILITIES

Engineering executes engineering work within the governance structure and expectations set out by the Chief Nuclear Engineer as per N-STD-MP-0024, Engineering and Design Authority. The Chief Nuclear Engineer delegates Engineering Authority to VP, Engineering and delegates Refurbishment Design Authority to Director, Design Engineering.

#### 3.1 Organization and Responsibilities

Within Engineering, there are two Divisions and two Departments; who together are collectively responsible to deliver engineering products and provide engineering Oversight to support the Project Execution teams.

**Figure 2: Engineering Organization**



**Note:** NK38-GUID-01900-10003, Engineering Interface Requirements, provides additional clarity on individual roles and responsibilities in NR Engineering.

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### **3.1.1 Vice President, Engineering**

The Vice President, Engineering is the Engineering Authority for all refurbishment project related activities.

Accountabilities for the Vice President, Engineering are defined in the role document N-MAN-08131-10000 SHT S5-0120, Vice President Engineering. Of note, the VP Engineering acts as Engineering Authority for Engineering as prescribed by N-STD-MP-0024, Engineering and Design Authority.

### **3.1.2 Director, Design Engineering Division**

The Director, Design Engineering is the Design Authority for all refurbishment project related activities.

The Design Engineering Division provides functional and modification support for the overall refurbishment project, including Campus Plan and Safety Improvement Opportunity (SIO) projects. A focused design engineering support is also provided for the RFR project.

#### **3.1.2.1 Design Authority**

Design Engineering provides the design function for Nuclear Refurbishment, including the role of Design Authority.

As defined in N-STD-MP-0024, Engineering and Design Authority, the Chief Nuclear Engineer delegates Refurbishment Design Authority to Director, Design Engineering, who is responsible for design control and design change management. Design Authority also approves all permanent and temporary design changes such that no change renders inaccurate the descriptions and analyses in the safety report or any document listed in the licensing basis. Additionally, Design Authority responsibilities for modifications include authorization of Design Plans and Modification Design Requirements, approval of Modification Outline and Non-Identical Component Replacement packages, acceptance of Design Completion Assurance Verification Review declarations, approval of Design Engineering Change releases as applicable, and approval of Modification Available for Service declarations. Modification Outlines require Design Authority approval of the design, and Director of Operations and Maintenance approval for the installation.

### **3.1.3 Sr. Manager, Plant Reliability Engineering Division**

The Sr. Manager, Plant Reliability Engineering ensures that all system and component activities and programs are implemented in compliance with all applicable codes, standards, license requirements and OPG governance for SSCs to validate operation within the Safe Operating Envelope, Design Basis, and Licensing Basis and to

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demonstrate that appropriate margins exist and can be sustained. These programs include the implementation of Life Cycle Plans, Periodic Inspection Programs and In-Service Inspection Programs during the Nuclear Refurbishment Project.

Plant Reliability Engineering accountabilities are as follows:

1. System Engineering and Components & Equipment departments provide functional systems and component engineering support to DRP projects along with matrix engineering resources to the project execution teams as defined in D-INS-09701-10004, Nuclear Refurbishment System Engineering Roles and Responsibilities.
2. System Engineering and Components & Equipment departments provide engineering leads to the DRP projects.
3. Components and Equipment department provides Major Components programmatic requirements support for all major components.
4. The Component and Equipment Engineering department interfaces and ensures alignment among DRP, the central Components Engineering Division and the Darlington Station Components department. The System Engineering department interface and ensures alignment among DRP and Station Performance Engineering.
5. The Return to Service (RTS) Engineering department provides engineering support for modification commissioning, Available for Service (AFS), System Available for Service (SAFS), Construction Completion Declaration (CCD), and the Restart Control Hold Points (RCHP's). This department also interfaces and ensures alignment with DRP Return to Service.

#### **3.1.4 Manager, Nuclear Safety Engineering Department**

The Manager, Nuclear Safety Engineering Department is accountable for:

1. Procurement of services for:
  - a. Nuclear Safety Analysis Department which provides support to the DRP by providing Outage Safety Assessments and Analysis, Deterministic Safety Analysis and Probabilistic Safety Analysis associated with the modifications and operations evolutions. Additionally, Nuclear Safety Analysis provides Reactor Safety support of the modification program and the maintenance and inspection programs for the refurbishment outage.

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- b. All nuclear design assists safety analysis, either directly or through verifying and accepting Contractor work.
- c. Refurbishment outage unit system reliability systems testing (SRST) scheduling and review, along with fault tracking and reporting in support of the S-98 Annual Reliability Report.

### **3.1.5 Manager, Quality Engineering Department**

The Manager, Quality Engineering Department is accountable for process improvements to EPC contractor interfaces, overall Engineering Quality improvements, Quality Engineering dashboard, prepare/approve applicable NR Engineering governance, Station Condition Record and Corrective Action Programs, self assessments, benchmarking, operating experience reviews, Quality Surveillance, Human Performance improvement, training coordination support and management/oversight of the Integrated Implementation Plan (IIP). Quality Engineering is the primary interface between Nuclear Engineering Governance and Engineering to ensure that the unique needs of the DRP are being considered in the creation or ongoing revision of engineering process support documents. In addition, Quality Engineering is accountable for the creation of any process support documents required to provide program specific direction for implementation of engineering requirements in the EPC environment of Nuclear Refurbishment.

NK38-PLAN-09701-10218, Darlington Refurbishment Quality Engineering Plan, defines the processes, roles and responsibilities of the Quality Engineering function. This document provides an overview of the scope of the Quality Engineering function and the methods used to implement Quality Engineering processes and programs throughout the refurbishment life cycle.

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## **4.0 DEFINITIONS AND ACRONYMS**

### **Definitions**

DRP is the Darlington Refurbishment Program which is being executed by the “Nuclear Refurbishment” organization. Consequently the acronym NRP for Nuclear Refurbishment Program is sometimes also used to refer to the DRP.

### **Acronyms**

DNGS	Darlington Nuclear Generating Station
DRP	Darlington Refurbishment Program
EFDR	Event Free Day Reset
EPC	Engineer, Procure, Construct
FMP	Functional Management Plan
NR	Nuclear Refurbishment
NRP	Nuclear Refurbishment Program
OPG	Ontario Power Generation
PgMP	Program Management Plan
RFR	Retube and Feeder Replacement
SSC	Structure, System, or Component
IIP	Integrated Implementation Plan

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## 5.0 REFERENCES

- D-PCH-09701-10000, Darlington Refurbishment Charter
- NK38-NR-PLAN-09701-10001 SHT-0001, Darlington Refurbishment Program Structure
- NK38-PLAN-09701-10223, SHT 004 Refurbishment Engineering Functional Management Plan
- NK38-PLAN-09701-10218 , Darlington Refurbishment Quality Engineering Plan
- D-INS-09701-10004, Nuclear Refurbishment System Engineering Roles And Responsibilities
- NK38-PLAN-09701-10113 SHT ENG-02, Refurbishment Design Engineering Ownership Transfer Plan
- N-STD-MP-0024, Engineering and Design Authority
- NK38-PLAN-06700-10001, Darlington Nuclear Refurbishment - Integrated Human Factors Engineering Program Plan
- N-PROG-MP-0001, Engineering Change Control Program
- N-PROC-MP-0090, Modification Process
- OPG-INS-08173-0001, Supplier Performance Monitoring and Scorecarding
- N-MAN-08131-10000 SHT S5-0120, Vice President Refurbishment Engineering
- NK38-NR-PLAN-09701-10001 Sht 0002, Darlington Refurbishment Planning and Controls Program Management Plan
- N-INS-09030-10002, Site and Department Level Event Free Day Resets



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### Appendix A: Fleet Governance and Process Support Documents<sup>1</sup> applicable to Nuclear Engineering

The following table lists fleet governance and Engineering process support documentation. Fleet governance is listed upfront followed by process support documentation that is specific to Engineering.

Document Number	Document Title	Applicable to Fleet (including Engineering) or Engineering specific	Applicability to Engineering
N-PROG-MA-0013	Welding	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	This program establishes controlled processes and standardized welding practices to safely and efficiently make sound welds that meet safety, structural integrity, code, and licensing requirements.
N-PROG-MA-0016	Fuel	Fleet. Applies to SSCs while they are turned over to Refurbishment.	This program establishes a formal and systematic process in OPG Nuclear for integrating and reviewing information related to fuel, and reporting its performance, condition, and compliance with fuel design basis documents.
N-PROG-MA-0017	Components and Equipment Surveillance	Fleet Applies to SSCs while they are turned over to Refurbishment.	This document describes the program elements that establish a focused surveillance monitoring process component and equipment health including inspection, maintenance, certification, and testing. It includes both component health and program management aspects. Important interfaces with other engineering programs that can affect component and equipment health are also identified. Implementation of these program requirements provides a consistent methodology for performing component and equipment surveillance for select components at all OPG sites.
N-PROG-MA-0025	Major Components	Fleet. Applies to SSCs while they are turned over to Refurbishment.	This program establishes a formal and systematic process in OPG Nuclear, for managing information related to four major component areas: Feeders, Steam Generators, Fuel Channels and Reactor Components and Structures. This program provides a framework for integrating and reviewing existing governance and reporting of the component performance, condition, and compliance with design basis documents. This hierarchy of documents, procedures, and other governance ensures the four major components perform safely and reliably over the life of the stations maintaining the design and licensing basis and the operational safety requirements while

<sup>1</sup> Additional documents are generated as the need is identified

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Document Number	Document Title	Applicable to Fleet (including Engineering) or Engineering specific	Applicability to Engineering
			optimizing production and cost-effectiveness.
N-PROG-MA-0026	Equipment Reliability	Fleet Applies to SSCs while they are turned over to Refurbishment.	This program ensures ongoing high levels of reliable performance of components important to nuclear safety, production, and environmental protection. Reliable performance means component failures are infrequent, degraded equipment condition is minimized, and redundancy is maintained on key systems. This is achieved by adopting the Institute of Nuclear Power Operations Equipment Reliability Process Description, AP 913.
N-PROG-MP-0001	Engineering Change Control	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	This program establishes the processes for plant modification from the engineering change request through installation, commissioning, and closeout. The Engineering Change Control program defines a systematic process and methodology for controlling design modifications to plant SSCs. The Engineering Change Control process systematically controls design changes from inception to design package completion, ensuring that they are designed, installed, commissioned, and placed in service within the Safe Operating Envelope, design bases, and plant licensing conditions.
N-PROC-MP-0005	Configuration Management	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	This program ensures OPG Nuclear facilities are operated, maintained, and modified in conformance with their design and licensing basis. It applies to: (a) Facility physical configuration, supporting hardware, and software, including: station SSCs, waste management facilities, training simulators, engineered tools, nuclear fuel, and station process computers (b) Policies, programs and procedures which contain information that could impact the design and licensing basis, physical configuration, or any configuration item or information. (c) Staff that support operation and preservation of OPG assets including contract service providers.
N-PROG-MP-0006	Software	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	This program identifies the processes and overall requirements for an effective software program that supports safe and efficient plant operation. It complies with N286-05, Management System Requirements for Nuclear Power Plants and N286.7-99, Quality Assurance of Analytical, Scientific, and Design Computer Programs for Nuclear Power Plants. This program applies to software classified as a) Real-Time Process Computing, b) Scientific, Engineering and Safety Analysis Software or c) Software Engineering Tools in OPG

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Document Number	Document Title	Applicable to Fleet (including Engineering) or Engineering specific	Applicability to Engineering
			Nuclear. This program identifies processes and overall requirements for classification of software and identifies governing standards for each software classification defining requirements for software development, maintenance, procurement, qualification, use and retirement including security of Real-Time Process Computing critical cyber assets.
N-PROG-MP-0007	Conduct of Engineering	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	This program, and interfacing engineering programs, standards, and procedures are consistent with the expectations established in: N-CHAR-AS-0002, Nuclear Management System N-POL-0001, Nuclear Safety Policy Codes and standards of record, including those of the Canadian Standards Association Applicable regulatory and statutory requirements, including those of the Canadian Nuclear Safety Commission Guidelines of the Institute of Nuclear Power Operations and the World Association of Nuclear Operators. This program establishes a series of requirements, standards and procedures for performing engineering activities in a consistent manner to ensure plant configuration is maintained in accordance with the design and licensing bases and operated within the Safe Operating Envelope. It establishes the engineering management expectations relative to the engineering safety culture necessary to protect the assets.
N-PROG-MP-0008	Integrated Aging Management	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	This program establishes requirements for the timely detection and mitigation of significant aging effects in structures, systems and components important to plant safety, reliability and economics. It provides the sound technical basis for the achievement of design life and possible life extension. It defines requirements for Plant condition assessments of Darlington SSCs.
N-PROG-MP-0009	Design Management	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	This program provides the framework for assurance that design and procedure changes to nuclear stations are introduced in a manner consistent with the plant design and licensing bases. The design management process, initiated under the control of Engineering Change Control, defines requirements for design planning, identifying design inputs, generating requirements for design

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			change, translating design inputs into design outputs and verifying design outputs against requirements. This program applies to activities, including design and procedure change activities, required to maintain plant design bases and design outputs within approved safety margins and regulatory requirements.
N-PROG-MP-0011	Procurement Engineering	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	Procurement Engineering shall establish requirements for a managed process of creating procurement specifications for materials, systems, components, and services. The Procurement Engineering function is to specify clear and adequate procurement requirements. The Procurement Engineering activities shall interface with other programs within the procurement chain in order to ensure purchased items perform their intended end-use design function(s).
N-PROG-MP-0014	Reactor Safety Program	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	This program defines organizational responsibilities and key program elements for the management of issues related to Nuclear Safety Analysis, in particular Generic Action Items, and the following major components of safe operation: Safety Analysis Basis (Safety Report and Analysis of Record) Safe Operating Envelope Severe Accident Management
N-PROG-OP-0004	Chemistry	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	The purpose of this program is to specify processes, requirements, and staff accountabilities to ensure effective control of plant chemistry, including provision of analytical services. This includes: <ul style="list-style-type: none"> <li>• Identification of issues or conditions that may impact on chemistry control performance</li> <li>• Maintenance of specifications for chemistry control</li> <li>• Control of laboratory methods</li> <li>• Sampling and analysis</li> <li>• Data management</li> <li>• Application of actions to maintain or restore chemistry control</li> <li>• Performance monitoring, including data review</li> <li>• Control process chemical quality</li> </ul>
N-PROG-RA-0006	Environmental Qualification	Fleet. Applies to design work and to SSCs while they are turned over	This program establishes an integrated and comprehensive set of requirements that provide assurance that essential equipment can perform as required if exposed to harsh Design Basis Accident conditions and this capability is preserved over the life of plant units.

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		to Refurbishment.	The program provides consistent methodology, programmatic controls, and interfaces for establishing and maintaining environmental qualification of equipment and components at OPG Nuclear generating stations.
N-PROG-RA-0016	Risk and Reliability Program	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	The purpose of the program is to provide organizational accountabilities, interfaces, and key program elements to ensure that risks from nuclear accidents are identified, monitored and controlled consistent with OPG Nuclear Safety Policy, Nuclear Management System and best practice in the industry.
N-COI-00120-00001	Contractor, Owner Interface Requirements for Nuclear	Fleet Applies to design work.	The purpose of the COIR is to facilitate the successful implementation of work at OPG Nuclear by ensuring that Engineering, Procurement, and Construction activities are in conformance with OPG and regulatory requirements.
N-STD-AS-0031	Field Engineering	Fleet. Applies to design work and to SSCs while they are turned over to Refurbishment.	This program describes Quality Control and Quality Surveillance processes that ensure services provided by Field Engineering comply with requirements of Canadian Standards Association CSA N286-05, Management System Requirements for Nuclear Power Plants. This program applies to construction and modification work where Field Engineering performs Quality Control and Quality Surveillance activities. This program does not apply to Pressure Boundary activities that must meet the requirements of CSA N285.0, General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants. The Pressure Boundary activities shall be performed in accordance with N-PROG-MP-0004, Pressure Boundary.
D-GUID-01920-10000	Guideline for Engineering Oversight	Engineering specific	This guideline communicates best practices and lessons learned from both internal and external nuclear projects to assist Engineering staff in identifying and specifying adequate engineering oversight activities using a graded approach based on the engineering risks.
D-GUID-09701-10004	Engineering Product Review	Engineering specific	A quarterly review of engineering products will be conducted as a self assessment using a cross functional engineering team as per D-GUID-09701-10004, Engineering Product Quality Review. The results of these self assessments will be reviewed at the Engineering Review Board with corrective actions assigned for adverse events or trends. Modifications are not included, as there is a standing mature process for reporting, trending and correcting of EC metrics.
N-GUID-00700-	Desktop Guide for the	Engineering specific	This guide ensures consistency when preparing Needs Documents

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10002	Preparation for a Needs Document		for Darlington Refurbishment as derived from the DSR. The Needs Document should be issued in Asset Suite and referenced in the Engineering Change Request (ECR). This document is not part of the governing hierarchy. It is a guideline published to aid in producing high quality Needs Documents as a supplement to N-PROC-MP-0090. N-PROC-MP- 0090 contains the authority.
N-GUID-01920-10000	Guide for Engineering Oversight	Engineering specific	This guideline communicates best practices and lessons learned from both internal and external nuclear projects to assist OPGN Engineering staff in identifying and specifying adequate engineering oversight activities using a graded approach based on the engineering risks.
N-GUID-09701-10020	Nuclear Refurbishment Commissioning Process	Engineering specific	Describes the commissioning process to be followed for new and/or modified SSCs during the restart program of each Darlington unit following the completion of refurbishment. Commissioning requirements for refurbishment projects are similar to those of a new build, as commissioning of modifications, commissioning of new SSCs and re-start of systems must all be coordinated with a start-up schedule that basically follows the schedule of a new build.
N-GUID-09701-10021	Nuclear Refurbishment Construction Completion Declaration	Engineering specific	This instruction describes the Construction Completion Declaration (CCD) Process and requirements to be followed for SSCs during the refurbishment of each Darlington unit following the completion of construction/installation activities performed on a given system. It provides the basis as to why the process is described as it is, the responsibilities of key personnel involved in the process, the forms to be used to provide proper documentation of construction completion, and the record keeping requirements.
N-QG-403-00001	Nuclear Safety Reactor Safety Engineering Qualifications Guide Description	Engineering specific	This QG is specifically applicable to Nuclear Safety Reactor Safety Engineering staff at OPGN. The information presented in this document includes duty area qualifications and continuing training requirements only.
N-QG-403-00003	Nuclear Procurement Engineering Qualification Description	Engineering specific	This QG is specifically applicable to Nuclear Procurement Engineering staff at OPGN. The information presented in this document includes duty area qualifications and continuing training requirements only.
N-QG-403-00008	Nuclear Plant Design Engineering Qualification Description	Engineering specific	This QG is specifically applicable to Plant Design staff at OPGN. The information presented in this document includes duty area qualifications and continuing training requirements only.

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N-QG-403-00019	Nuclear System Engineering Qualification Description	Engineering specific	This QG is specifically applicable to System Engineering staff at OPGN. The information presented in this document includes duty area qualifications and continuing training requirements only.
N-TQD-403-00001	Nuclear Engineering Support Personnel Training and Qualification Description	Engineering specific	This Qualification Description is specifically applicable to Nuclear Engineering Support staff at OPGN. The information presented in this document includes duty area qualifications and continuing training requirements only.
NK38-GUID-01900-10001	Darlington Refurbishment, Design Completion Assurance	Engineering specific	This guideline provides the direction and expectations for the preparation, verification and review of Design Completion Assurance packages completed by Contractor Agencies for modifications related to the Darlington Refurbishment Project. This guideline also defines the required documentation to be included in the Design Completion Assurance Package to be prepared by the Contractor Agency.  This direction and guidelines is complementary to N-PROC-MP-0090 "Modification Process" and N-PROG-MP-0009 "Design Management" and does not replace the instructions of those procedures.
NK38-GUID-01900-10002	Darlington Refurbishment: Non-Intent Deviation Notice	Engineering specific	This Guideline provides the mandatory requirements and restrictions for managing, processing and controlling Non-Intent Design Deviations. This Guideline is written in accordance with Section 1.4 of N-PROC-MP-0090 "Modification Process".
NK38-GUID-01900-10003	Darlington Refurbishment – Engineering Interface Guide	Engineering specific	This guideline provides the direction and expectations for Engineering interface with OPG Project Managers and Contractor Agencies during the definition and execution of EPC contracts in support of the Darlington Refurbishment Program. This guideline is complementary to N-PROC-MP-0090 "Modification Process" and NSTD-MP-0009 "Contractor/Owner Engineering Interface and Oversight".
NK38-GUID-01900-10004	Darlington Refurbishment – Guide to the Development of a Conceptual Design Report	Engineering specific	Outlines the contents and process to be followed during the development of a Conceptual Design Report. Conceptual Design Reports (CDR) should be prepared to evaluate the options available to resolve a problem or implement an improvement idea as identified in the scoping documentation. CDRs need not be prepared for modifications where the appropriate solution is apparent in the scoping documentation and this is agreed upon by the

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			Refurbishment Program Stakeholders.
NK38-GUID-09701-10028 and associated D-FORM-10947	Darlington Refurbishment – Field Initiated Change Request	Engineering specific	This Guideline describes the process of initiating, processing and managing a Field Initiated Change (FIC) request. This Guideline allows installation to proceed at risk once a hard copy approval of the FIC request (D-FORM-10947) is received. This Guideline applies to a non-intent revision made to an approved or active Design Engineering Change (EC), Project EC, Non-Identical Component Replacement (NICR) EC, or Master NICR EC prior to Available for Service (AFS).
NK38-GUID-09701-10003	Nuclear Refurbishment Operations And Maintenance Procedure Process	Engineering specific	This Guideline is a description of how OPG and the OPG Contractors will interact with each other, dividing up the process of updating technical procedures and who will do what requirements as described in N-PROC-AS-0028.
NK38-GUID-09701-10020	Generic Process For Execution Of Darlington Refurbishment Services Conceptual Studies	Engineering specific	Describes a standard process that can be applied during the development of conceptual studies for provision of services required during the execution of Darlington Refurbishment Project. The output from these conceptual studies will facilitate and support the preparation of a subsequent Engineering Change Requests and Scopes of Work.
NK38-GUID-09701-10021	Guideline For Training Oversight (Refurbishment)	Engineering specific	This Guideline provides assistance to OPG Nuclear Projects Training staff in the selection and application of training oversight activities required to support the Nuclear Refurbishment Project Manager in the preparation of the Project Oversight Plan and to provide recommended practices for the preparation, execution and documentation of training oversight activities.
NK38-GUID-09701-10023	Functional Management Plan Guideline	Engineering specific	The Guideline describes the requirements for structure and content during preparation of comprehensive Management Plans for each Function. The Function Management Plan gets its authority from the Program Management Plan (PgMP). It describes in detail how the Function will execute the requirements outlined in PgMP over the life-cycle of the program.
NK38-GUID-09701-10024	Refurbishment Guideline For Comprehensive Work Packages	Engineering specific	This Guideline recommends the layout and content for the creation of Comprehensive Work Packages (CWP) to be used on the Darlington Refurbishment Project. The intended audience are the OPG Project Managers and their respective Contractors who are tasked with getting the work done safely, meeting quality



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			requirements, maintaining documentation all within schedule duration and budget.
NK38-GUID-09701-10048	Guideline for Nuclear Refurbishment Field Related Activities	Engineering specific	This guideline lists some, but not necessarily all, of Ontario Power Generation (OPG) standards, procedures and guidance for the execution of field work for the Nuclear Refurbishment (NR) project. This guideline supplements the guidance covered under NK38-GUID-09701-10034 Nuclear Refurbishment Engineering Related Activities Guide. It includes the standards and processes associated with most generic field related activities. These include field related construction planning, engineering supported field activities, Equipment and Component Calibration and Verification as well as Installation Procedures. Field work must meet applicable codes and design-specific requirements.
NK38-GUID-09701-10034	Guideline for Nuclear Refurbishment Engineering Related Activities	Engineering specific	This guideline has been prepared to describe Ontario Power Generation's (OPGs) relevant programs, processes, and expectations currently in place for the execution of engineering work for the Nuclear Refurbishment (NR) project. This guideline is complementary to N-COI-00120-00001, Contractor/Owner Interface Requirements for Nuclear (COIR), including the project specific COIR deviations, and does not supersede it.
NK38-PLAN-09701-10113 Sht ENG-01	System/Component Engineering Ownership Transfer Plan	Engineering specific	The purpose of this Department Ownership Transfer plan is to ensure that personnel in Nuclear Refurbishment Systems Engineering Department and the Darlington Performance Engineering and Components & Equipment Engineering Departments have a clear understanding of specific activities and responsibilities associated with the preparations for U2-U1-U3-U4 shut down and 2-unit operations at Darlington Nuclear, as well starting up the Darlington units after refurbishment and return to a 4-unit operation. The activities and responsibilities include support for unit turnover; development and/or revision of training materials and delivery of training; transition of work management processes; program, process and procedure changes, hiring and training additional personnel, as required, to support refurbishment and return to service.
NK38-PLAN-09701-10113 Sht ENG-02	Design Engineering Ownership Transfer Plan	Engineering specific	The purpose of this Department Ownership Transfer plan is to ensure that personnel in the department of Darlington Plant Design, Refurbishment Design Engineering department, and Station are

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			<p>aligned and have a clear understanding of specific deliverables required to support the following transition: Preparation for Unit Shutdown for refurbishment 2 Units Operation at Darlington Nuclear Returning to 4 Units Operation</p> <p>The activities and responsibilities include support for unit turnover; development and/or revision of training materials and delivery of training; transition of work management processes; program, process and procedure changes and hiring and training additional personnel, as required, to support refurbishment and return to service.</p> <p>This plan also communicates management expectations for personnel performance, recent industry operating experience, overviews of unit changes and modifications, and schedules for upcoming activities.</p>
NK38-PLAN-09701-10113 Sht NS-01	Nuclear Safety Analysis Ownership Transfer Plan	Engineering specific	The purpose of this Refurbishment Emergency Preparedness Ownership Transfer Plan is to ensure that personnel, programs and processes involved in Darlington Nuclear Generating Station Emergency Preparedness are integrated into Nuclear Refurbishment. This plan will ensure the protection of the public, employees, contractors and the environment in the event of an emergency. Nuclear Refurbishment will follow N-PROG-RA-0001, The Consolidated Nuclear Emergency Plan.
NK38-PLAN-09701-10116	Refurbishment Engineering Human Performance Plan	Engineering specific	The Human Performance plan defines the requirements and initiatives in Engineering for identifying as an event free organization minimizing/reducing errors. The plan is for use in conjunction with N-PROG-AS-0002, Human Performance.
NK38-PLAN-09701-10218	Darlington Refurbishment Quality Engineering	Engineering specific	Defines the processes, roles and responsibilities of the Quality Engineering (QE) function within the Darlington Refurbishment Organization. This document provides an overview of the scope of the QE function and the methods used to implement QE processes and programs throughout the Refurbishment life cycle.
NK38-REP-09701-10067	Darlington Refurbishment –	Engineering specific	Ensures that all the Station and Refurbishment staff are aligned and have a clear understanding of the specific deliverables required to

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	Transition Plan Strategy		support the transition to the Refurbishment Island and back to Station operation. Additionally, it further demonstrates the overall buy-in from each department in a cooperative team effort to support a seamless transition to and from Refurbishment. Finally, the main issues to be communicated regarding the transition and operational readiness, which include Darlington Refurbishment project progress and other issues related to site personnel including benefits and impacts, are identified to ensure a consistent message is provided site-wide.



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**Darlington Refurbishment -  
Maintenance Program Management  
Plan**

**NK38-NR-PLAN-09701-10001-0009-R001**  
2015-01-20


Order Number: N/A  
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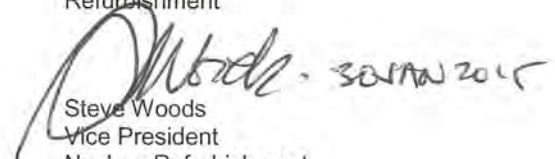
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### Reviewers Listing

This plan has been reviewed and concurred by:

**Name:** Todd Taylor  
**Title:** Section Manager Maintenance  
**Site:** Nuclear Refurbishment

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### Revision Summary

Revision Number	Date	Comments
R000	2013-12-02	Initial issue.
R001	2014-09-05	Updated based on comments from Snapshot Self Assessment (RF 14-000625)

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## 1.0 PURPOSE

The Nuclear Refurbishment (NR) Project will result in significant physical changes to the Darlington site. It is important that degradation of critical components, such as motor, pumps, valves and monitoring equipment, be avoided while these changes are being made. As well, it is vital that SSC's be maintained from the view of system health and safety as well as preventing foreign material from entering plant systems. These requirements along with the need for timely support form DNGS maintenance are recognized by our stakeholders.

This Maintenance Management Plan provides NR and other business unit support staff with clear understanding of the maintenance management requirements for the entire NR Program. The plan is linked to N-PROG-MA-0004: Conduct of Maintenance which describes the goals of the NR Maintenance Program along with expectations of contractors. The goals of the program are:

- To establish an effective Maintenance Program that ensures safe and reliable operation of plant equipment within the refurbishment unit. This applies to OPG and contractor staff.
- To ensure any deviations from N-PROG-MA-0004 are first presented to the NR Maintenance Manager for review and then to the Director – Center led Functional Area Manager (CFAM) for Approval, before implementation of the changes.

## 2.0 PROGRAM REQUIREMENTS

N-PROG-MA-0004: Conduct of Maintenance, remains the overall program document for the maintenance of operating units across OPG, Nuclear fleet as well as refurbishment units. The hierarchy of the governing documents and the relationship of these documents to the maintenance program objects are shown in Appendix A. This plan does not supersede existing governing documents but has a dotted line relationship.

The Maintenance Program ensures personnel and public safety, protection of the environment, and reliable operation. The program includes work planning, work execution, and tool calibration and control.

The transfer of staff, training, staffing and work program is covered under NK38-NR-PLAN-09701-10113 SHT-MTC 01 Maintenance Ownership transfer plan.



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## 2.1 Maintenance Vision

The Nuclear Refurbishment vision is:

- Safe Production, error free through job planning and event prevention framework.
- A high performance team of maintenance professionals who value:
  - Precise execution of plans.
  - High standards.
  - Self Critical through peer coaching.
  - Collectively learning from industry such that the sum total leads the industry in results. Cooperative effort within OPG and with Vendors

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## 2.2 Maintenance Performance Metrics

A single, consistent set of Maintenance Performance Metrics (measures and targets) for Nuclear Refurbishment and Contractors is compiled using existing Darlington performance metrics. The set includes the following items

Safety
Last LTA (SCR & date) per Conventional Safety Report
Last Medically Treated Injury (SCR & date) per Conventional Safety Report
WP Events, Reportable, Mtce Related
WP Events, Low Level, Mtce Related
Maintenance Rad Dose (YTD)
Human Performance and Leadership
Last [Mtce specific] Station EFDR (SCR & date)
Department EFDR (YE Target = 24)
Expired Qualifications (YE Target = 7)
Number of SCR's Generated - YTD
Average days to complete CAP (Station target 35)
Overdue CAPs - YTD
Reliability
Schedule Adherence (Station Target = 85%)
Schedule Completion (Station Target = 95%)
Scope Stability (Station Target = 92%)
Injected / Carry over tasks
Crit 1&2 PM - Completion   Deferrals
PM with feedback
PdM missed/saved failures
CM Backlog WO/Unit (CC+CN)
Station Leaks
Rework (In Process Mtce+Failed PMT+Repeat Mtce)
Value for Money
YTD Budget Variance \$k (Base & Outage OM&A vs. Target)
YTD Overtime Variance \$k (Base OM&A vs. Target)

Maintenance performance metrics will be tracked on a prescribed frequency and reported graphically, or otherwise, through the refurbishment monthly status reports as well as the project manager status reports.

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NR Senior Line Management, NR Project Teams and Contractors will use the metrics to identify unsatisfactory performance against prescribed targets and identify corrective actions to eliminate causes

### **3.0 ROLES AND ACCOUNTABILITIES**

#### **3.1 Manager, NR, Maintenance Department**

Maintenance oversight and monitoring requirements for Nuclear Projects will be the responsibility of the Manager, NR, Maintenance Department. Ensure that any deviations to N-PROG-MA-0004 or related procedures have been reviewed and concurred with by SME's before presentation to the Director CFAM for approval.

#### **3.2 Manager, DNGS, Maintenance Department**

The Manager, DNGS Maintenance, will assist in ensuring if required qualified staffs are available to support the overall NR maintenance program.

#### **3.3 Section Manager NR, Maintenance Department**

The Section Manager has the accountability for monitoring and trending performance metrics, along with ensuring for the safety and quality of field maintenance activities.

#### **3.4 Director – CFAM Maintenance, Fleet Maintenance**

Approve deviations from N-PROG-MA-0004 or any related procedures ensuring that a thorough review has been completed to their satisfaction.

#### **3.5 Project Manager, NR**

Project managers are required to notify in writing any deviations to N-PROG-MA-0004 to the Manager, NR, and Maintenance Department and to not proceed with the activity that requires the deviation until written approval has been obtained.

### **4.0 DEFINITIONS AND ACRONYMS**

#### **4.1 Definitions**

None

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**DARLINGTON REFURBISHMENT - MAINTENANCE PROGRAM MANAGEMENT PLAN**

## 4.2 Acronyms

<b>CFAM</b>	Centerled Functional Area manager
<b>FLM</b>	First Line Manager
<b>SSC</b>	Systems, structures and components
<b>NR</b>	Nuclear Refurbishment
<b>DNGS</b>	Darlington Nuclear Generating Station
<b>OPG</b>	Ontario Power Generation

## 5.0 REFERENCES

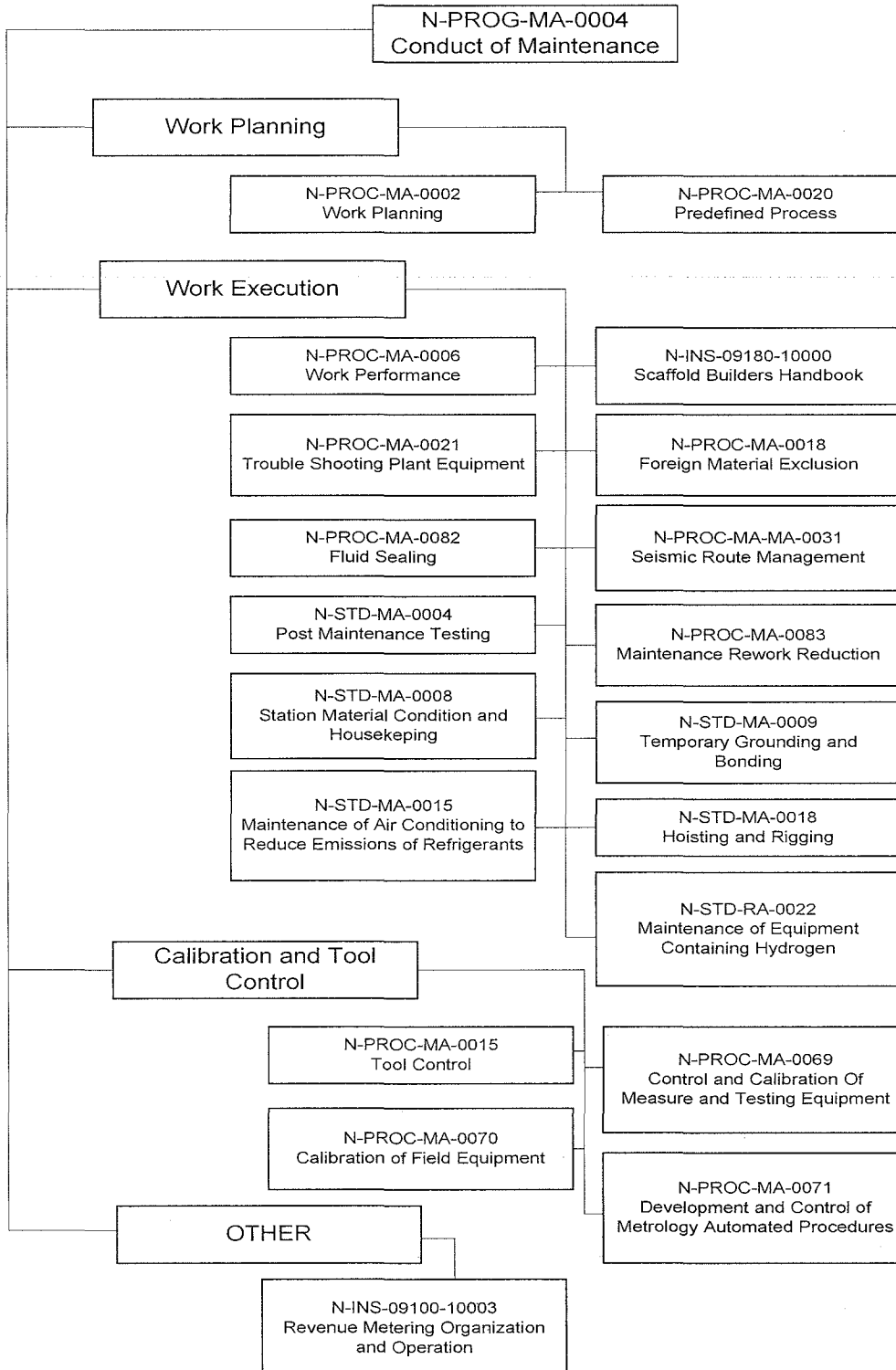
[R-1] N-PROG-MA-0004, "Conduct of Maintenance"

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**Appendix A: Relationship of Plan to Maintenance Governance**





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Title:

**DARLINGTON REFURBISHMENT MANAGEMENT SYSTEMS AND PERFORMANCE  
IMPROVEMENT PROGRAM MANAGEMENT PLAN**

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**Darlington Refurbishment Management  
Systems And Performance  
Improvement Program Management  
Plan**

**NK38-NR-PLAN-09701-10001-0010-R003**  
2016-06-14

Order Number: N/A  
Other Reference Number:

Prepared By: G. Meter  
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Vice President  
Project Assurance and Contract  
Management

**Plan**

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**Revision Summary**

<b>Revision Number</b>	<b>Date</b>	<b>Comments</b>
R003	2016-05-05	Revised to incorporate additional Manager and appropriate distribution of responsibilities.
R003	2016-06-14	Revised to reflect current responsibilities.



**Plan**

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### Records Table

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None	NA	NA	NA

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**DARLINGTON REFURBISHMENT MANAGEMENT SYSTEMS AND PERFORMANCE  
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## **1.0 PURPOSE AND SCOPE**

The purpose of this document is to define the requirements and processes used to carry out the Management Systems and Performance Improvement programs functions in Managed Systems Oversight (MSO), a department in Project Assurance and Contract Management (PACM) division, of Nuclear Projects. The Program Assurance related functions of MSO are described in NK38-NR-PLAN-09701-10001 Sht 0011, Darlington Refurbishment Program Assurance Program Management Plan.

## **2.0 PROGRAM REQUIREMENTS**

Figure 1 below shows the implementing documents associated with the MSO Program Management Plan.

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# DARLINGTON REFRUBISHMENT MANAGEMENT SYSTEMS AND PERFORMANCE IMPROVEMENT PROGRAM MANAGEMENT PLAN

## Nuclear Refurbishment – Management System Process Support Documents

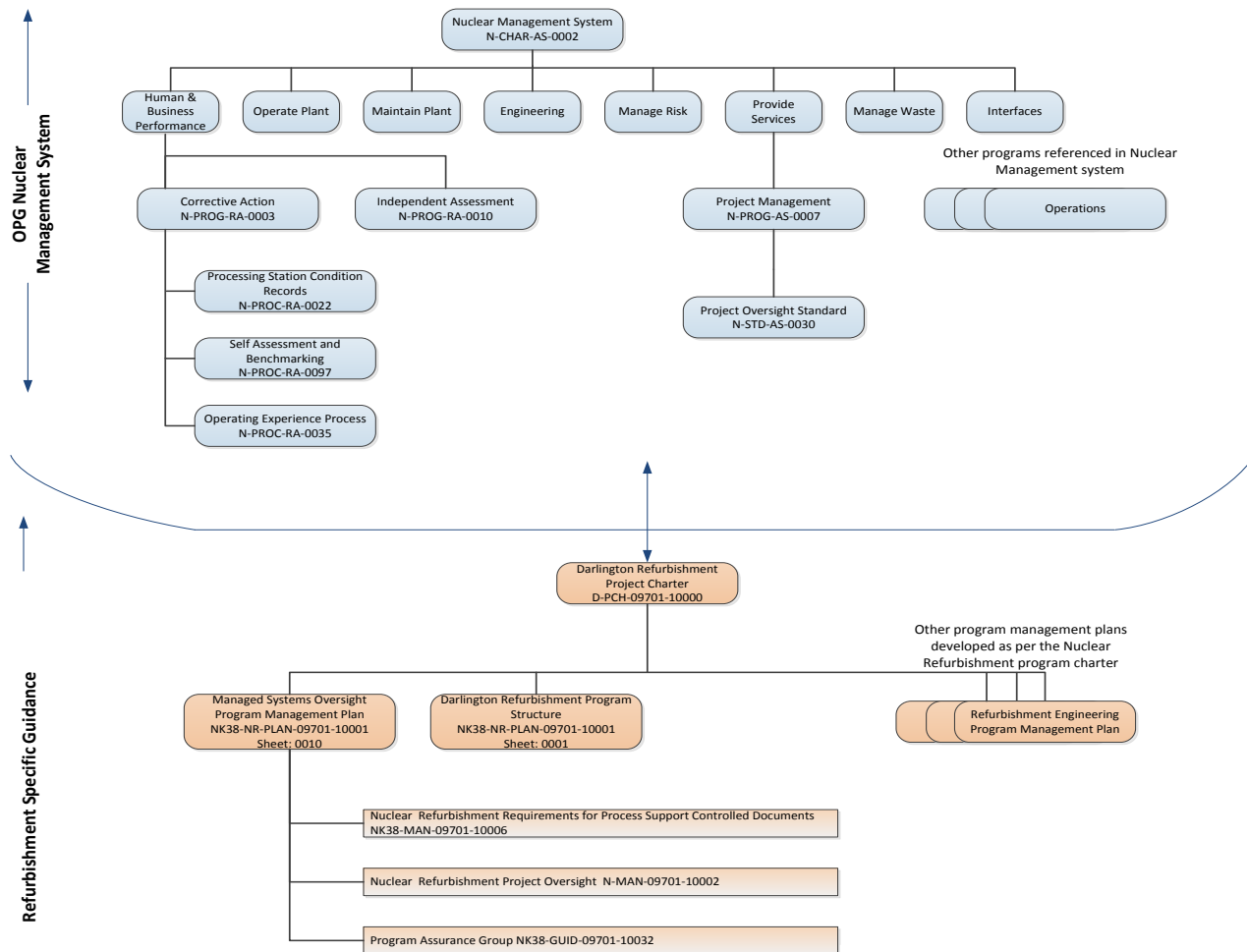


Figure 1 – MSO Program Management Plan Hierarchy

## 2.1 Management Systems

### 2.1.1 Darlington Refurbishment Program Framework

D-PCH-09701-10000, Darlington Refurbishment Project Charter, establishes the high level direction on the scope, objectives, timing, cost, and resources for execution of the project. To fulfill this direction, the Program Management Program (NK38-NR-PLAN-09701-10001 Sheets 0001-0023) was established. The Program Management Plan sheets are intended to convey requirements and processes used within the DR Program to meet the intent of the existing OPG Management System and document approved deviations to existing OPG governance.

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The following sections document the requirements and processes used by MSO.

## **2.1.2 Governance of the Darlington Refurbishment Program**

The role of MSO is to provide Oversight of the overall Management System for the DR Project and to ensure alignment in accordance with the DR Project Charter. As per NK38-MAN-09701-10006, Nuclear Refurbishment – Requirements for Process Support Controlled Documents, this includes monitoring the:

- creation, revision, superseding, and obsolescing of new controlled documentation/processes,
- implementation of controlled documentation/processes, and
- effectiveness of controlled documentation/processes.

## **2.2 Program Assurance**

### **2.2.1 Program Assurance**

Program Assurance is conducted following NK38-NR-PLAN-09701-10001 Sht 0011, Darlington Refurbishment Program Assurance Program Management Plan.

## **2.3 Performance Improvement**

### **2.3.1 Corrective Action Program for Darlington Refurbishment**

Per Section 5.11 of the Canadian Standards Association (CSA) N286-05 standard, designs, documents, tools, materials, parts, processes, services, and practices that do not meet requirements shall be identified and recorded as problems. This standard also emphasizes the importance of not only using a Corrective Action Process (CAP) but to assess its effectiveness. Since Engineer Procure Construct (EPC) contractors supporting the DR Program must meet the requirements outlined in CSA N286-05, they too must be held to this standard. OPG and each of its EPC contractors are operating in a partnership. The specific requirements regarding use of contractors' managed systems, including use of contractors' corrective action processes, will be included in the respective contracts, where relevant. For work performed by vendors under their own managed systems, there is a need to specify the framework regarding adverse conditions that would trigger the use of OPG's CAP versus leveraging the EPC contractors' CAP. For example, if one of OPG's processes were to fail, the onus is on OPG to use its CAP to resolve the issue. If an EPC contractor's process were to fail, the EPC contractor's CAP is used to resolve the issue.

#### **2.3.1.1 Use of OPG's CAP Program**

Within the DR Program, N-PROC-RA-0022, Processing Station Condition Records, will be used by OPG staff to document day-to-day adverse conditions for their own work and for all breakthrough quality issues. The CAP will be used to resolve the noted adverse conditions and breakthrough quality issues. The corrective actions may be used to modify a specific project's POP or, if common to all projects, all POPs.

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OPG's and contractors' corrective action processes will interface only for specific types of adverse conditions. Using OPG CAP for contractor events will proactively manage NR project risk by verifying that significant adverse trends are being identified and effectively addressed, actions taken to preclude recurrence, and appropriate levels project management teams are notified.

For circumstances where the contractors' adverse conditions are reported within OPG's CAP (specifically Significance Level 1 and 2 issues), Station Condition Records (SCRs) will be processed according to N-PROC-RA-0022, "Processing Station Condition Records" and use the SCR database to document adverse conditions. OPG may request the contractor representatives attend the Corrective Action Review Board (CARB) to present the corrective actions and/or effectiveness reviews (Reference N-GUID-00120-10012, Use of OPG Corrective Action Program for Contractor Issues.)

For contractors' adverse conditions, the following are examples that will lead to the use of OPG's CAP:

- an adverse condition that significantly impacts the ability to safely operate and/or maintain the plant, or represents an actual conventional or radiation safety, operability, or environmental concern, or that represents a condition reportable under the Power Reactor Operating Licence (PROL), or under other regulatory requirements (e.g. OSHA, CNSC REGDOC-3.1.1 (formerly S-99), Ministry of Environment),
- damage to equipment or systems outside of contractor's Scope Of Work (SOW),
- a significant adverse trend or reoccurrence observed by OPG through oversight activities – the threshold of reporting will depend on the consequences of the adverse events that may arise or the consequences of the reoccurrence on relevant business drivers (e.g. quality, safety, cost, and schedule).

The category and significance level of an SCR will be based on assessed risks and consequences of the adverse conditions and/or reoccurrence. The corrective actions may be tracked through other established processes and protocols (e.g. project management processes, contract management processes, oversight processes etc.), outside of the SCR process.

### **2.3.1.2 Use of Contractor's CAP Program**

The contractors use their own management systems and corrective action programs in order to comply with CSA N286 regulatory standards include the need to demonstrate that "Experience is sought, shared and used" and "Problems are identified and resolved".

OPG Supply Chain Quality Services (SCQS) conducts contractor prequalification assessments and Approved Supplier List (ASL) audits to verify that all contractors' management systems meet the requirements of CSA N286. Non-conformance and Corrective Action Requests (NCAR) are generated to the vendor for response and resolution of deficiencies or issues as needed and project teams will monitor vendor responses and closeout of actions.

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#### **2.3.2 OPEX and Lessons Learned**

DR OPEX is managed in accordance with OPG Nuclear N-PROC-RA-0035, Operating Experience Process. This identifies, evaluates, and takes action based on internal and external industry lessons learned in order to improve project and plant safety, reliability and performance.

N-MAN-00120-10001-RISK-06, Nuclear Refurbishment Processing Operating Experience, and Key Lessons Learned, provides guidance on the process to integrate relevant Project and Contract Management OPEX and Key Lessons Learned into the planning and execution phases of the DR program.

#### **2.3.3 Self-Assessments for the Darlington Refurbishment Program**

On an annual basis, the DR business unit will develop and publish a Divisional Level Self-Assessment and Benchmarking schedule. It is the accountability of MSO to develop and publish the Self-Assessment schedule in accordance to N-PROC-RA-0097, Self Assessment and Benchmarking.

MSO participates on Divisional Level Self-assessments, as required, and monitors Department Level Self-assessments.

#### **2.3.4 Trending**

Trending shall be conducted using OPGN governance.

#### **2.3.5 Oversight of Risk Management and Oversight Tool Actions**

PI will monitor the issues log on a quarterly basis for compliance and Coach individuals that are not compliant with the definition of issues in the guide.

PI will continue to monitor and trend RMO issues log on a quarterly basis and to determine if a cognitive trend is discovered. Statistical trending conducted by P and C in their standard report may also be used. Cognitive trending will be recorded by the PI. Results of trending to be included in the quarterly PI report.

PI will hold monthly DR leadership review meetings of External Oversight and Nuclear Oversight Audit actions

### **2.4 Performance Indicators**

Metrics are used to monitor the performance of key components in Nuclear Refurbishment. Metrics for the Corrective Action Program are monitored and reported through CARB. Additional metrics for governance and to support the DR managed systems are being established.

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## **3.0 ROLES AND ACCOUNTABILITIES**

### **3.1 Vice President Project Assurance and Contract Management**

Reports directly to the Senior Vice President, Nuclear Projects and is accountable for the management of PACM. This includes oversight of the DR Program by the MSO Department.

### **3.2 Director, Management Systems Oversight**

Responsible to the Vice President, PACM, for Program Assurance within the DR Project, and ensures that the management system and performance Improvement functions are in place and working effectively.

#### **3.2.1 Manager, PI**

Responsible to the Director, MSO, for:

- Managing the Corrective Action Program (N-PROG-RA-0003) in the DR Program
- Coordinating the development of the DR Division-level Self-assessment Plan and participates in all Division-level Self-assessments
- Conducting and assisting with Root Cause Evaluations for Nuclear Refurbishment
- Facilitating internal and external audits and communicates internal audit results to the Darlington Refurbishment CARB
- Managing the OPEX and Lessons Learned processes in the DR program
- Facilitating and coordinating external oversight (RCRB).

#### **3.2.2 Manager, PA**

Responsible to the Director, MSO, for:

- establishing the framework for the DR Program as per charter D-PCH-09701-10000 and monitors and maintains the framework.

## **4.0 DEFINITIONS & ACRONYMS**

### **4.1 Definitions**

None.

### **4.2 Acronyms**

<b>ASL</b>	Approved Supplier List
<b>CARB</b>	Corrective Action Review Board
<b>CAP</b>	Corrective Action Program
<b>CSA</b>	Canadian Standards Association
<b>CNE</b>	Chief Nuclear Engineer

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### **DARLINGTON REFURBISHMENT MANAGEMENT SYSTEMS AND PERFORMANCE IMPROVEMENT PROGRAM MANAGEMENT PLAN**

<b>CNO</b>	Chief Nuclear Officer
<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>DR</b>	Darlington Refurbishment
<b>DRC</b>	Darlington Refurbishment Committee
<b>EPC</b>	Engineering, Procurement, and Construction
<b>GOC</b>	Generation Oversight Committee
<b>IA</b>	Internal Audit
<b>MSO</b>	Management Systems Oversight
<b>NCAR</b>	Non-conformance and Corrective Action Report
<b>NO</b>	Nuclear Oversight
<b>NPO</b>	Nuclear Projects Oversight
<b>OPEX</b>	Operating Experience
<b>OPG</b>	Ontario Power Generation
<b>PACM</b>	Project Assurance and Contract Management
<b>PA</b>	Performance Assurance
<b>PI</b>	Performance Improvement
<b>POP</b>	Project Oversight Plans
<b>PROL</b>	Power Reactor Operating License
<b>RCRB</b>	Refurbishment Construction Review Board
<b>SCR</b>	Station Condition Record
<b>SCQS</b>	Supply Chain Quality Services
<b>SOW</b>	Scope of Work
<b>SVP</b>	Senior Vice President

## 5.0 REFERENCES

- [R-1] CSA N286-05, Management System Requirements for Nuclear Power Plants
- [R-2] N-CHAR-AS-0002, Nuclear Management System
- [R-3] D-PCH-09701-10000, Darlington Refurbishment Project Charter
- [R-4] N-PROG-AS-0007, Project Management
- [R-5] N-STD-AS-0030, Project Oversight Standard
- [R-6] N-MAN-09701-10002, Nuclear refurbishment Project Oversight
- [R-7] NK38-MAN-09701-10006, Nuclear Refurbishment – Requirements for Process Support Controlled Documents
- [R-8] N-PROG-RA-0003, Corrective Action Program
- [R-9] N-PROC-RA-0022, Processing Station Condition Records
- [R-10] N-PROC-RA-0097, Self Assessment and Benchmarking
- [R-11] N-GUID-00120-10012, Use of OPG Corrective Action Program for Contractor Issues.





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Title:

**DARLINGTON REFURBISHMENT PROGRAM ASSURANCE PROGRAM MANAGEMENT PLAN**

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**Darlington Refurbishment Program  
Assurance Program Management Plan**

**NK38-NR-PLAN-09701-10001-0011-R002**  
2016-02-22

Order Number: N/A  
Other Reference Number: N/A

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Darlington Refurbishment

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**DARLINGTON REFURBISHMENT PROGRAM ASSURANCE PROGRAM MANAGEMENT PLAN**

### Revision Summary

Revision Number	Date	Comments
R002	2016-02-15	General update to reflect latest organizational structure and processes.
R001	2015-09-01	Program Assurance Group (PAG) model updated to match PAG framework. Added definition for Oversight from INPO 09-002. Added reference to Refurbishment Construction Review Board (RCRB). Added process support document framework in Appendix B.
R000	2014-01-31	This document supersedes NK38-PLAN-09701-10067 Sheet 0011. The changes between NK38-PLAN-09701-10067 Sheet 0011 and this document are as follows: <ul style="list-style-type: none"> <li>The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001,</li> <li>The security classification has been removed so that the document can be submitted to the CNSC, and</li> <li>References have been updated.</li> </ul>

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# DARLINGTON REFURBISHMENT PROGRAM ASSURANCE PROGRAM MANAGEMENT PLAN

## 1.0 PURPOSE AND SCOPE

The purpose of this document is to explain how assurance is achieved in the Darlington Refurbishment Program (DRP). Assurance for the purpose of this document is defined as a set of tools, organizations, and processes that have been implemented to ensure that all DR business objectives are achieved.

The scope of this document is for the DRP only. This program management plan takes its authority from the D-PCH-09701-10000, Darlington Refurbishment Project Charter.

The flow of information and the organizational hierarchy of oversight and assurance providers are captured in Figure 1 below. The details of the role of each of the oversight and assurance providers are available in Appendix A.

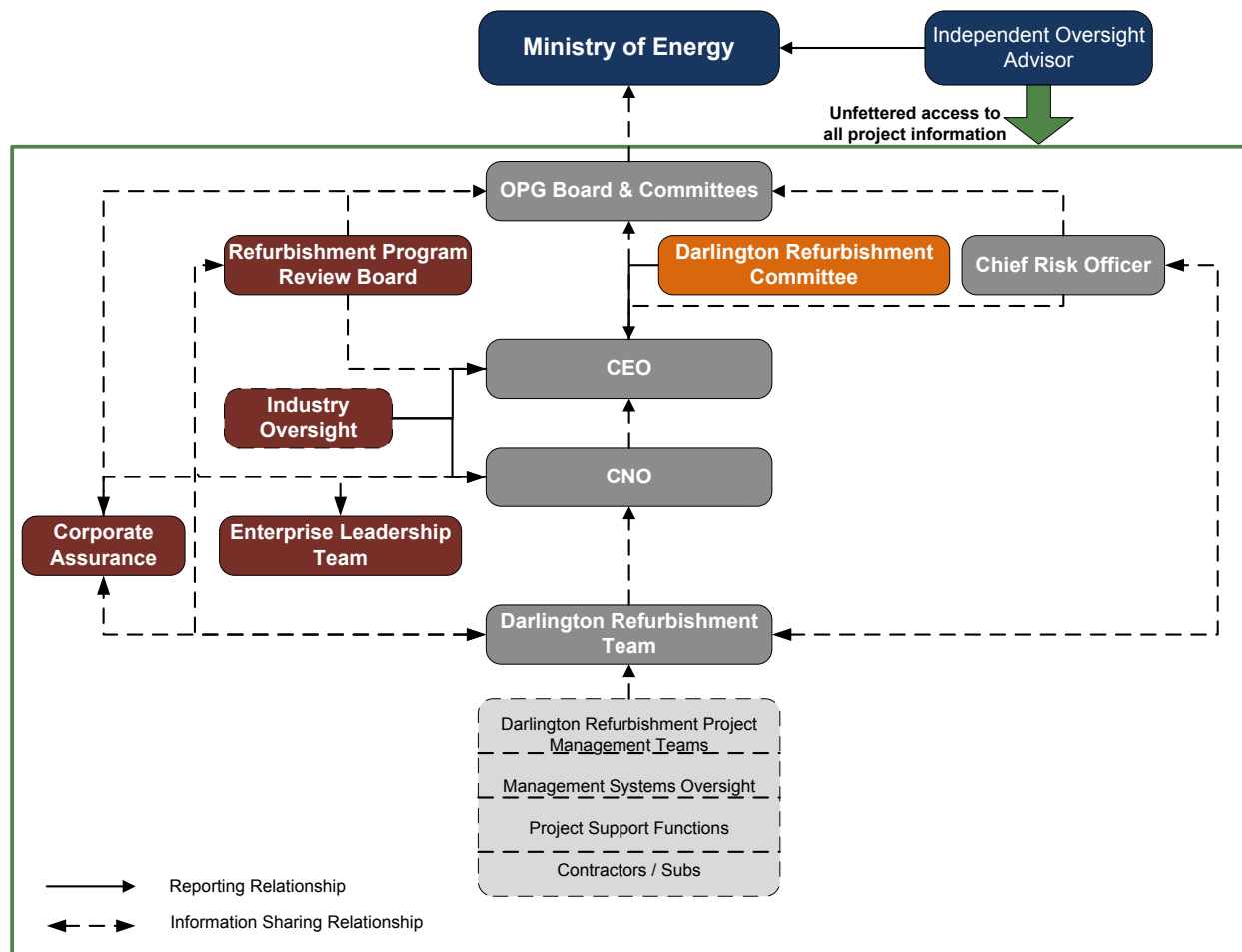


Figure 1 – Hierarchy of Oversight and Assurance Providers

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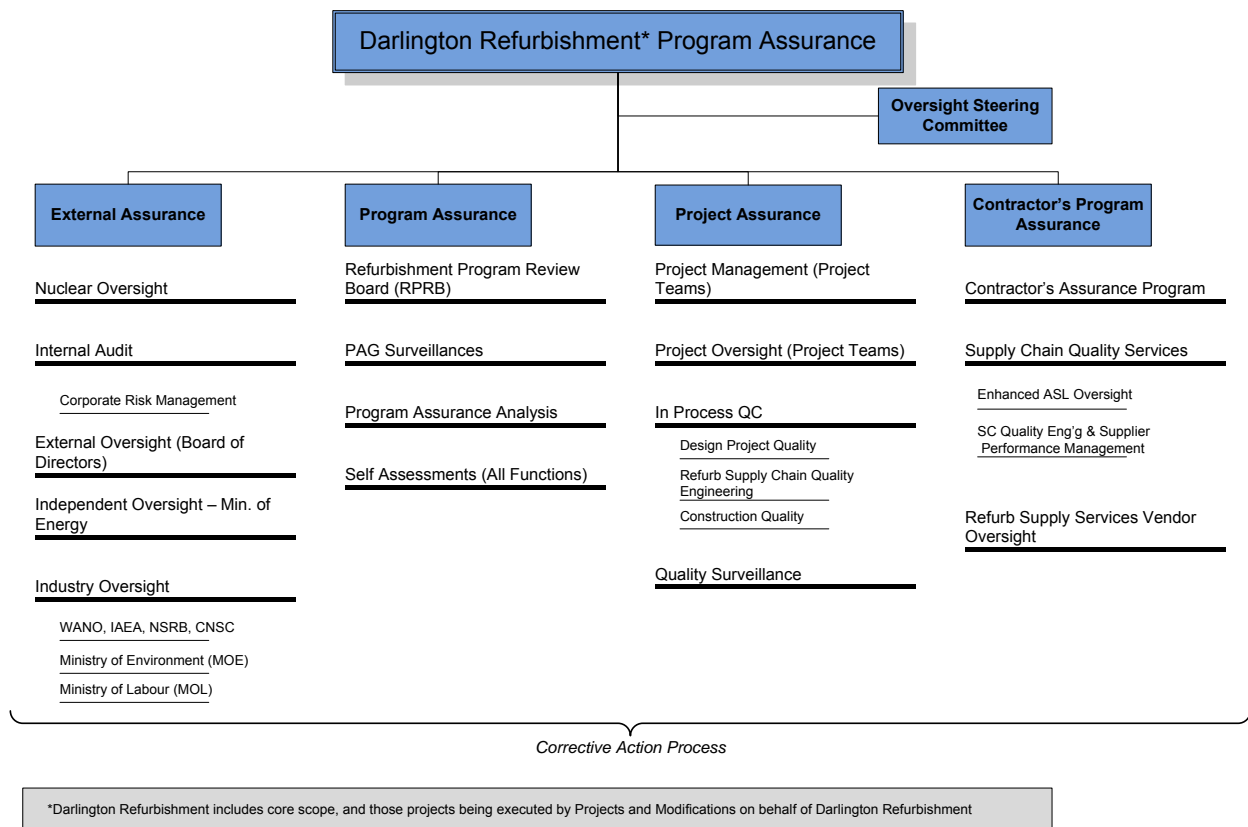
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# DARLINGTON REFURBISHMENT PROGRAM ASSURANCE PROGRAM MANAGEMENT PLAN

## 2.0 PROGRAM REQUIREMENTS

As per Institute of Nuclear Power Operations (INPO) 11-007 Principles for Strong Governance and Oversight of Nuclear Power Organizations, Oversight is defined as “...the verification that the standards, expectations, and goals established through governance of the organization are met...; [all employees] identify performance gaps for corrective action, monitor the effectiveness of corrective actions, and escalate issues to higher levels of line management when necessary. Oversight—through its fundamental elements of audit, evaluation, monitoring, inspection, and investigation—enhances organizational effectiveness, productivity, and integrity.”

Darlington Refurbishment Program Assurance is comprised of four main separate elements: External Assurance, Program Assurance, Project Assurance, and Contractor’s Program Assurance, see Figure 2. Each element plays an important role in providing assurance to the stakeholders that the project is being executed safely, to the required quality, on time, and on budget.



**Figure 2 – Darlington Refurbishment Program Assurance Model**

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The Darlington Refurbishment Program Assurance Model, by design, incorporates multiple layers of oversight to support building and maintaining internal and external confidence. The intent of the Program Assurance Model for the DRP is to ensure the refurbishment program (1) meets all safety, quality, cost, and schedule expectations; (2) that any issues will be identified and resolved expeditiously; and (3) that transparent and accurate information flows up to the Board in a way that supports Board oversight effectiveness and decision making. The following sections explain key requirements the DRP which focus to establish consistency in oversight across the program.

## **2.1 External Assurance**

### **2.1.1 Nuclear Oversight (NO)**

NO's audit mandate includes audit of the Darlington Refurbishment Project. The role of this group is to audit the OPG Management System to ensure that it meets the requirements of N286 and N-CHAR-AS-0002, Nuclear Management System. The audit results are shared with the OPG Darlington Refurbishment Management Team and when required, the results are escalated to the Senior Management Team.

### **2.1.2 Internal Audit (IA)**

IA's audit mandate is to ensure that the risks for the company are being adequately managed through proper planning, cost control and schedule adherence. This group audits Enterprise Risk Management processes in accordance with the Strategic Audit Plan approved by the Board. This audit plan includes risk-based audits aligned with the top strategic and enterprise risks per the assurance section in OPG-PROG-0004, Enterprise Risk Management. In addition periodic audits of business processes are also performed.

### **2.1.3 External Oversight**

The Board of Directors (BOD) has a layer of assurance comprised of External Assessors reporting directly to them. The role of the External Assessors is to conduct oversight of the Darlington Refurbishment Management Team to ensure that the Project's leadership reflects a competent team capable of managing a mega project to achieve the Program's objectives. Their focus is also to ensure that the project's processes and compliance reflects the Industry best Project Management practices.

### **2.1.4 Independent Oversight**

A MOE appointed person has been embedded in the DRC sub-committee of the BOD. This person reports out to the MOE on Darlington Refurbishment results.

### **2.1.5 Industry Oversight**

Industry regulatory and oversight bodies, including Canadian Nuclear Safety Commission (CNSC) and World Association of Nuclear Operators (WANO) perform

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routine audits, assessments, and inspections of the Darlington Nuclear Generating Station (DNGS) performance. As the DR Project progresses, these reviews will include insights into the project's compliance with our Power Reactor Operating License (PROL) and WANO best practices. The Ministry of Environment and Climate Change and the Ministry of Labour will also provide oversight during the Darlington Refurbishment Project as required.

## **2.2 Program Assurance**

### **2.2.1 Refurbishment Program Review Board**

The Refurbishment Program Review Board (RPRB) advises OPG on overall project management, as well as management of specific projects within the DRP. The RPRB makes impartial assessments to help ensure that the project teams' actions are meeting expectations, and that commitments and industry-proven project management practices are in place in all areas of safety, human performance, cost, schedule, and quality.

The RPRB is comprised of external members who have expertise in nuclear plant operations, regulatory matters, and construction mega-projects. It conducts quarterly site visits and reports on the results of its assessments to management, including recommendations on actions for improving performance. The Chair of the RPRB presents a summary of findings to the DRC annually.

### **2.2.2 Program Assurance Group**

Program Assurance Group (PAG) leads horizontal surveillances (across the projects) with support from Refurbishment Functions. This programmatic oversight is based on risks and themes emerging from project oversight data, program and project risks, and OPEX. These surveillances are evaluated against INPO 09-007 Principles for Excellence in Nuclear Project Construction.

The goal of PAG surveillances is to create sustainable value for the organization. Surveillances are focused on identifying emerging problems and opportunities in time to do something about them, including: process improvement, lessons learned and providing coaching and assistance to the project team and Contractors as part of an effective risk management culture.<sup>1</sup>

The PAG baseline schedule is developed on a yearly basis. The schedule outlines surveillance topics by quarter. The topics are selected based on refurbishment program and project risks and vulnerabilities associated with the work in the coming year. In order to ensure a balanced and representative sampling, a cross project/functional approach is used to identify the surveillance topics. The finalized PAG schedule is approved by the Director of Management Systems Oversight (MSO). Progress and results of the surveillances are reported at the monthly Oversight Steering Committee (OSC).

<sup>1</sup> Derived from [www.mosaicprojects.com.au](http://www.mosaicprojects.com.au) White Paper "Proactive Project Surveillance".



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The schedule is reviewed on a quarterly basis to ensure selected surveillance topics are still in alignment with project risks. Changes to the schedule are approved by the Director MSO.

PAG surveillance results are recorded in the Risk Management and Oversight database (RMO) for tracking of scope, objectives, assigned team members, timing, and for documenting any findings and corrective actions required. Further guidance on the PAG is documented in NK38-GUID-09701-10032, Program Assurance Group Guide .

PAG facilitates coordination of external audits and surveillances to minimize disruption of ongoing project work. A PAG plan is developed to document all planned, non-routine project oversight to ensure any overlap or potential interferences are determined early on for review and disposition.

#### **2.2.3 Program Assurance Analysis**

Performance monitoring and reporting are key components of the assurance model and process controls. Regular performance reviews and status meetings are held to ensure processes are implemented as designed, results are achieved as anticipated, and corrective actions are identified where results are not meeting expectations. Various performance reports are provided to all levels of the organization and the stakeholders to assist them in executing their oversight roles. Program Management Plans for each function provide more detail on specific metrics being tracked.

DRP Assurance metrics are designed to evaluate the execution and effectiveness of the planned oversight. RMO database is the primary source of data for Program Assurance metrics. Surveillance execution per planned schedule, surveillance quality, corrective action completion and corrective action effectiveness are some examples of planned metrics to be tracked for improvement.

Reporting of trends from all Darlington Refurbishment oversight is captured in a Monthly Report issued by MSO.

#### **2.2.4 Self-Assessment**

Self-assessments are an element of the DRP Assurance. Self-assessments place an increased emphasis on individual accountability and robust management systems. Self-assessments and benchmarking evaluations provide a structured method to compare performance with management expectations, industry standards of excellence, and regulatory requirements to identify areas needing improvement. Self-assessments are conducted in accordance with N-PROC-RA-0097, Self-Assessment and Benchmarking.

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### **2.3 Project Assurance**

OPG Project staff interface directly with their contractors and subcontractors, and are most familiar with the risks faced by the project. Project Assurance makes use of this knowledge to provide assurance.

#### **2.3.1 Project Management**

Each Project has matrixed resources who are equipped with the expertise to provide clarity around the contracted requirements, and who are able to judge the competency of the Contractor's resources. Project Management is the day to day interactions of the project and removal barriers when required to progress work. The focus of this layer is to keep the projects moving while ensuring that they meet the quality requirements within contract cost & timing.

#### **2.3.2 Project Oversight**

The intent of Project Oversight is the examination of the Contractor's readiness to perform the work based on risk. Project Oversight is proactive in nature and is referred to as the vertical oversight assessing the specific requirements stipulated in the contract. This oversight is performed by the Projects with assistance from the functions when required.

Project Oversight Plans (POP) are developed in accordance with N-STD-AS-0030, Project Oversight Standard. The POP outlines the strategy for oversight activities. Guidance for POPs is provided in N-MAN-09701-10002, Nuclear Projects Oversight Guide. The oversight results, performance metrics, Station Condition Records (SCR), and trends may be reviewed to determine if there is an unidentified risk or opportunity surfacing across the projects. This may result in changes to the POPs.

Project oversight activities and findings are recorded in the RMO database. The monthly OSC meeting is one forum used by the projects to share oversight results.

#### **2.3.3 In Process Quality Control**

One of the assurance elements is the In Process Quality Control (QC) for Engineering, Procurement and Construction. OPG has stipulated in the Contractor Owner Interface Requirements (COIR) a number of quality hold points to confirm that the products meet all requirements before advancing to the next stage. The hold points are based on OPEX along with Lessons Learned from working with contractors over the years.

#### **2.3.4 Quality Surveillance (QS)**

The last layer of Project Assurance is Quality Surveillance (QS). Project personnel conduct surveillances on the Contractor's QC activities to verify the integrity of the Contractor's QC process. This is an important process to verify that the Contractor's resources are adhering to their own QC processes and are identifying areas which have failed within their corrective action program.

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## **2.4 Contractor's Program Assurance**

### **2.4.1 Contractor's Assurance Program**

Each of the contracts requires that the prime contractors and their sub-contractors have a Quality Program which complies with Canadian Standards Association (CSA) N286, Management System Requirements for Nuclear Power Plants. It is a contractual requirement that the Contractor's Quality Organization will provide sufficient oversight to confirm that their management system is rigorously followed and that all deficiencies are documented in their corrective action system. It is further expected that the Contractor Quality organization is independent of production pressures.

This layer of assurance reviews all Contractors' and Subcontractors' Management Systems to ensure they meet the requirements of CSA N286. The audits look for programmatic issues that could negatively impact the success of the overall project.

### **2.4.2 Supply Chain Quality Services**

#### **2.4.2.1 Approved Supplier List Audits**

Nuclear Supply Chain (NSC) is accountable for the Approved Supplier List (ASL) for OPG. Supplier qualification is established by a graded approach for each type and scope of item or service based on Codes, Standards, and OPGN Design and Quality requirements. Supply Chain shall not be permitted to place a purchase order with any supplier requiring a Quality Program until an acceptable qualification status has been established by Supply Chain Quality Services (SCQS). Requirements of N-PROC-MM-0010, Establishing and Maintaining OPG ASL apply to both Safety Related and Augmented Quality items and services suppliers.

#### **2.4.2.2 Quality Engineering & Supplier Performance Management**

Supply Chain is accountable for measuring and managing supplier's quality performance, investigation and management of supplier corrective actions related to SCR and Operating Experience (OPEX), reduction of initial receipt inspection material quarantine, management of supplier reported non-conformances and development of suppliers. This includes maintaining ASL Critical Supplier List, Quality Key Performance Indicators, ASL Critical Supplier Quality Health Index, and supplier quality escalation process per N-PROC-MM-0041, Quality Engineering and Supplier Performance Management.

### **2.4.3 Refurbishment Supply Services Vendor Oversight**

The Refurbishment Supply Services Vendor Oversight supports the project teams with oversight of all procurement related quality activities. These oversights provide key inputs to NSC ASL Audit Group and Quality Engineering and Supplier Performance.

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## 2.5 Oversight Steering Committee

The OSC provides a monthly cross-project and cross-functional forum to review various aspects of DR oversight. Topics discussed include project-specific, phase-specific, and Contractor-specific OPEX and lessons learned.

## 2.6 Corrective Action Program

DRP follows N-PROG-RA-0003, Corrective Action Program (CAP). OPG and each of its Engineer Procure Construct (EPC) contractors have requirements to address adverse conditions that trigger the use of OPG's, and/or EPC contractors' CAP Programs, see NK38-NR-PLAN-09701-10001 Sheet 0010, Nuclear Projects Oversight Program Management Plan and N-GUID-00120-10012, Use of OPG Corrective Action Program for Contractor Issues for further details.

## 3.0 ROLES AND ACCOUNTABILITIES

Refer to Appendix A for details.

## 4.0 DEFINITIONS & ACRONYMS

### 4.1 Definitions

**Oversight:** Oversight is the accountability to critically monitor, assess, and evaluate the conduct of the project managers and their organizations. This includes the review of action plans that address gaps between current performance and governance standards, as well as the independent analysis of trends, data, and performance information that provides assurance that functional outcomes are achieved and policy boundaries are being respected.<sup>2</sup>

### 4.2 Acronyms

ASL	Approved Supplier List
BOD	Board of Directors
CAP	Corrective Action Program
CEO	Chief Executive Officer
CNSC	Canadian Nuclear Safety Commission
CRO	Chief Risk Officer
CSA	Canadian Standards Association
DRC	Darlington Refurbishment Committee
DRP	Darlington Refurbishment Program
EPC	Engineer Procure Construct
IA	Internal Audit
INPO	Institute of Nuclear Power Operations
MOE	Ministry of Energy
MSO	Management Systems Oversight
NO	Nuclear Oversight
NSC	Nuclear Supply Chain

<sup>2</sup> INPO 09-002 – Excellence in Nuclear Project Management; Section 19.1.9 Integrated Process Control

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OSC	Oversight Steering Committee
PAG	Program Assurance Group
POP	Project Oversight Plans
PROL	Power Reactor Operating License
QC	Quality Control
QS	Quality Surveillance
RMO	Risk Management and Oversight database
RPRB	Refurbishment Program Review Board
SCQS	Supply Chain Quality Services
SCR	Station Condition Record
WANO	World Association of Nuclear Operators

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## 5.0 REFERENCES

- 1) CSA N286-05, Management System Requirements for Nuclear Facilities
- 2) D-PCH-09701-10000, Darlington Refurbishment Project Charter
- 3) INPO 09-002: Excellence in Nuclear Project Management
- 4) INPO 09-007: Principles for Excellence in Nuclear Project Construction
- 5) INPO 11-007 Principles for Strong Governance and Oversight of Nuclear Power Organizations
- 6) N-CHAR-AS-0002, Nuclear Management System
- 7) N-GUID-00120-10012, Use of OPG Corrective Action Program (CAP) for Contractor Issues
- 8) N-GUID-01070-10001, Nuclear Oversight Audit Handbook
- 9) N-MAN-09701-10002, Nuclear Projects Oversight Guide
- 10) N-PROG-AS-0007, Project Management
- 11) N-PROC-MM-0010, Establishing and Maintaining Ontario Power Generation Approved Suppliers List
- 12) N-PROC-MM-0041, Quality Engineering and Supplier Performance Management
- 13) N-PROG-RA-0003, Corrective Action Program
- 14) N-PROG-RA-0010, Independent Assessment
- 15) N-PROC-RA-0048, Conducting Audits
- 16) N-PROC-RA-0097, Self Assessment and Benchmarking
- 17) N-STD-AS-0028, Project Management Standard
- 18) N-STD-AS-0030, Nuclear Projects Oversight Standard
- 19) NK38-GUID-09701-10032, Program Assurance Group Guide
- 20) NK38-NR-PLAN-09701-10001 Sheet 0010, Nuclear Projects Oversight Program Management Plan for Darlington Refurbishment
- 21) OPG-PROG-0004, Enterprise Risk Management

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## **Appendix A: Organizational Accountabilities**

### **A.1.0 DARLINGTON REFURBISHMENT TEAM**

The DR organization is comprised of Project and Function organizations. The organization design is based on a *Strong Matrix* principle where function staff will be assigned to support the project teams in achieving the project deliverables. The DRP uses EPC contractors to perform the majority of the work. This work is overseen by the project teams. Project Management is in accordance with N-PROG-AS-0007, Project Management and N-STD-AS-0028, Project Management Standard.

#### **A.1.1 DR Project Management Teams**

There are seven DR Projects within the program. They are:

- (1) Retube and Feeder Replacement
- (2) Turbine and Generator Upgrades
- (3) Islanding
- (4) Lay-up and Services
- (5) Steam Generators
- (6) Fuel Handling
- (7) Balance of Plant

Each project is led by a Project Manager or Director and is assisted by additional project staff. The Project Manager is accountable for the planning and execution of their project. The Project Managers are accountable to ensure that the EPC contractor(s) delivers the contracted products and services to the quality specified, on time and on budget, and conduct oversight in accordance with their POP. The Project Managers will request from the function organizations additional or specialized resources when required to plan and execute oversight activities.

#### **A.1.2 DR Project Support Functions**

There are Nine DR Functions within the program. They are:

- (1) Engineering
- (2) Planning and Controls
- (3) Supply Chain
- (4) Contract Management\*
- (5) Management Systems\*
- (6) Operations and Maintenance
- (7) Construction Oversight
- (8) Quality Management
- (9) Center Led Functions

\*Sub-departments of *Project Assurance and Contract Management*

Functions are led by a Director or Vice President. Functions set standards for projects and provide function support for the execution of the project. Functional organizations collaborate with the Project Teams in the development of the POP, and when required

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provide specialized or additional resources to execute the oversight activities. In addition to oversight, Function Leads are responsible for:

- Fulfilling Project Managers' resource requests by assigning required staff with the right skill-sets
- Forecasting resource demands and remedying gaps appropriately (e.g., hiring more people, negotiating with Project Managers to sequence demand)
- Establishing and enforcing project-wide safety and QA standards
- Establishing project-wide technical standards in their areas of accountability

### A.1.3 Management Systems Oversight (MSO)

MSO's main role is to ensure that the management system is in place and working effectively for the DRP. Specific accountabilities include:

- Execution of the PAG program. This includes performing process surveillances of the DRP and associated projects, and providing feedback to the Function Leads and Project Managers and RPRB.
- Providing support and assistance to project staff performing oversight activities of EPC Contractors.
- Supporting External Oversight reviews and evaluations.
- Managing the Corrective Action Program for DR.
- Coordinating the development and providing support for the execution of the Divisional Level Self-assessment schedule.
- Managing internal and external OPEX and Lessons Learned for DRP.

### A.1.4 Senior Vice President (SVP) Nuclear Projects

SVP Nuclear Projects provides direction and oversight to the entire Nuclear Projects organization. The SVP has overall accountability for oversight of the DRP with support from the Nuclear Project Executive Team (NPET). The SVP uses reports and updates from the Project Management Team and findings from IA, NO, and the Chief Risk Officer (CRO) to manage the DRP. The SVP is accountable for:

- Planning, directing, and providing vision and leadership for all aspects of the DR organization. These include producing a Release Quality Estimate (RQE) and schedule for the refurbishment project(s) and ultimately delivering a successful implementation of approved projects.
- Establishing performance standards for DR activities and functions.

### A.2.0 CHIEF NUCLEAR OFFICER (CNO)

CNO manages OPG's nuclear generation assets and resources in accordance with the approved business plan, producing targeted performance and results in a safe, reliable, and cost effective manner. The CNOs portfolio includes the DRP.

CNO provides the CEO with specialized advice and guidance regarding the nuclear generation business.



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### **A.3.0 CHIEF EXECUTIVE OFFICER (CEO)**

OPG CEO has overall responsibility for corporate performance. The CEO provides executive direction to the DRP in the context of business oversight. The CEO uses reports from the SVP Nuclear Projects on program status, audit reports from IA, NO, External Oversight groups and risk reports from the CRO to assist in executing his oversight accountabilities.

### **A.4.0 OPG BOARD OF DIRECTORS AND COMMITTEES**

OPG's BOD and Committees have an advisory and decision role in the operations of OPG business. The BOD uses the following information to provide direction to the DRP:

- Reports from the CEO and SVP Nuclear Projects on project status
- Risk reports from the CRO
- Audit and NO reports
- External Oversight reports

#### **A.4.1 Darlington Refurbishment Committee (DRC)**

The DRC is a sub-committee of the BOD. They provide oversight of the Darlington Refurbishment project.

### **A.5.0 ENTERPRISE LEADERSHIP TEAM (ELT)**

The ELT uses program updates from the SVP and Project Management Team to advise and support the SVP Nuclear Projects.

The core objective is to communicate the status of the DRP and to ensure alignment of objectives between the project team and its stakeholders. Additional objectives in support of this include:

- Communicating project and program level updates
- Sharing information, and when required, seek advice
- Confirming stakeholder support for deliverables required by the project, i.e. project financing
- Providing a forum for healthy challenges between stakeholders and the project teams

### **A.6.0 CORPORATE ASSURANCE**

Corporate Assurance is a centre led organization consisting of two divisions: IA and NO. The scope of their activities includes the evaluation of the effectiveness and efficiency of OPG's governance, risk management and control processes.

#### **A.6.1 Nuclear Oversight**

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NO scope includes assessments of programs under the Nuclear Management System, N-CHAR-AS-0002, as per N-PROG-RA-0010, Independent Assessment. A 3-year rolling audit schedule is produced to align audit activities with station activities or evolutions to confirm the continuing effectiveness of the management system. Oversight processes and reviews performed by the Supply Chain quality function and the external Nuclear Safety Review Board are also covered within this program.

Specific to DR, NO conducts audits and assessments are conducted for all phases of the program including Project Definition, Preliminary Planning, Detailed Planning, Execution and Project Closeout.

N-PROC-RA-0048, Conducting Audits establishes the methodology and requirements for planning, scheduling, staffing, preparing, performing, reporting and follow-up of audits and surveillances performed by NO. Additional guidance is provided in N-GUID-01070-10001, Nuclear Oversight Audit Handbook

#### **A.6.2 Internal Audit**

The IA organization reports directly to the CEO and BOD. OPG internal audits are identified through the Integrated Annual Audit Plan for OPG that is approved by the Audit and Finance Committee (AFC) of the BOD.

Independent objective assurance by IA assists the Board in fulfilling its strategic oversight responsibilities. IA helps OPG accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of the organization's risk management, control, and governance processes.

#### **A.7.0 INDUSTRY OVERSIGHT**

Industry regulatory and oversight bodies, including CNSC and WANO perform routine audits, assessments, and inspections of the DNGS performance. As the DR Project progresses, these reviews will include insights into the project's compliance with our PROL and WANO best practices. The Ministry of Environment and Climate Change and the Ministry of Labour will also provide oversight during the Darlington Refurbishment Project as required.

#### **A.8.0 REFURBISHMENT PROGRAM REVIEW BOARD (RPRB)**

RPRB is responsible for making impartial assessments of the Refurbishment Project to ensure that the team's actions are meeting expectations, commitments and are following industry proven project management practices. The RPRB executes specific monitoring, reviews and oversight to ensure that the Project remains on track, and that interfaces with Nuclear Operations and other key support functions (i.e., Supply Chain, People & Culture) are effective. The RPRB provides periodic reports to OPG Executives.

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#### **A.8.1 External Oversight**

The Darlington Refurbishment Committee (DRC) sub-committee of the board uses External Oversight (EO) as an independent external organization to assist in fulfilling their mandate by providing independent assessments on the performance of the DRP.

The scope of the external evaluations or assessments may include:

- Reviewing and monitoring the definition, development and risk management of the Refurbishment Program
- Monitoring the progress of the Refurbishment Program against cost, schedule, financing, risk, safety and other targets
- Reviewing execution performance of the Refurbishment Program
- Review of relevant Refurbishment Program project management documentation

#### **A.9.0 CHIEF RISK OFFICER (CRO)**

The BOD approved Corporate Risk Management Policy holds the CRO accountable for independently overseeing risk management and mitigation programs within OPG.

The Enterprise Risk Management (ERM) group is accountable for performing oversight on behalf of the CRO. For OPG's destiny projects, ERM will focus on project risks which could significantly impact the achievement of corporate objectives.

#### **A.10.0 INDEPENDENT OVERSIGHT ADVISOR**

The Minister of Energy has contracted an Independent Oversight Advisor (IOA). The advisor has full access to the DRP. The IOA is embedded in the DRC.

The purpose of the IOA is to advise the Minister of Energy on the effectiveness of execution of the Refurbishment Program with respect to risks associated with the Refurbishment Program budget and schedule.

#### **A.11.0 MINISTRY OF ENERGY/GOVERNMENT OF ONTARIO (MOE)**

OPG's sole shareholder is the Government of Ontario. The shareholder expects the DRP to be on time, on budget and with high safety and quality performance. The shareholder uses reports from the CEO and EVP Nuclear Projects on project status, including External Oversight reports and access to External Oversight firms.



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**Darlington Refurbishment Construction  
Program Management Plan**

**NK38-NR-PLAN-09701-10001-0012-R001**  
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Revision Number	Date	Comments
REV000	2014-01-31	<p>This document supersedes NK38-PLAN-09701-10067 Sheet 0014. The changes between NK38-PLAN-09701-10067 Sheet 0014 and this document are as follows:</p> <ul style="list-style-type: none"> <li>• The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001,</li> <li>• The security classification has been removed so that the document can be submitted to the CNSC, and</li> <li>• References have been updated.</li> </ul>
REV001	2016-08-15	Minor changes done to reflect Construction Organizational make-up and Reference Document additions/title changes.

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## 1.0 PURPOSE

The purpose of this Program Management Plan (PgMP) is to define how Construction Management will occur for the refurbishment program.

Construction Management is the responsibility of the individual EPC contractors. The OPG Refurbishment Execution Organization is structured to support each of the major project bundles within the Refurbishment program by providing each bundle with an experienced Construction Manager, Safety Team, and Materials Support for the purposes of performing field support and oversight. The project bundles are as follows:

1. Shut down, Lay up and Services
2. Islanding
3. Fuel Handling
4. Retube and Feeder Replacement
5. Turbines and Generators
6. Steam Generators
7. Balance of Plant

OPG Construction Managers, reporting to the OPG Director of Construction, has a matrix reporting relationship to each of the OPG Project Managers for the length of the Refurbishment Project.

The OPG Construction Execution Team provides risk based oversight as laid out in each individual Project Oversight Plan (POP). Construction Execution Oversight of Supplemental Personnel is accomplished through N-STD-AS-0032, Oversight of Supplemental Personnel and NK38-GUID-09701-10043, Refurbishment Construction Execution And Field Support-Supplemental Worker Oversight which are aligned to AP-930, INPO Supplemental Worker Process.

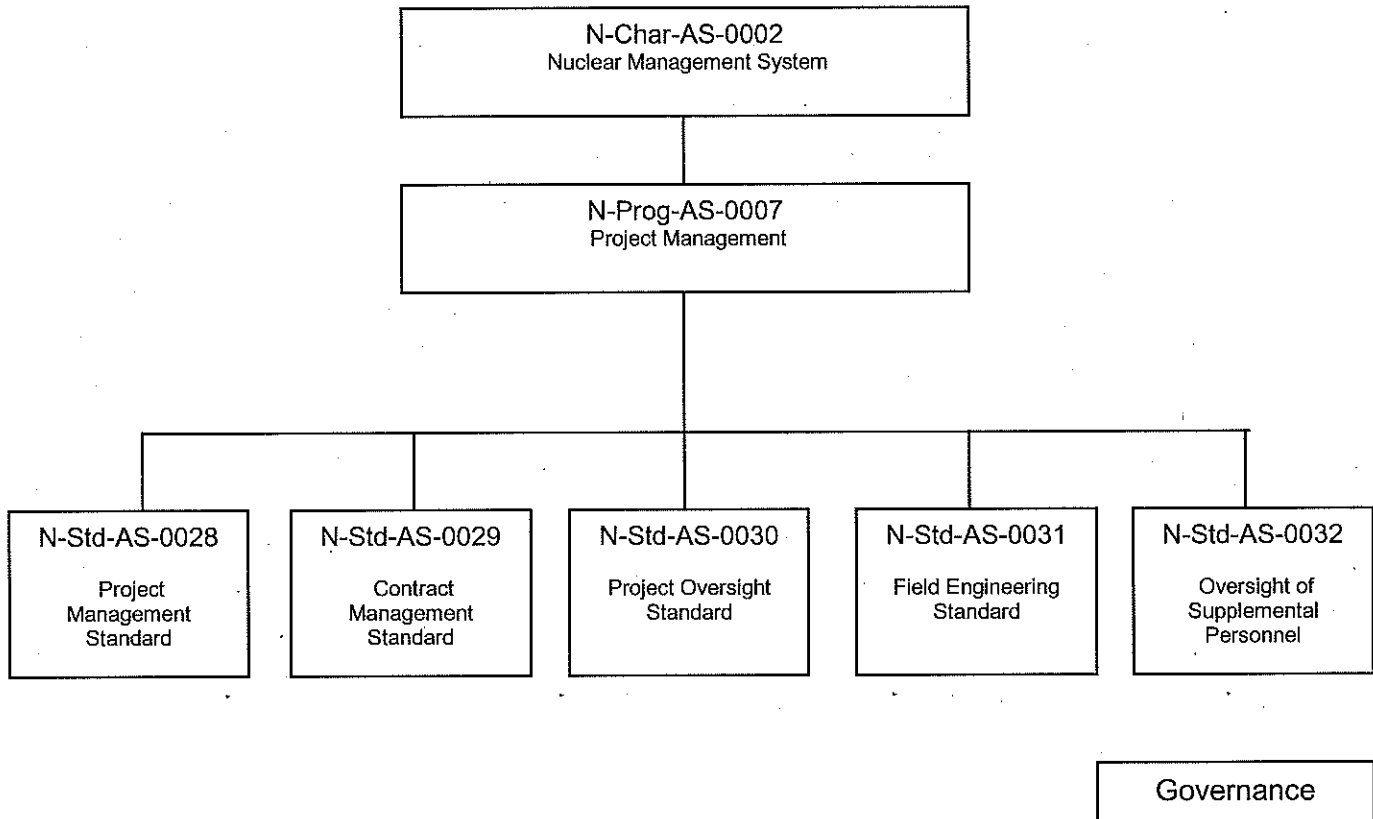
## 2.0 PROGRAM REQUIREMENTS

This Construction PgMP aligns with Corporate, Nuclear, and other business unit governance, governance support and non-governance documentation. Figure 1 shows the framework of documents that impact this PgMP.

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Figure 1: Construction Management Framework



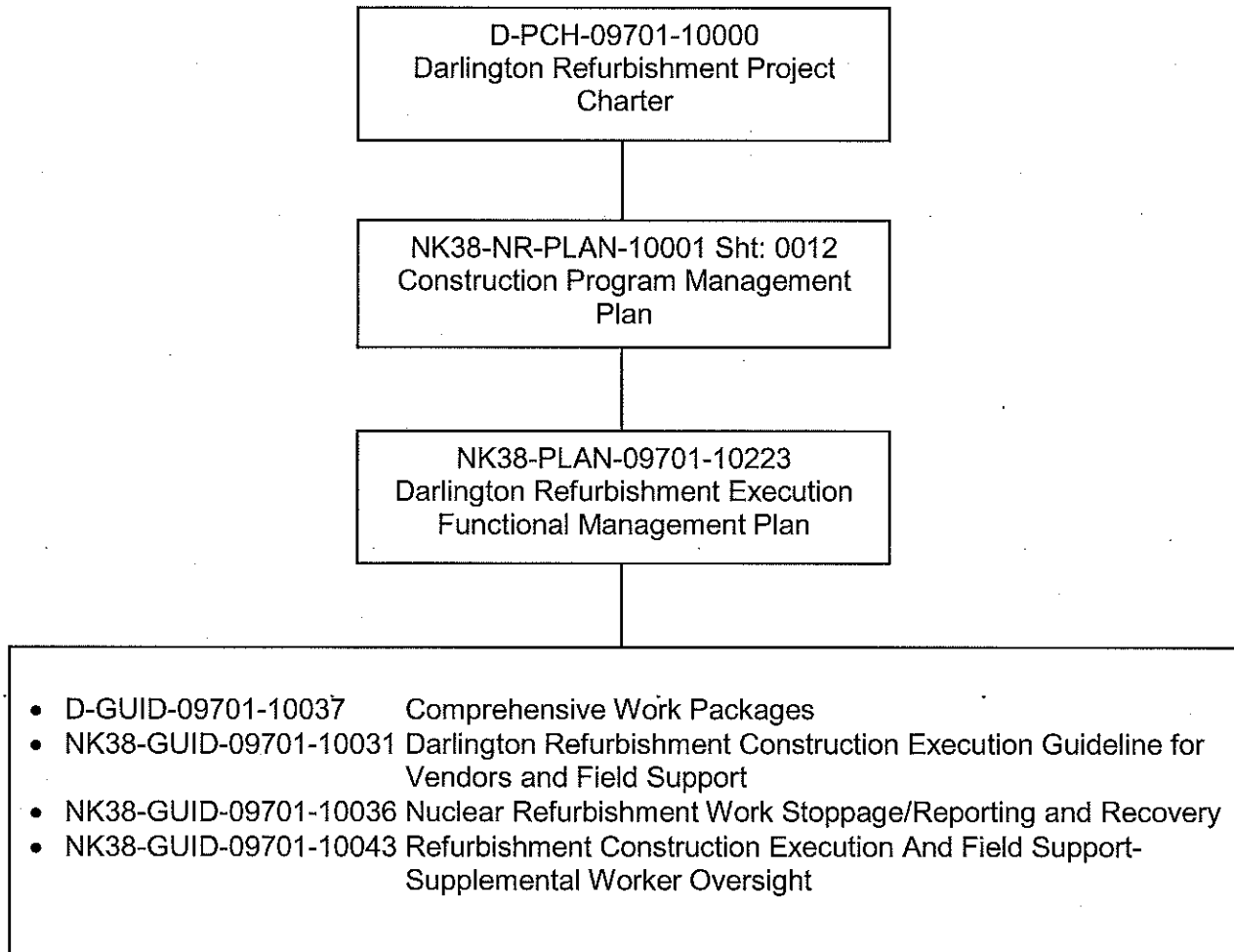


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Non-Governance



## 2.1 Construction Execution Processes

Construction Execution produces and implements methods and processes which clarify expectations and requirements of both OPG and Vendors. Documentation produced including guides and memorandums which will further support industry best practices, efficiencies, and alignment between Vendors (e.g. Construction Lookahead team as defined in NK38-GUID-09701-10043, Refurbishment Construction Execution And Field Support-Supplemental Worker Oversight).

NK38-GUID-09701-10031, Darlington Refurbishment Construction Execution Guideline For Vendors And Field Support, is a "living document" identifying processes, strategies, direction and expectations related to field execution activities, considering the Refurbishment Contractor/Owner Interface Requirements (N-COI-00120-00001),

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INPO Principals for Excellence in Nuclear Project Construction, and significant Operating Experience (OPEX) from other large refurbishments as well as internal OPEX.

D-GUID-09701-10037 Comprehensive Work Packages provides recommendations on creation (layout and content) of Comprehensive Work Packages (CWP) to be used on the Darlington Nuclear Refurbishment (DNR) project.

Work stoppage events on the Darlington Nuclear Refurbishment Project, pose significant risks to the refurbishment cost and schedule. To mitigate these risks, strategies must be implemented for event management and event recovery. NK38-GUID-09701-10036 Nuclear Refurbishment Work Stoppage/Reporting and Recovery details recovery strategies to reduce the impact.

## 2.2 Construction Execution Oversight

There are four Fundamental Support and Oversight Accountabilities as described below. Oversight staff in each of the groups work cross-functionally in support of the four fundamentals and accountabilities:

1. Financial/Commercial Aspects: Project Director/Project Manager accountability utilizing Project Planning and Control staff.
2. Field Support and Vendor Behaviours: Construction Execution Director accountability utilizing Construction Oversight Personnel
3. Field Monitoring of Quality Program: Quality Director accountability utilizing Quality Surveillance staff.
4. Refurbishment Program Assurance: Managed System Oversight Director accountability utilizing Program Assurance Group (PAG) staff.

Additional details are captured in following Program Management Plans

- NK38-NR-PLAN-09701-10001 Sht 002, Darlington Refurbishment Planning And Controls Program Management Plan
- NK38-NR-PLAN-09701-10001 Sht 0023, Darlington Refurbishment Quality Program Management Plan
- NK38-NR-PLAN-09701-10001 Sht 0011, Darlington Refurbishment Program Assurance Program Management Plan

The POP includes oversight to confirm:

- Work is adequately planned and executed event free.
- Quality requirements are satisfied.

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- Industry best practices workmanship standards are maintained.
- Contractor Supervision is Capable, Competent, and Qualified.

### 2.3 Performance Indicators and Monitoring Activities

The following is a list of Construction performance indicators/monitoring activities tracked and trended on the Construction Dashboard:

- Vendor Safety Performance
- Oversight Observations
- Construction Readiness
- Field Initiated Changes
- Overdue Actions
- Work Efficiencies
- Hall Metrics
- Cost

## 3.0 ROLES & ACCOUNTABILITIES

### 3.1 Director of Construction

- 3.1.1 Provides leadership, strategic direction and support to the field execution teams.
- 3.1.2 Ensures OPG Construction Managers are providing the required oversight of contractors employed on the Darlington Refurbishment project.
- 3.1.3 Provides direction to the OPG Construction Managers on oversight of contractors with regards to performing work safely, effectively and in a manner consistent with the terms of the respective contract and the requirements as laid out in the POP and NK38-GUID-09701-10043, Refurbishment Construction Execution And Field Support-Supplemental Worker Oversight.
- 3.1.4 Provides assurance to the Vice President Refurbishment Execution that risk based Construction oversight is being provided in accordance with the project POPs and the contract standards.
- 3.1.5 Provides the governance and guidance for construction oversight and is the document owner and is responsible for the definition and implementation of this document.

### 3.2 Project Director/Manager

Provides the Construction Manager with direction on day to day accountabilities per the POP.

### 3.3 Construction Manager

- 3.3.1 Reports to the Construction Director while functionally reporting to the respective Project Manager and provides Construction support and oversight for the specific

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project bundle in accordance with the POP and NK38-GUID-09701-10043, Refurbishment Construction Execution And Field Support-Supplemental Worker Oversight.

- 3.3.2 Supports the identified oversight based on risk and as laid out by the individual Project teams based on the needs and requirements of the specific EPC contract and it's POP.

#### **4.0 DEFINITIONS AND ACRONYMS**

##### **4.1 Definitions**

None

##### **4.2 Acronymns**

- EPC Engineer, Procure, Construct
- PgMP Program Management Plan
- POP Project Oversight Plan
- COIR Contractor/Owner Interface Requirements
- INPO Institue of Nuclear Power Operations

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## 5.0 REFERENCES

- [R-1] NK38-PLAN-09701-10223 Darlington Refurbishment Execution Functional Management Plan
- [R-2] N-STD-AS-0030 Project Oversight Standard
- [R-3] N-STD-AS-0032 Oversight of Supplemental Personnel
- [R-4] NK38-GUID-09701-10031 Darlington Refurbishment Construction Execution Guideline for Vendors and Field Support
- [R-5] N-FORM-09071-10001 Oversight Report
- [R-6] N-INS-09701-10007 Project Oversight Planning and Implementation
- [R-7] NK38-GUID-09701-10043 Refurbishment Construction Execution And Field Support-Supplemental Worker Oversight
- [R-8] N-MAN-09701-10002 Nuclear Project Oversight Guide
- [R-9] NK38-LIST-09701-10001 Project Oversight Plan – Health & Safety
- [R-10] D-GUID-09701-10037 Comprehensive Work Packages
- [R-11] NK38-GUID-09701-10031 Darlington Refurbishment Construction Execution and Field Support –Supplemental Personnel Oversight
- [R-12] NK38-GUID-09701-10036 Nuclear Refurbishment Work Stoppage/Reporting and Recovery
- [R-13] NK38-GUID-09701-10043 Refurbishment Construction Execution And Field Support-Supplemental Worker Oversight
- [R-14] N-COI-00120-00001 Refurbishment Contractor/Owner Interface Requirements
- [R-15] AP-930 INPO-Supplemental Personnel Process Description



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**Darlington Refurbishment  
Communications Program Management  
Plan**

NK38-NR-PLAN-09701-10001-0014-R003  
2016-09-06

Order Number: N/A  
Other Reference Number:

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### Revision Summary

Revision Number	Date	Comments
R003	2016-09-06	Updated and revised. Minor adjustments to wording and to reflect name changes and reporting structures.
R002	2015-08-24	Revised to include Management Systems Oversight as a reviewer required in NK38-MAN-09701-10006: Nuclear Refurbishment- Requirements for Process Support
R001	2015-01-16	Revised to incorporate Communication Program Process Support Document flowchart and Stakeholder Management
R000	2014-01-31	<p>This document supersedes NK38-PLAN-09701-10067 Sheet 0007. The changes between NK38-PLAN-09701-10067 Sheet 0007 and this document are as follows:</p> <ul style="list-style-type: none"> <li>The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001,</li> <li>The security classification has been removed so that the document can be submitted to the CNSC, and</li> <li>References have been updated</li> </ul>



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## 1.0 PURPOSE

The purpose of the Refurbishment Program Communication Management Plan is to ensure that all Refurbishment Program information, which is considered an asset, is managed such that information is communicated to those who need the information in a manner that ensures the information is current, correct, and timely.

The Refurbishment Program Communications Management Plan provides overall direction on communications, information management and reputational management for internal and external audiences.

## 2.0 PROGRAM REQUIREMENTS

This Communication Management Plan aligns with Nuclear, Corporate, and other business unit governance, governance support and non-governance documentation. Figure 1 shows the framework of documents that impact this Management Plan.

The program is further aligned with the Refurbishment Execution organization and leadership team.

All methods and forms of communication by or on behalf of the Project including written, oral, and electronic communications shall be processed in accordance with the managed system illustrated in Figure 1.

Stakeholder's needs are analyzed when determining communications actions.

To ensure overall Refurbishment Program requirements are being met as specified, communication effectiveness is monitored through: leadership forms, performance indicators such as quantitative and qualitative surveys, stakeholder feedback and management team opinion.

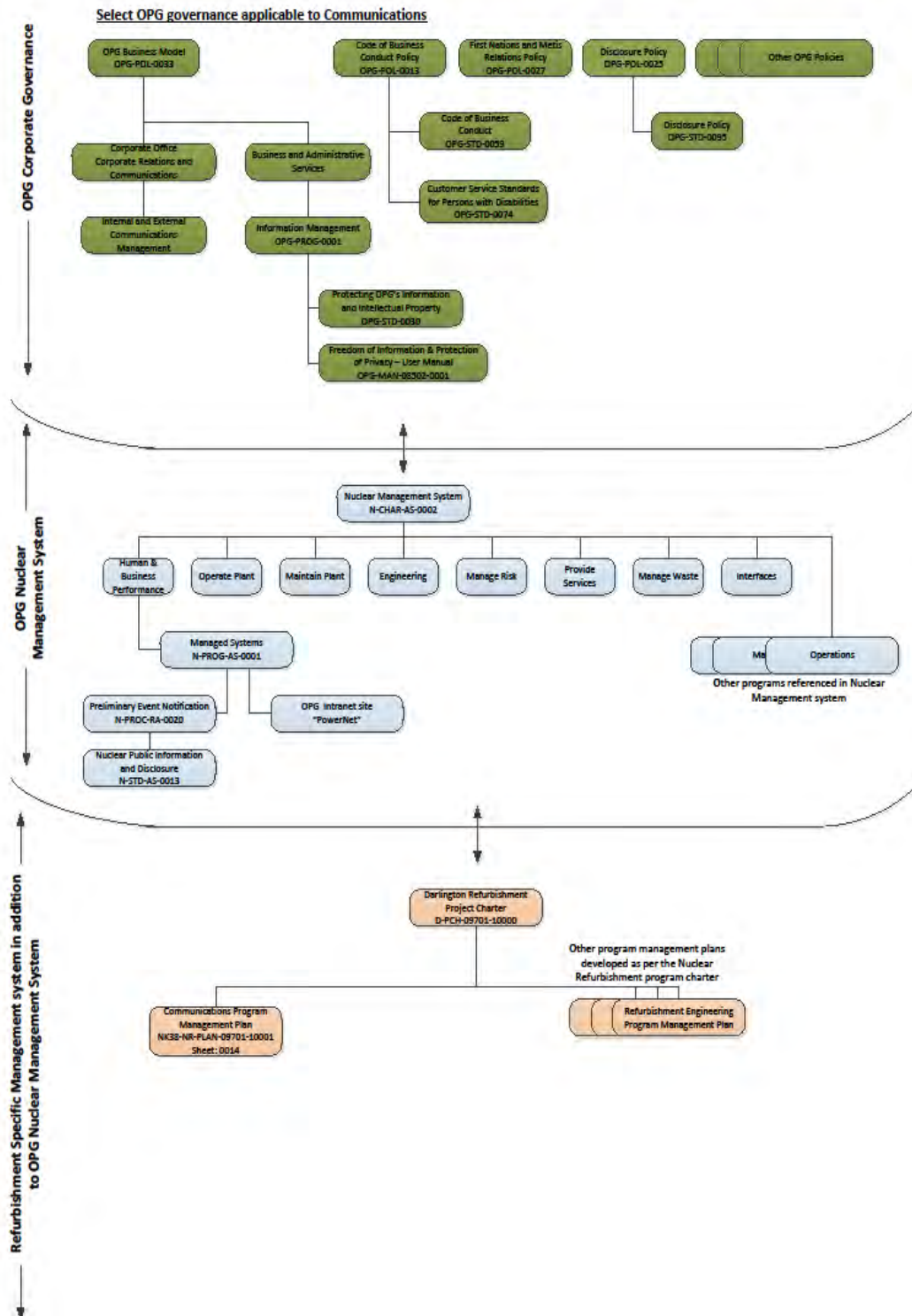
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Figure 1: Nuclear Refurbishment – Communications Program Process Support Documents

**Nuclear Refurbishment – Communications Program Process Support Documents**



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## 2.1 INTERNAL COMMUNICATIONS

All internal communications shall be executed in a professional manner that is open, honest, accurate and timely. Unless specifically noted, all communications shall adopt the most effective communication channels and methods to ensure correct and current information is provided in time to the people who need it.

Communications Relations and Communications (CRC) will ensure alignment in communications with Corporate CRC, Refurbishment Organization and with line-base support through the Refurbishment Execution organization.

Major events or Program changes may require the development of an event specific communication plan. Event specific communication plans are reviewed for acceptance by the Director, Planning and Controls (P&C) and Director, Nuclear CRC following consultation with the appropriate Executive Management.

### 2.1.1 Ontario Power Generation Executive Management

The VP Planning & Project Controls, shall, with the SVP, Nuclear Projects, coordinate internal communications between the Project and OPG Executive Management. The Director shall produce, write and coordinate submissions to the OPG Board of Directors and other Board and Executive Committees, including the Nuclear Projects Executive Team (NPET) and ensure the timely and appropriate committee scheduling for corporate review and approval of designated items.

### 2.1.2 Project Team Communications

Open communication is essential for timely decision-making and efficient execution of the Refurbishment Program, a 'no surprises' approach to Project execution is desired. Key elements of Project Team communications include, but are not limited to:

- Planning meetings involving key Project Team members to define the scope of work and establish baseline budgets and schedules for future work.
- Monthly progress meetings involving key Project Team members to review cost and schedule performance versus the baseline plan.
- Lessons Learned meetings, at appropriate points, to review lessons learned and implement identified improvements.
- Project Execution Update meetings, convened by the SVP Refurbishment Execution, involving status of various projects.
- Other team meetings as required.
- Face-to-face forums.
- Intranet and SharePoint sites dedicated to the Project.
- E-mail interface.

Where appropriate, efforts of the Project Team will be coordinated and integrated to facilitate effective communication. Meeting Notes should be used to document the purpose, date, location, attendance, file number, summary of the discussion, results, and follow-up actions required; and prepared and issued by the meeting organizer

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within one week after the meeting. A copy of the Meeting Notes is to be filed in the Project Records Centre by the meeting organizer. Action items identified at meetings will be issued using the Refurbishment database Action Log to all Program Team members to enhance the level of communications and understanding of the Project development.

### 2.1.3 Nuclear and OPG Employees

Some Refurbishment Program communications may also be targeted at all Nuclear employees as well as OPG Employees as appropriate. Refurbishment communications shall be developed by CRC in consultation with the Program, and issued by the SVP, Refurbishment Program.

### 2.1.4 Darlington Nuclear Generation Station Employees

Lessons learned and Operating Experience supports the creation of a separate communications organization from the plant, for major projects such as a refurbishment. As the Refurbishment program has progressed so has interface with the Darlington Nuclear Generating Station. The alignment between the Refurbishment Program and the Station will continue to grow and become increasingly integrated and aligned as we approach the first unit outage in 2016. Key elements of station integration communications include, but are not limited to:

- updates in the Darlington Director of Operations and Maintenance weekly employee message.
- Joint senior leadership messages including: organizational announcements, station events, human performance messages and informational updates.
- Intranet articles on Nuclear News, accessible for Darlington Employees.
- Intranet spotlight on Nuclear News titled "Site Activities", dedicated to construction updates regarding the Projects and Modifications projects (also referred to as Campus Plan Projects, and Refurbishment Pre-Requisite Projects) projects located within and outside the Darlington Public Area.
- Refurbishment spot light in all station outage communications including: Refurbishment Outage Manager Message regarding Refurbishment outage activities.
- Target vision slides including site updates regarding Refurbishment Pre-Requisite Projects, risk management slides, and other timely Refurbishment updates.
- Refurbishment quarterly updates at the Darlington Stratum 3/4/5/ monthly meetings.
- Bi-weekly Newsletters, posters, site-wide emails, face-to-face communications, presentations and outage briefing materials.

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## 2.2 External Communications

All external communications shall be made in a professional manner that is open and transparent and which supports effective reputational management. External Project communications will typically be driven by key regulatory steps and phases, initiation of work phases and outage segments, semi-annual reporting, major milestones and proactive media/external communication opportunities such as stories on employees, innovation and technology. Major events (key Project announcements, schedule changes, etc.) may require the development of an event specific communication plan.

Event specific communication plans are to be developed and reviewed for acceptance by the Director, Planning and Controls (P&C) and Director, Nuclear CRC following consultation with the appropriate internal stakeholders such as Nuclear Project Executive Team (NPET) members.

Darlington Refurbishment communications build on the extensive work and existing relationships in the host communities, communities of interest, industry and with other relevant stakeholders. These provide a solid foundation for the Darlington Nuclear Refurbishment Program to build upon and will help mitigate challenges and issues should they arise.

### 2.2.1 External Communications Audience

External Refurbishment Program communications includes the sharing of information with the public, external stakeholders and audiences, which can include:

- First Nations and Métis communities,
- Host communities, the general public, elected officials and opinion leaders within the host communities,
- Industry partners and OCI members,
- Other local communities, municipalities and other communities of interest,
- Key industry stakeholders, including COG and CNA,
- OPG employee unions and other organizations of civil society,
- Federal Ministers, Members of Parliament, and senior officials within the Federal departments and Regulatory Agencies,
- Government of Ontario and other Provincial Agencies,
- Engaged activists and Project followers,
- Others with an interest in the Project due to its locations, costs or effects, and
- Media.

### 2.2.2 Key External Communication Goals

The key goals of Refurbishment Program external communications are:

- Provide a communications platform that is, and is seen as open, transparent and meeting the needs of the audience;

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- Ensure all regulatory requirements regarding communications and/or public consultation are satisfied;
- Develop and maintain support for the Program through proactive engagement of relevant stakeholders; and
- Protect and maintain OPG's reputation by demonstrating OPG's commitment to accountability and that the Program is well-managed.

### 2.2.3 Key Principles

Consideration will be given to:

**Timing:** Timely, accurate notification of key program milestones, commencement of refurbishment activities, EA milestones and Program completion.

**Relationships:** Notification of and responsiveness to stakeholder interests including government, media, interest groups, neighbours, general public and host community opinion leaders, First Nation and Métis communities.

**Communication Vehicles:** Effective use of various proven communications media (print, web-based, social media, broadcast and other media to deliver messages) as well as community committees, and other forums for face-to-face communication.

### 2.3 External Communications – Regulatory

All official communication with the Canadian Nuclear Safety Commission and other Regulatory Agencies will be through the OPG Nuclear Regulatory Affairs Division. N-PROC-RA-0047 Communications with the CNSC, and N-PROC-RA-0006 Regulatory Action Management, are used to manage all regulatory communications.

### 2.4 External Communications - Engineer, Procure, and Construct/Vendor Company Communications

All official communications with the EPC/Vendor Companies will be through the VP, Project Execution or persons designated by the VP. All methods and forms of communication with the EPC, by or on behalf of Darlington Refurbishment, including written, oral, and electronic communications, event reporting and notifications and receipt of reports from EPC shall be processed in accordance with the Vendor Communication expectations as outlined in the specific Refurbishment Project Management Plans.

### 2.5 Stakeholder Management

OPG will engage with external stakeholders about the project. The strategy for engagement will build on the foundation established through extensive work and relationships over the past several years. These strong relationships and existing processes provide the ground work and allow Corporate Relations and Communications to build and to mitigate challenges and issues as they arise.

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Stakeholder Group	Includes	Role
Government	<ul style="list-style-type: none"> <li>Municipal, Regional, Provincial, Federal</li> <li>Federal Ministers, Members of Parliament, and senior officials within the Federal departments and Regulatory Agencies,</li> </ul>	Decision makers
Influencers of Government	<ul style="list-style-type: none"> <li>Boards of Trade/Chambers of Commerce, education institution leaders, opinion leaders, senior executive of companies and corporations</li> </ul>	Direct pipeline to the decision makers, and help establish OPG's reputation in non-host communities.
Industry and Suppliers	<ul style="list-style-type: none"> <li>Industry – CNA, CNS, COG, OCI, Assoc. Power Producers Ontario, Can Assoc Nuclear Host Communities, INPO/WANO, Ontario Energy Network, Prof Engineers of Ontario, etc.</li> <li>Suppliers – B&amp;M, Siemens, B&amp;W, SNC-Lavalin Nuclear, Aecon, Candu Energy Inc., GE/Hitachi, Alstom, Cameco, etc.</li> </ul>	May be key to the project's success, and can be a positive voice for the project and OPG.
Communities	<ul style="list-style-type: none"> <li>OPG host communities (nuclear and non-nuclear)</li> </ul>	OPG has a good reputation in nuclear and non-nuclear host communities – must continue to cultivate understanding and support for OPG in general and Darlington Refurbishment project in particular.
Media	<ul style="list-style-type: none"> <li>Local, Provincial/National, editorial boards, trade journals/publications, technology and innovation, including earned media through special projects</li> </ul>	Can affect the opinions of decision makers, influencers of government, communities, etc. for the project as well as drive their response to various reports in the media.
Special Interest	Engaged activists and Project	Can be influential on the

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Stakeholder Group	Includes	Role
Groups	followers, others with an interest in the Project due to its locations, costs or effects, OPG employee unions and other organizations of civil society, etc.	nature and direction of a project.

## 2.6 Indigenous Communities

OPG recognizes that it must conduct its business in a manner that is both socially and environmentally responsible. OPG's demonstration of this commitment is founded within a corporate-wide policy that provides a framework for engaging with Aboriginal Peoples and supporting programs, committees and community initiatives that reflect its tenets and puts the philosophy into practice.

These principles (among others) form the basis of communication and engagement efforts with First Nation and Métis communities and help direct the establishment of long-term mutually beneficial working relationships with communities in proximity to its present and future operations.

## 3.0 ROLES AND ACCOUNTABILITIES

Corporate Relations and Communications [CRC] is a centre-led function responsible for establishing corporate policies and standards to be used in communications management. Additionally, the function is accountable for performing activities relevant to their function in consultation and agreement with the Project.

The Manager, Nuclear Corporate Relations and Communications (CRC), is responsible to plan, manage and control communications regarding the Project, consistent with Project needs, in accordance with appropriate corporate standards, and as per CNSC requirements where applicable.

Nuclear Regulatory Affairs Division is accountable for all official communication with the Canadian Nuclear Safety Commission and other Regulatory Agencies.

## 3.1 Program Communications Management Plan Approvals

CRC will oversee Refurbishment Program communications with reviews and approvals by the SVP, Nuclear Refurbishment, Director, CRC and the SVP, Nuclear Projects.

CRC will ensure alignment with the communications support between Darlington Station and the communications line-based effort for the project generated under the



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SVP of Project Execution. CRC management will ensure appropriate consultation and approval from VP Corporate Relations is sought for Program alignment with OPG reputation and overall Corporate communication strategy.

### 3.2 Documentation and Filing

Refurbishment Program shall follow OPG-PROG-0001. An annual Refurbishment Communications report will be developed by CRC.

## 4.0 DEFINITIONS AND ACRONYMS

### 4.1 Definitions

**Communications Planning** is the process of determining the information and communication needs of the program stakeholders, who will need what information, when they need it, how they need it, how it will be given to them and by whom.

**Regulatory Agency(s)** include any federal, provincial, or municipal government agency, ministry or department that is responsible for the regulation of the project including any requirements to authorize, permit, licence, or otherwise approve the project.

### 4.2 Abbreviations and Acronyms

<b>B&amp;M</b>	Black & MacDonald
<b>B&amp;W</b>	Babcock & Wilcox
<b>CNA</b>	Canadian Nuclear Association
<b>CNS</b>	Canadian Nuclear Society
<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>COG</b>	CANDU Owners' Group
<b>CRC</b>	Corporate Relations and Communications
<b>EPC</b>	Engineer, Procure, and Construct
<b>INPO</b>	Institute of Nuclear Power Operations
<b>NPET</b>	Nuclear Project Executive Team
<b>OPG</b>	Ontario Power Generation
<b>P&amp;C</b>	Planning and Controls
<b>SVP</b>	Senior Vice President
<b>VP</b>	Vice-President
<b>WANO</b>	World Association of Nuclear Operators

## 5.0 REFERENCES

**N-PROC-RA-0047** – Communications with the Canadian Nuclear Safety Commission  
**N-PROC-RA-0006** – Regulatory Action Management  
**OPG-PROG-0001**- Information Management



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**DARLINGTON REFURBISHMENT SUPPLY CHAIN PROGRAM MANAGEMENT PLAN**

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**Darlington Refurbishment Supply Chain  
Program Management Plan**

**NK38-NR-PLAN-09701-10001-0015-R001**  
2015-09-30

Order Number: N/A  
Other Reference Number:

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**DARLINGTON REFURBISHMENT SUPPLY CHAIN PROGRAM MANAGEMENT PLAN**

### Revision Summary

Revision Number	Date	Comments
R001	2015-09-30	Revise to reflect changes to Darlington Refurbishment Supply Chain Functional Management Plan

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## 1.0 PURPOSE

This Program Management Plan defines the Program Requirements and Roles and Accountabilities for Refurbishment Supply Chain (RSC) for the Darlington Refurbishment (DR) Project, and within the framework of sheets of this document, describes the Supply Chain elements of the program as it applies to DR.

RSC reports to the centre led Business Administrative Services (BAS) Supply Chain. RSC is matrixed to the NR Program, and is also supported by Projects and Modifications SC, Vendor Oversight, and Darlington SC.

This Program Management Plan aligns with Nuclear, Corporate, and other business unit governance, governance support and non-governance documentation.

## 2.0 PROGRAM REQUIREMENTS

Procedure OPG-PROC-0164: Procurement Activities: Projects, outlines the processes used by Ontario Power Generation Inc. (OPG) to procure services (including engineering, procurement, and construction) related solely to support construction projects . This includes work related to hydro/thermal generating facilities, nuclear facilities including nuclear waste, Darlington refurbishment, and real estate projects such as new building construction. Procurement processes include planning, creating and issuing a Request for Information (RFI), Request for Quotations (RFQ) or Request for Proposals (RFP), receipt and evaluation of quotations or proposals from suppliers, negotiation, selection of a supplier, and the finalization and award of a contract.

### 2.1 Core Principles for Procurement Activities

OPG shall acquire items and/or services required to meet OPG's requirements in the most safe, economical and efficient manner. Specifically, OPG shall adhere to the following principles:

- a) Vendor Access, Transparency, and Fairness. Access for suppliers to compete for OPG's business and the procurement process shall be conducted in a transparent manner, providing fair treatment to suppliers. Conflict of interest, both real and perceived, shall be avoided during the procurement process and the ensuing contract, ensuring continuous reliance on a particular supplier for a particular kind of work is avoided.
- b) Value for Money. Items and services shall be procured only after consideration of OPG's business requirements, alternatives, timing, supply strategy, and procurement method.
- c) Responsible Management. The procurement of items and services shall be responsibly and effectively managed through appropriate organization structures, systems, policies, processes, and procedures.

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- d) Geographic Neutrality and Reciprocal Non-Discrimination. To the extent OPG is subject to any Ontario trade agreements with other jurisdictions, OPG shall also ensure that access for suppliers to compete for OPG's business is geographically neutral with respect to other jurisdictions that practice reciprocal non-discrimination with Ontario.

OPG shall use a competitive procurement process. Single source/sole source shall be used as an exception to the normal competitive procurement process.

OPG shall not take any action(s), such as subdividing projects or contracts and awarding multiple consecutive contracts to the same supplier, thereby reducing the value of a purchase with the potential to avoid any requirements regarding competition, approvals, or reporting.

### 3.0 PROCUREMENT OVERSIGHT

Guideline N-GUID-09701-10022: Supply Chain Oversight, outlines the processes used for planning, conducting and reporting of oversight performed by Supply Chain on Procurement contracts. This guide takes authority from N-STD-AS-0030, Projects Oversight Standard.

Oversight is based on a graded and risk based approach. The frequency of the oversight is applied strategically based on project complexity, risks, and contractor performance, as documented in respective Project Oversight Plans.

### 4.0 ROLES AND ACCOUNTABILITIES

#### 4.1 Vice President, Supply Services, Refurbishment Supply Chain

Ensure that Supply Chain staff (including temporary employees or contractors) complies with the requirements of OPG-PROC-0164.

Ensure the integrity of OPG is managed to ensure the Code of Business Conduct is upheld and all suppliers and proponents are treated fairly, ethically and responsibly.

#### 4.2 Director, Supply Services – OPG Projects

Ensures requirements for proposals, quotations and supplier quotation / proposal evaluations are adhered to by appropriate staff.

#### 4.3 Senior Manager, Supply Services – OPG Projects

Ensure requirements for proposals, quotations and supplier quotation / proposal evaluations are adhered to by appropriate staff.

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### **4.4 Senior Manager, Procurement Oversight**

Responsible for assigning qualified and trained staff to perform Procurement oversight activity.

Ensures Supply Chain oversight activities are performed as planned.

## **5.0 DEFINITIONS AND ACRONYMS**

### **5.1 Definitions**

None

### **5.2 Acronyms**

BAS	Business Administrative Services
DR	Darlington Refurbishment
OPG	Ontario Power Generation
RFI	Request for Information
RFP	Request for Proposals
RFQ	Request for Quotations
RSC	Refurbishment Supply Chain\
SC	Supply Chain

## **6.0 REFERENCES**

OPG-PROC-0164, "Procurement Activities"

N-GUID-09701-10022, "Supply Chain Oversight"



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**DARLINGTON REFURBISHMENT STAFFING PROGRAM MANAGEMENT PLAN**

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**Darlington Refurbishment Staffing  
Program Management Plan**

**NK38-PLAN-09701-10001-0016-R003**  
2016-09-08

Order Number: N/A  
Other Reference Number:

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### Revision Summary

Revision Number	Date	Comments
R000	2014-02-10	<p>This document supersedes NK38-PLAN-09701-10067 Sheet 0008. The changes between NK38-PLAN-09701-10067 Sheet 0008 and this document are as follows:</p> <ul style="list-style-type: none"> <li>• The content of the document and its document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001,</li> <li>• The security classification has been changed to OPG Confidential, and</li> <li>• References have been updated.</li> </ul>
R001	2014-06-13	Updated to remove confidential information and to declassify the document.
R002	2015-03-01	Revised to address comments from Self Assessment RF14-000625
R003	2016-09-08	Minor changes to the department names and remove appendices

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## 1.0 PURPOSE

This document describes the plan for staffing the Darlington Refurbishment Program and the processes to manage staffing and succession planning over the life of the Program. This includes hiring of OPG employees as well as contract staff, succession planning and performance development. This plan references existing OPG and refurbishment planning processes, People, Culture & Communications policies, Supply Chain policies, and applicable Collective Agreements that may be used for program staffing. In this plan, the term “Staffing” is used broadly to define the staffing life-cycle from recruitment and selection, on-boarding, succession planning, performance development, retention and employee terminations. This document addresses Darlington Refurbishment (DR) resources as well as those external to the program (within or outside the organization). Given the nature of the work program, it is anticipated that program staffing needs will evolve and change as work scope, milestones and external factors change. Nothing in this plan is intended to limit management’s ability to alter staffing plans and resourcing needs associated with the Project.

## 2.0 PROGRAM REQUIREMENTS

### 2.1 Staffing Assumptions

As an over-riding principle, and from a business efficiency and project continuity perspective, it is OPG’s intent to maintain qualified personnel within the DR Program or replace with existing, qualified OPG personnel. Contractors and temporary staff should be used to augment base staffing levels and manage peaks in demand or address areas where there is a shortage of critical resources or qualified and experienced staff.

Existing OPG job documents will be used to staff the Project, except where new, specific job documents are required to address organizational needs. In such cases, OPG job evaluation processes will be used to create new job documents as needed.

OPG’s core business is operating and managing the maintenance of its generating assets. As a result, OPG does not have the requisite project management expertise to take on various critical roles within the Projects and DR Organizations. To address this need, OPG’s plan is to utilize external industry expertise in areas that are not core to its business. There are, however, several external factors impacting OPG’s ability to adequately staff the Project such as competition for resources from external organizations, an EPC model that is new to existing OPG staff and government restrictions on compensation that make it difficult to attract external talent and retain existing talent, especially at the Management Group level. Section 2.2 details the approach for staffing into the Project given the existence of these external factors which are impacting the DR Project.

It is understood that a robust succession planning process and defined development plans and career paths are needed to ensure that staff are retained and promoted

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within the organization and utilized from across the fleet. While program ownership of the Succession Planning process lies with People, Culture & Communications, line management must take accountability for the process, its significance and associated deliverables.

## 2.2 Staffing and Resource Requirements

Staffing and resource requirements will change as the program progresses through the definition phase. Keeping in mind the staffing assumptions noted in Section 2.1, this document will be updated as required to prepare for upcoming phase changes.

The Darlington Refurbishment Project may be resourced in a number of ways, ensuring compliance with OPG policies and relevant Collective Agreements:

- (a) Direct OPG staff reporting to the Darlington Refurbishment organization and contributing to deliverables for the Darlington Refurbishment program. These staff may be full-time, temporary or on rotational assignments into the organization.
- (b) Support from other OPG Business Units in a “matrix” (functional staff working in project teams), as planned in the Business Planning process and documented in individual procedures and/or interface agreements. Partnering and interface agreements will document and formalize the working relationships amongst all groups.
- (c) External purchased services contracts for the provision of specialized technical, project management and other staff/services including Augmented Staff, specialized contracts and managed task contracts. At the time of writing, these include Ian Martin, CPUS, AMEC, Worley Parsons, F&G and others. All external purchased services must comply with relevant Supply Chain procedures and Collective Agreements, Union settlements and Memorandums of Understanding.

Details of the staff and resources are contained within the Program Business Plan, which is part of OPG’s Business Plan, as outlined in N-PROG-AS-0005 Nuclear Business Planning, and it’s supporting Business Planning process, N-PROC-AS-0080.

## 2.3 Staffing Processes and Strategic Elements

Darlington Refurbishment will follow OPG People, Culture & Communications staffing processes and relevant Supply Chain contract staff processes with support from local Human Resources. Documents related to staffing are available to supervisors via the OPG intranet, Manager Self Serve, the HR Service Centre and local HR Offices. Staffing will be in compliance with all labour requirements/collective agreements and be aligned with corporate goals relating to Business Transformation and organizational designs.

In addition to relevant collective agreements, Functional Line Managers shall ensure compliance with all People, Culture & Communications and Supply Chain policies and

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procedures (e.g. Hours of Work, Overtime, etc.) as well as the Organizational Change Control Procedure (N-PROC-AS-0068).

DR will participate in the corporate workforce planning process. Functional Line Managers should also ensure they are familiar with the DR On-Boarding process and the OPG Staff Orientation package found on the OPG Human Resources webpage.

## 2.4 Darlington Refurbishment Staffing and Succession Plan (DRSSP)

Succession Planning efforts at the nuclear level are enshrined in the current Nuclear Executive Committee (NEC) Succession Planning process and the Peer Team processes. NEC examines those positions identified as Priority 1 roles, while the respective Peer Teams review positions identified as Priority 2 roles. See Appendix A for an illustration of this process and the roles reviewed.

Succession planning efforts in DR take place at the Nuclear Projects level and by organization in DR. They are not intended to replace discussions held at the fleet level on this topic, either at the NEC Succession Planning meetings or via the Peer Teams. In order to be successful and ensure a wide breadth of opportunities and development for staff, integration of the DR Succession Planning efforts into broader efforts is critical. The DR process will establish some rigour and oversight into performance development and talent growth for the Project. It is expected that Integration should occur in three ways: in HR via the VP, Nuclear Business Partners who attends the NEC Succession Planning meetings, with the SVP, Nuclear Refurbishment who also attends such meetings and the DOM and VP, Engineering in DR who attend the Nuclear Fleet Peer Team discussions on succession planning. Integration with Projects & Modifications has taken place via formal succession planning meetings with an aim to assessing and cultivating project management talent across the broader Nuclear Projects organization.

The DR Staffing and Succession Planning process will focus on High priority positions specific to DR and critical job families required for the successful completion of DR (known as Priority 3 roles). Consideration for whether positions are deemed critical follow the centre-led model. In order to address succession planning in DR and staffing for critical roles, a formalized Succession Planning Process has been developed.

The DR Staffing and Succession Planning Process will also focus on the creation of mitigation plans as needed for critical job families in the Project. Functional Line Managers shall have ownership of these plans which will be reviewed quarterly at the formal succession planning meetings as required.

### 2.4.1 Program Plan and Set-Up Phase

Program staffing and resourcing profiles for each Refurbishment department and project have been developed as part of the Definition Phase planning effort. At the time of Board approval of Release 4D, the staffing plans were baselined.

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Further changes/increases to the staffing plan baseline approved for Release 4D) will be through the Refurbishment Cost and Schedule Change Control process, N-MAN-00120-10001-PC-01 and the Project Gated Process, N-MAN-00120-10001-GRB.

## 2.5 Defining Program Staffing and Resources Requirements

Staffing and Resources requirements for the Project are based on the scope, the existing matrixed organization as defined in Section 2.2 (b), and the need to provide oversight to Engineering Procurement Construction (EPC) contractors.

Program Staffing Requirements include:

- Refurbishment Program Executive Team
- Administrative support
- Corporate support (strategic e.g. Law, Regulatory Affairs, Finance, People, Culture & Communications)
- Functional Management, including Program Planning & Control, Managed Systems Oversight, Engineering
- Project Managers and staff, including matrixed staff, for each of the Program's Projects
- OBU support (technical e.g. Nuclear Engineering, Finance)

Each Function and Project requires an overall resource plan that is included in their Management plans that support Business Planning.

## 2.6 Program Organization

The Darlington Refurbishment Program Organization can be found in the Darlington Refurbishment Project Charter (D-PCH-09701-10000).

## 2.7 Program Staff Tracking and Management

Darlington Refurbishment Program staff will use OPG Nuclear's standard time reporting system, TEMPUS, for timekeeping and time management related needs, such as vacations.

Darlington Refurbishment supervisors will use OPG Nuclear's standard Human Resource tools and processes for performance monitoring; e.g. Performance Planning & Review (PPR). Clear linkages to development planning and Annual Incentive Plans (where applicable) will be formally documented as part of the PPR process. It is expected that Managers endeavour to hold quarterly performance review meetings with their staff to assist in this activity and entrench a culture of continuous development.

## 2.8 Replacement of Program Staff

Refurbishment Program staff vacancies are addressed through the normal OPG hiring processes as outlined in Section 2.2 of this plan.

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## 2.9 Program staff Transition at Program Commencement and Execution through to Completion

A plan will be developed to transition staff to and from the Refurbishment Program and to Nuclear Operations during the phases of the Project. The Integrated Workforce Transition Team under DR Operations & Maintenance contemplates how these “swing staff” will be selected and staffed from the Fleet. This will be complete as part of the transition plans that are being developed for each organization. Further planning will be required for core Darlington Refurbishment Program staff (NK38-PLAN-09701-10113 Sht: OPS-01).

## 2.10 Approved Organization Changes

Organization changes will be processed per N-PROC-AS-0068 Organizational Change Control.

## 3.0 ROLES AND ACCOUNTABILITIES

Responsibility for staff and resource planning lies with the Functional Line Manager with support from the Human Resources Manager, the Director, Planning and Controls and the Controller. The Functional Line Manager is accountable for resource planning and identification of staffing needs as part of the overall planning process. This includes alignment with business planning and headcount targets. It is expected that the Functional Line Managers periodically review their staffing needs and ensure alignment with their work programs. Fiscal responsibility and adherence to OPG values and behaviours is required where increases or decreases to staff numbers are necessary. Roles and responsibilities are defined at all levels of the organization and are available in Passport under series N-MAN-08131-10000.

### 3.1 Senior Manager, Human Resources Nuclear Projects

Is the document owner and is accountable for its definition, implementation and continual improvement.

## 4.0 DEFINITIONS & ACRONYMS

### 4.1 Definitions

None.



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## 4.2 Acronyms

<b>CFAM</b>	Centre-Led Functional Area Manager
<b>DNGS</b>	Darlington Nuclear Generating Station
<b>DOM</b>	Director Operations and Maintenance
<b>DR</b>	Darlington Refurbishment
<b>DRSSP</b>	Darlington Refurbishment Staffing and Succession Planning
<b>EPC</b>	Engineer Procurement Construction
<b>HRBP</b>	Human Resources Business Partners
<b>NEC</b>	Nuclear Executive Committee
<b>OBU</b>	Other Business Unit
<b>PPR</b>	Performance Planning & Review
<b>RPET</b>	Refurbishment Project Executive Team

## 5.0 REFERENCES

- D-PCH-09701-10000, Darlington Refurbishment Project Charter
- N-MAN-00120-10001-GRB, Nuclear Projects Gated Process
- N-MAN-00120-10001-PC-01, Nuclear Refurbishment Cost and Schedule Change Control
- N-MAN-08131-10000, Job Document Series
- N-PROG-AS-0005, Business Planning
- N-PROC-AS-0068, Organizational Change Control
- N-PROC-AS-0080, Nuclear Business Planning
- NK38-PLAN-09701-10113 Sht: OPS-01, Operations – Ownership Transfer Plan



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Appendix A: Nuclear Succession Planning – Integrated Schedule

Nuclear Integrated Succession Schedule												
Succession Forums	Jan Topic	Feb Topic	March Topic	April Topic	May Topic	June Topic	July Break	August Topic	Sept Topic	Oct Topic	Nov Topic	Dec Topic
OPG/Fleet Talent Milestones					BOD May? NOC May?				9 Box, IDPs to COE for ELT/BOD (as required)	NPDS & AOOM Opps Approved	SNPM & WANO Opps Approved BOD Nov? NOC Nov?	
NEC (Group 1,2)	Integrated Roles  Group 2 Jan 21/16	Nuc Safety Pri1 Group 1 Feb 18/16	Mtce Pri1 Group 2 Mar 10/16	Project Mgmt Pri1 Group 1 Apr 29/16	Stn Eng Pri1 Group 2 May 26/16	Ops Pri1 Group 1 Jun 9/16	#2 July 21/16	Design Pri1 Group 1 Aug 15/16	Project Manager Pri1 Group 2 Sep 28/16	WM Pri1 Group 1 Oct 20/16	NOC Review, Next Year SNPM & WANO/INPO Group 2 Nov 7/16	Ops Pri1 Group 1 Dec 15/16
NEW Project Mgmt Peer Team		Project Mgmt Pri2(Mgr)			Project Mgmt Pri2(SM)				Project Mgmt Pri2(Mgr)			Project Mgmt Pri2 (SM)
ENG Peer Team 3 <sup>rd</sup> Wednesdays	Nuc Safety Pri2		Talent Summit	C&E, PE Pri2		Design Pri2 + Input to Pri1	Break		Next Year Fleet Dev't Opps	Talent Summit	Nuc Oversight, IMS, Waste	
DOM/DWM Peer Team 1 <sup>st</sup> Thursdays	FH/RF/TRF Pri2	Mtce Pri2+ Input to Pri1	Talent Summit	IMS/Waste Pri2	Ops Pri2+ Input to Pri1			WM Pri2	Talent Summit	CS/Chem/NO/HP Pri2		Ops Pri2+ Input to Pri1
Ops Peer Team				Ops Pri3 SM, SMT								Ops Pri3SM, SMT
Mtce Peer Team	Mtce Pri3					Mtce Pri3						
Stations DN 1 <sup>st</sup> Fridays PN 2 <sup>nd</sup> Fridays	Mtce Pri 2 & cross functional (Trng, etc.)		Ops Pri3 (SM, SMT)	Ops Pri2 & cross funct (IMS, Waste, etc)	WM Pri3	WM Pri2 & cross functional roles		CS/Chem/ TRF Pri3, 2 Roles	Next Year Fleet Dev't Opps	FH/RF/TRF Pri3, 2 & cross functional roles	Ops Pri3 (SM, SMT)	Mtce Pri3
IMS, Waste, SES, CFAM/Rad, SES Dates	Integrate with Stations			Integrate with Stations, DOM/DWM Peer Team		Integrate with Stations		Integrate with Stations	Next Year Fleet Dev't Opps	Integrate with Stations and DOM/DWM Peer Team	Integrate with Engineering Peer Team	Integrate with DOM/DWM Peer Team
Nuclear Projects	Projects H/G Roles	Refurb H/G Roles	NPET Mar10 Nuc Proj F/E Roles	Projects H/G Roles		NPET Jun9 Nuc Proj F/E Roles	Proj H/G Roles		NPET Sept8 Next Dev't Opps Nuc Proj F/E Refurb H/G	Projects H/G Roles		NPET Dec8 Nuc Proj F/E Roles
Colour Legend: Maintenance Roles DOM, Ops, IMS, Waste Roles Work Mgmt Roles Integrated Roles Engineering Roles Project Mgmt Roles Break Fleet Dev't Opps X-Funct Talent Summit												
Succession Forum HR Contacts:	• NEC - C. Hergert • DOM/DWM – Dayment/Bower			• Pickering – T. Bower • Darlington - J. Dayment		• Nuclear Projects = C. Kay • Rad/CFAM –C. MacVichie		• IMS – A. Shannon • Decom & Waste - S. Ott		• SES – G. Gordon • DOE - H. Benn		







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## Appendix B: Decision Support for Critical Positions Tool

### Decision Support for Critical Positions

*A guideline for Human Resources to support their clients in determining what a "Critical Position" is in Succession Planning.*

Decision Support Considerations		Indicate Impact		
Position: _____		High	Med	Low
		Score		
		5	3	1
<b>Critical Tasks and Decision Making</b>	The position exerts critical decision making and influence to OPG's operational/strategic objectives and performance outcomes			
	The level of impact on bottom-line results			
	The position is important to the future delivery of projects, programs and services			
	The extent to which position manages other critical positions			
	A vacancy in the position would cause substantial disruption to the functioning of OPG's operations productivity, performance and level of service			
<b>Hard to Recruit</b>	The position is specialized or requires unique expertise that is difficult to replace			
	The position demands a high level of competency limiting the ability to "start as a rookie"; the development process to qualify a candidate for the position is lengthy			
	In the current job market, the position is a less attractive option for high potential talent (in the terms of status, profile, perceived developmental value)			
	Degree of Competition for this position in the marketplace (Consult with Recruiting to answer this question)			
	Current market value of the position (Consult with Compensation & Recruiting to answer question)			
	The geographic location is unattractive or the least attractive of similar roles			
<b>Knowledge at Risk</b>	The position is in danger of "knowledge" drain due to forecasted attrition			
<b>Total</b>		<b>0</b>	<b>0</b>	<b>0</b>

**Risk Rating Legend:**

	Score
	High 40 - 50
	Med 30 - 39
	Low 20 - 29



DECISION SUPPORT FOR CRITICAL POSITIONS

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## Appendix C: Individual Development Plan Template



# Individual Development Plan

Individual Development Plans using SMART objectives enable the achievement of both business and career goals. Employees are expected to take responsibility for their learning and development. During the performance reviews, managers and employees will review the development plan and agree on development activities for the year. Managers are expected to support development and monitor employees' development activities and coach them by giving timely on-the-job and formal feedback throughout the year.

Employee Name:		Employee Number:	
Employee Department:		Employee Work Location:	
Time in current role:		Employee Job Title:	
Manager's Name:		Date of Completion:	

Begin your development planning by selecting 2-3 behaviours and development goals that you feel are most important to address. These may be selected in order to leverage existing strengths or to address gaps. Use the [Identifying your Development Priorities Worksheet](#) to help you prioritize your development priorities.

<b>OPG Behaviour</b> What behaviour do I want to work on?			
<b>Area for Development</b> This could include strengths to build on.			
<b>Development Actions</b> What specifically will I do and what will it achieve?  What are the best development activities for my identified area for development?			
<b>Target Completion Date</b>			
<b>Measure of Success</b> How will I measure my development?			
<b>Support and Feedback</b> What support do I need and from whom?  Who will give me feedback?			
<b>Areas of Interest</b>			
<b>Target Positions</b>			



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**DARLINGTON REFURBISHMENT - OPERATIONS PROGRAM MANAGEMENT PLAN**

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**Darlington Refurbishment - Operations  
Program Management Plan**

**NK38-NR-PLAN-09701-10001-0017-R002**  
2016-07-19

Order Number: N/A  
Other Reference Number:

**Internal Use Only**

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**DARLINGTON REFURBISHMENT - OPERATIONS PROGRAM MANAGEMENT PLAN**

### Revision Summary

Revision Number	Date	Comments
R002	2016-07-19	To incorporate updates since R001 was issued.
R00	2015-01-14	To incorporate Changes and improvements based on MSO program audit Self Assessment RF14-000625. Refer to Self Assessment RF14-000625 for details.



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### Records Table

The following Records may be generated by use of this document and shall be registered in the appropriate document management system in accordance with the following table:

Record Created	Associated Form or Template Number	QA Record? Y/N	Filing Information/Retention (AIMS Type/Sub-Type)

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## 1.0 PURPOSE

N-PROG-OP-0001 [R1] *Nuclear Operations* implements for Ontario Power Generation, Nuclear a series of standards and procedures to ensure safety of public, environment, plant personnel, and plant equipment.

This program establishes safe, uniform, and efficient operating practices and processes within Nuclear facilities that provide nuclear professionals the ability to ensure facilities are operated in such a manner that Reactor Operating License, Operating Policies and Principles, and other applicable regulations and standards are followed.

During refurbishment preparation phase operations team members will be:

- Developing and maintaining OPEX, Risk Management and SOER programs
- Work Protection and Ops Execution for pre requisite and scope definition inspections and maintenance work
- Operations Scoping and Assessment
- Design Package Review and Approval
- Work Plan Review and Approval
- Support for Shutdown and Lay Up, Balance of Plant, Return to Service , Fuel Handling, Retube and Feeder Replacement, Turbine Generator and Boiler refurbishment groups
- Document Reviews and Governance Development and Revisions
- Strategic Plans and Schedules Development & Reviews

This Darlington Refurbishment Operations Program Management Plan (PgMP) confirms that employees working within the Darlington Refurbishment Program will perform their work while conforming to the existing OPG Management System, specifically N-PROG-OP-0001.

For refurbishment, changes have been made to the current Operating Policies and Principles and License Condition Handbook (LCH). The changes were processed and approved in accordance with N-PROG-AS-0001, *Managed Systems*, N-PROG-AS-0006, *Records and Document Control* and any other appropriate governance



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## 2.0 PROGRAM REQUIREMENTS

Nuclear operations are governed by program document N-PROG-OP-0001 *Nuclear Operations* and all of the supporting standards and procedures.

The Nuclear Operations program is organized by six focus areas: Operations Management and Leadership, Conduct of Operations, Operator Skill and Knowledge, Operator Procedures and Documentation, Operations Facilities and Equipment, Plant Status and Configuration Control. This relationship is illustrated in N-PROG-OP-0001, *Fig 1. - Nuclear Operations Program Interfaces*. Any changes to the interfacing programs will be documented in Program specific Program Management Plans. The hierarchy of the governing documents and the relationship of these documents to the operations program objectives are shown in N-PROG-OP-0001 Fig. 1.1 *Nuclear Operations Programs Governing Documents Hierarchy* and transposed in Appendix A.

As stated in NK38-PLAN-09701-10113 Operations Ownership Transfer Plan [R-2] some of these supporting documents will require revision in order to meet the needs of Darlington Refurbishment.

Actual changes will follow N-PROG-AS-0001, *Managed Systems*, N-PROG-AS-0006, *Records and Document Control* and any other appropriate governance.

### 2.1 New Governance Specific to the NR Project

The requirement for new governance outside the hierarchy of documentation specified in N-PROG-OP-0001 is not anticipated. Some of the existing governance within this hierarchy will require updates to accommodate Nuclear Refurbishment. A scoping assessment of LCH referenced licensee documents was completed for revisions that may be required due to proposed OP&P changes.

Changes proposed in this OPP revision affect documents related to:

- authority and organization
- conduct of operations and maintenance
- certified staff requirements (later submission)
- specific states and evolutions (example; defueling)

Nuclear safety assessments for modifications, evolutions, and specific refurbishment unit states are to follow and will affect licence limits and documents detailing safety requirements

### 2.2 Governance Updates

NR Operations has performed an exhaustive review of the listed standard, procedures and instruction that fall under hierarchy of N-PROG-OP-0001. As a result of this review it is apparent that many of the documents require no updates at all however multiple documents require updates ranging from minor to intent. It has also become apparent



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that some of these changes are awaiting regulatory approval of refurbishment OP&P's and the License Condition Handbook. Action tracking item # 28168336 has been created to track the review and update process.

### 2.3 Methodology of Change Implementation

In order to implement the changes to the existing governance under N-PROG-OP-0001 that will be required to accommodate nuclear refurbishment in its various states a methodology has been developed that will achieve the desired results, within the refurbishment timelines without overwhelming the document owners. Refurbishment operations will review the documents and edit the required sections. They will also review the required timelines for change implementation and compare it to the documents normal review schedule. If the review schedule meets refurbishment timelines then the changes will be submitted to the doc author for incorporation during the next review. If the review cycle does not meet refurbishments timelines then NR will contact the doc owner and arrange to have the document released to refurbishment for updates. Once updated the document will be sent through it's normal review process. All changes will follow N-PROG-AS-0001, *Managed Systems*, N-PROG-AS-0006, *Records and Document Control* and any other appropriate governance.

### 2.4 Performance Indicators

Most Operations activities are to support other refurbishment groups and as such have no performance metrics. All governance changes and document development required to support nuclear refurbishment have been identified through a review process and are tracked on the Level 3 Operations and Maintenance Program schedule and tied to the OP-00-1410 milestone. Action tracking items have been created for individual procedure updates and progress is monitored bi weekly during progress review meetings conducted by the Refurbishment Operations Manager. The L3 O&M Program Schedule is reviewed and updated monthly and reported on at the integrated schedule review meeting. A listing of the various AR# has been appended. All have been completed and signed off in Action Tracking.

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### **3.0 ROLES AND ACCOUNTABILITIES**

#### **3.1 Director Operations and Maintenance -DNGS**

Ensures qualified staff is in place to implement requirements of N-PROG-OP-0001 and support Nuclear Refurbishment

#### **3.2 Director Operation and Maintenance –NR**

Ensures qualified staff is in place to specifically implement requirements of N-PROG-OP-0001 with respect to Nuclear Refurbishment

#### **3.3 Manager - Operations DNGS**

Reporting to the Darlington Director of Operations and Maintenance is responsible for Station Operations, including the operating units, excluding the units that are in refurbishment and turned over to the NR Operations Manager. During the preparation phase of refurbishment the DNGS Operations Manager will review and approve new governance generated for refurbishment.

Primary contact point for the NR Operations Manager for interface and coordination strategy between Darlington Station Operations and NR Operations.

#### **3.4 Manager - Operations- NR**

Reporting to the Director of Operations and Maintenance, Nuclear Refurbishment, is responsible for the planning, preparation and execution phases of Operations for the refurbishment unit(s), and to ensure that appropriate governance and other documentation is in place to support this effort.

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**4.0 DEFINITIONS AND ACRONYMS**

**4.1 Definitions**

None

**4.2 Acronyms**

None



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## 5.0 REFERENCES

[R-1] N-PROG-OP-0001, Nuclear Operations

[R-2] NK38-PLAN-09701-10113 OPS-01, Operations Ownership Transfer Plan

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## Appendix A: Operations Program Governing Document Hierarchy

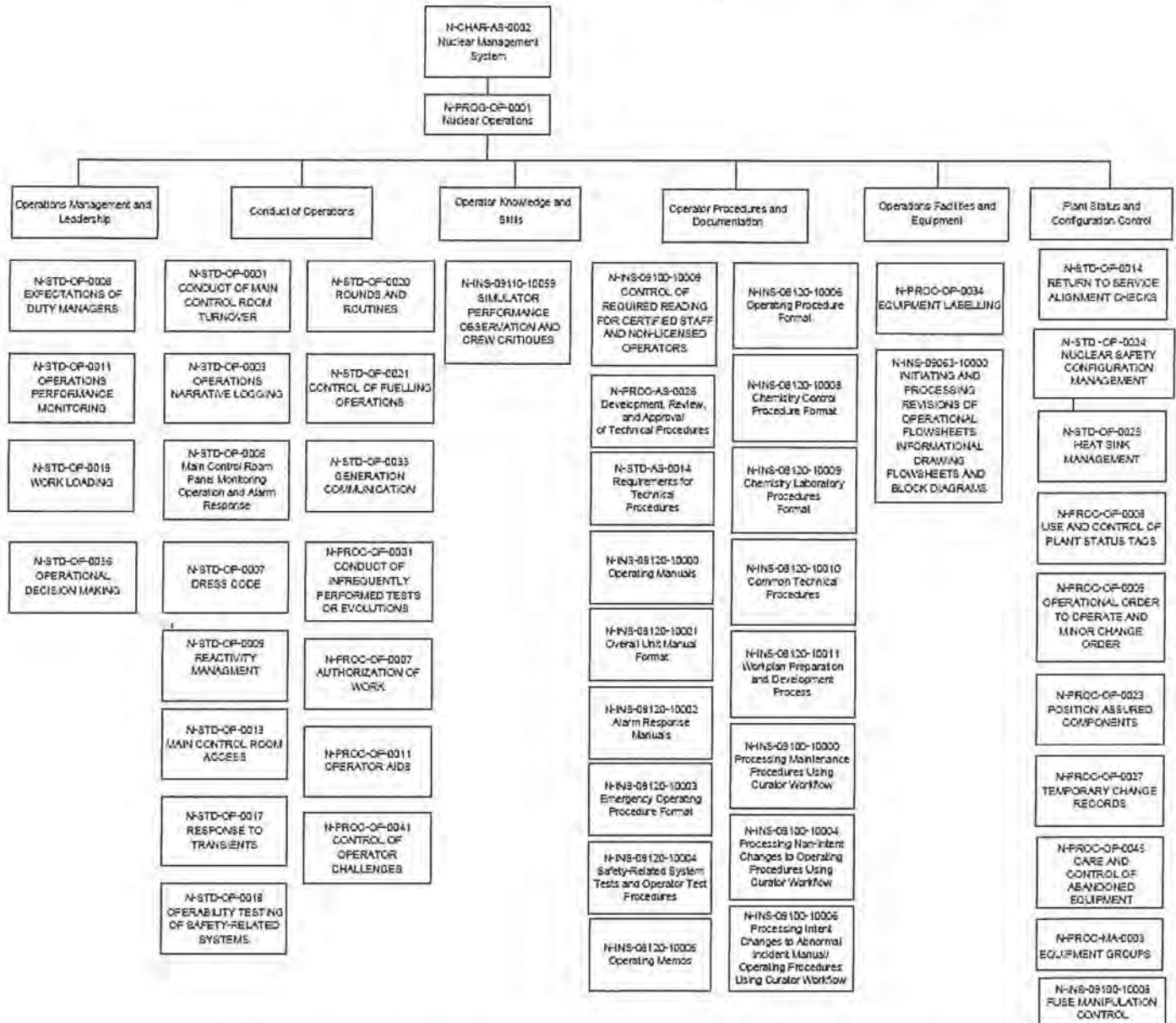


Figure 1.1 Nuclear Operations Programs Governing Document Hierarchy



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### Appendix B: Action Tracking Table

Doc No.	Document Name	AR #
D-INS-03490-10001	In Plant Coordinator	28161008-22
D-INS-03490-10002	SHIFT RESOURCE COORDINATOR	28161008-14
D-INS-03490-10005	Assembly Area Supervisor	28161008-14
D-INS-03490-10007	Response to Warning Signal	28161008-13
INS-03490-10030	Evacuation/Relocation	28161008-06
D-INS-09110-10013	Plant Status Control	28167027-25
D-INS-09110-10019	Operator Surveillance	28167027-24
D-INS-09110-10032	Use Of Unit 0-4 Operators on Supernumerary Shifts	28167027-13
D-INS-09260-10001	Duty Crew Minimum Complement Assurance	28167027-18
D-PROC-OP-0009	Station Shift Complement	28167027-12
D-PROC-OP-0034	Official Station Log	28167027-07
N-INS-09063-10000	Initiating and Processing Revisions of Operating Flowsheet	28167027-21
N-PROC-MA-0011	Mtce Authority Roles and Responsibilities	28167027-14
N-PROC-MA-0012	Work Protection	28167027-05
N-PROC-MA-0031	Seismic Route Management	28167027-11
N-PROC-OP-0008	Use And Control Of Plant Status Tags	28167027-26
N-PROC-RA-0020	Event Notification	28167027-19
N-PROC-RA-0045	Emergency Preparedness Drills and Exercises	28161008-14
N-STD-OP-0005	MCR Panel Monitoring operation alarms	28167027-06
N-STD-OP-0011	Operations Performance Monitoring	28167027-23
N-STD-OP-0013	Main Control Room Access	28167027-20
N-STD-OP-0017	Response To Transients	28167027-17
N-STD-OP-0024	Nuclear Safety Configuration Management	28167027-16
D-INS-03490-10005	Assembly Area Supervisor	28161008-18
N-STD-OP-0003	Operations Narrative Logging	28167027-08
N-PROC-OP-0009	Operational Order To Operate And Minor Change Order	28167027-22
N-PROC-OP-0007	Authorization Of Work	28167027-04
N-PROC-AS-0028	Development Review And Approval Of Technical Procedures	28167027-27
D-PROC-OP-0032	Response To Transients	28167027-09
D-INS-09100-10019	Authorization Of Work	28167027-01
D-INS-08100-10001 sht 1.032	When Work Authorizations Are Required In Facilities	28167027-03
D-INS-09100-10008	Darlington Site Timekeeping Expectations For Operations And Maintenance Staff	28167027-02
D-INS-09100-10017	Attendance At System Health Meetings	28167027-10



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**DARLINGTON REFURBISHMENT - RADIATION PROTECTION PROGRAM MANAGEMENT PLAN**

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**Darlington Refurbishment - Radiation Protection Program Management Plan**

**NK38-NR-PLAN-09701-10001-0018-R002**  
2016-08-23

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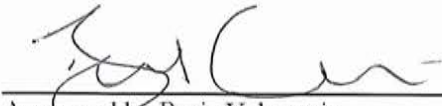
  
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Plan

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### Revision Summary

Revision Number	Date	Comments
R002	2016-08-23	Revision to update reference to P6 L3 schedule, remove references to White Paper, and minor page and pagination formatting.
R001	2015-01-06	Revision to add additional references to Refurbishment RP documentation, strategy documents, and white paper.

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## 1.0 PURPOSE

N-PROG-RA-0013 *Radiation Protection (RP) Program* [R-1], implements a series of standards and procedures for the conduct of activities within nuclear sites and with radioactive materials, intended to achieve and maintain high standards of RP.

This Darlington Refurbishment Radiation Protection Program Management Plan (PgMP) stipulates radiation protection requirements and processes specific to the Darlington Refurbishment Project execution. It conveys how employees working within the Darlington Refurbishment Program will do their work while meeting the intent of the existing the OPG Management System, specifically N-PROG-RA-0013.

## 2.0 PROGRAM REQUIREMENTS

N-PROG-RA-0013 *Radiation Protection (RP) Program* remains the overall program document for operating units across the OPG Nuclear fleet including refurbishment units. The hierarchy of the governing documents and the relationship of these documents to the program objectives are shown in N-PROG-RA-0013, Fig.1.0 *Radiation Protection Program Implementing and Interfacing Documents*

Some RP governance and supporting documents may require revision in order to meet the needs of Darlington Refurbishment. The Nuclear Refurbishment Radiation Protection Department shall receive and review any requests for governance revisions. These document reviews and potential revisions shall follow N-PROG-AS-0001, *Managed Systems*, N-PROG-AS-0006, *Records and Document Control* and any other appropriate governance. Nuclear Refurbishment Radiation Protection has a set of P6 L3 schedule items (NR.FN.OM.06.U2.73444.6.02.01) to perform reviews of the RP Program and governance to identify any potential revisions required.

Any program changes will be documented in future revisions of this Plan.

### 2.1 New Governance Specific to the NR Project

The implementation and strategy description of the Radiation Protection program in Nuclear Refurbishment is documented in NK38-REP-09701-10088 "Darlington Nuclear Refurbishment -Radiation Protection Strategy" [R-2].

### 2.2 Ownership Transfer Plans

NK38-PLAN-09701-10113 Sht: RAD-01 "Radiation Protection - Ownership Transfer Plan" [R-3] documents the issues and interfaces between the Nuclear Refurbishment Radiation Protection Department and the DNGS Radiation Protection Department.

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### 3.0 ROLES AND ACCOUNTABILITIES

#### 3.1 Director, Radiation Safety

With respect to the Darlington Refurbishment Project:

- Assumes Program Owner roles and accountabilities outlined in N-PROG-AS-0001 for the RP program.
- Implements the RP program framework including setting standards of RP performance and ALARA.

#### 3.2 Department Manager, Radiation Protection – Nuclear Refurbishment

Provide and maintain Nuclear Refurbishment RP direction, programs, procedures and services pertaining to Health Physics, Occupational RP, and Nuclear Refurbishment RP coverage.

Roles and Responsibilities are detailed in NK38-PLAN-09701-10113 Sht: RAD-01 "Radiation Protection - Ownership Transfer Plan" [R-3]

### 4.0 DEFINITIONS AND ACRONYMS

#### 4.1 Definitions

None

#### 4.2 Acronyms

None

### 5.0 REFERENCES

- [R-1] N-PROG-RA-0013 Radiation Protection (RP) Program
- [R-2] NK38-REP-09701-10088 Darlington Nuclear Refurbishment -Radiation Protection Strategy
- [R-3] NK38-PLAN-09701-10113 Sht: RAD-01 Radiation Protection - Ownership Transfer Plan



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Title:

**DARLINGTON REFURBISHMENT - TRAINING PROGRAM MANAGEMENT PLAN**

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**Darlington Refurbishment - Training  
Program Management Plan**

**NK38-NR-PLAN-09701-10001-0019-R003**  
2016-09-01

Order Number: N/A  
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### Revision Summary

<b>Revision Number</b>	<b>Date</b>	<b>Comments</b>
R001	2015-01-23	Revised to reflect Issuance of N-TQD-901-00001 Nuclear Refurbishment Training and Qualification Description
R002	2015-09-02	Revised to align with last revision of the NK38-NR-PLAN-09701-10001 "Project Training Work Plan" issued August 17, 2015
R003	2016-09-01	Revised to align with last revision of the NK38-NR-PLAN-09701-10001 "Project Training Work Plan" issued 2016-06-16 and the revisions to N-TQD-901-00001 "Nuclear Project Training and Qualification Description" and N-TQD-510-00001 "Supplemental BTU, Direct Hire and Contract Management Training and Qualification Description" and N-TQD-901-Nuclear Project

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## 1.0 PURPOSE

The purpose of this Program Management Plan (PgMP) is to provide the Darlington Refurbishment Organization and other business unit support staff with a clear understanding of the training requirements for the Darlington Refurbishment Project.

This PgMP aligns with the requirements of NK38-NR-PLAN-09701-10001 Sht: 0001, Darlington Refurbishment Program Structure and takes its authority from D-PCH-09701-10000, Darlington Refurbishment Project Charter.

## 2.0 PROGRAM REQUIREMENTS

Due to the unique requirements associated with a refurbishment outage (multi-employer, owner-only islanding, Owner/Constructor configuration, the large scope and duration of the project, etc.), it is recognized that a dedicated training program is required for Darlington Refurbishment.

The Darlington Refurbishment Training Program has been developed consistent with the requirements of Nuclear and Corporate governance. The figure in Appendix A illustrates the relationship between Nuclear Governance specific to training and training documentation developed specifically for the Darlington Refurbishment Project.

An overall Darlington Refurbishment Project Training Work Plan (NK38-PLAN-09701-10007) has been established to define the activities and tasks required to fulfill the training requirements for the Darlington Refurbishment Project. The Project Training Work Plan identifies the key elements and steps necessary for training the various staff at various phases of the Darlington Refurbishment Project. As the Darlington Refurbishment Project progresses through its various phases, the Training Work Plan will be reviewed and revised as required.

The Darlington Refurbishment Training Program is structured to address the following three areas:

- (1) Supplemental personnel on-boarding training;
- (2) Supplemental personnel Project/Job Specific Training;
- (3) OPG Personnel Training
  - a) Operations & Maintenance Personnel Training;
  - b) Engineering Training;
  - c) Modifications and Return to Service Training.

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*N-PROG-TR-0005, Training:* Remains the overall training program document and provides the structure, processes, and tools for defining, developing, implementing, documenting, assessing, and improving the training required to ensure Nuclear staff have the appropriate knowledge and skills. This program document describes the structure and content of OPG Nuclear Training Governance and from this framework, additional tiered supporting Training Governance exists.

*N-TQD-901-00001, Nuclear Projects Training and Qualification Description:* This TQD describes the training requirements for OPG (Darlington Refurbishment, Project and Modifications and Fleet) personnel.

**Note:** For OPG personnel, N-TQD-901-00001 specifies the **incremental** training requirements – such as Interface and Islanding training, Oversight training, etc. – in addition to existing OPG TQDs applicable consistent with the tasks that staff is performing.

*N-TQD-510-00001 Supplemental BTU Direct Hire And Contract Management Training And Qualification Description* defines the incremental training and qualification requirements for the BTU Direct hire and Contractor Personnel associated with Nuclear Refurbishment project

*NK38-GUID-09701-10021, Guideline for Training Oversight (Refurbishment):* This guideline assists OPG Nuclear Projects Training staff in the selection and application of training oversight activities required to support OPG Darlington Refurbishment Project Managers in the preparation of the Project Oversight Plan and to provide recommended practices for the preparation, execution and documentation of training oversight activities.

*N-GUID-09701-10118, Nuclear Refurbishment Training Change Control:* Each modification associated with Darlington Refurbishment can potentially result in the need for new or modified training. The process detailed in N-GUID-09701-10118 covers:

- The preliminary review of each modification to determine if training action will be required;
- The appropriate actions to initiate detailed training assessments (Training Needs Analyses);
- The process for tracking training issues associated with each modification;
- The responsibilities of involved staff/stakeholders.

It should be noted that existing governance covers the processes outlined above primarily in N-PROC-MP-0090, Modification Process, and N-PROC-TR-0008, Systematic Approach to Training. N-GUID-09701-10118 only identifies the specific implementation details associated with Darlington Refurbishment.

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*N-GUID-09701-10122, Guideline for Nuclear Refurbishment - Training Plan*

*Development:* The purpose of this document is to provide guidance on the practice of developing a Training Plan and to describe the practice overview, requirements, activities, and key terms related to these requirements.

This document applies to Darlington Refurbishment Projects and Darlington Refurbishment related projects and modifications.

There are two scenarios where a training plan is required:

- Vendor Training Program Training Plan - Training developed and delivered by Vendor to their own staff (i.e. under Vendor QA Program);
- OPG Training Program Training Plan - Training developed and delivered by Vendor to OPG staff (operators, maintainers, engineers, etc.) (i.e., under OPG QA Program).

### 3.0 ROLES AND ACCOUNTABILITIES

#### 3.1 Contractor/Vendor/Manufacturer

- Provide OPG with a training plan that clearly shows how each trade will be processed and trained to meet the requirements to work at an OPG nuclear station;
- Train their personnel to be competent to perform the work they are assigned;
- Provide training to own staff for rehearsal on the mock-up;
- Maintain documented evidence of all training provided to their staff including examinations, training attendance, assessments, certificates, course correspondence, and objectives;
- Provide to OPG a summary of qualified personnel, training rosters, examinations, assignments, and evaluations;
- Accountable for the QA of training provided to their staff;
- Provide own facilities for any training conducted under their accountability;
- Accountable for the scheduling and rostering of their training.

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- **Vendors must demonstrate and ensure all workers are qualified and competent to perform assigned work. One of the most important principles of personnel qualification is the qualification being traceable.**
- Vendors must utilize TIMS or their own program that incorporates the principles of a robust Qualification tracking process to adequately demonstrate worker qualifications. Holders of Record and Supervisory competence must also be robust. This means that when someone is qualified, a declaration of competency form completed by the Contractor organization must be submitted to OPG, and the associated records including examinations must be available. Qualification of Workers will be a focus area for OPG and their respective Oversight Groups. Refer to OHSA and N-GUID-09701-10011 Safety Essentials Guide. Appendix A and N-TQD-510-00001 Supplemental BTU Direct Hire and Contract Management Training and Qualification Description – 1.8.1. Contract Personnel Training and Qualification Traceability.

### 3.2 Project Manager

- Oversee the training plans provided by the vendor, with support from NR Training;
- Provide oversight of the development and delivery of specialized training.

### 3.3 Director, Nuclear Refurbishment Training

- Is the owner of this document and is accountable for its definition, implementation and continuous improvement;
- Manages and provides oversight of Darlington Refurbishment training plans and programs;
- Provide support in overseeing contractor developed training material and delivery.

### 3.4 Senior Officer Training Technologist, Darlington Refurbishment Training

- Provide support in overseeing contractor training plans and programs including accountability for monitoring and trending performance metrics;
- Provide support in overseeing contractor development and delivery of training material.

### 3.5 Training Section Manager, Refurbishment Training Change Control (TCC)

- Oversee the training analysis of modification and procedure revisions;

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- Accountable for the initial update/incorporation of the contractor/vendor/ manufacturer training plans and training materials;
- Accountable for turning vendor training materials into the OPG training material collection and issue in Asset Suite;
- Maintain implementation documents (INS, GUIDE) for the NR TCC Centre;
- Supervise NR TCC Centre staff and contractors;
- Single Point of Contact for working with Fleet Learning & Development to ensure NR Modification training is included in existing training schedules for OPG staff;
- Accountable for developing and maintaining reporting metrics which to ensure training in support of operational readiness and training completion to ensure qualified personnel for AFS/RTS.

### 3.6 Training Officers and Authorized Training Supervisor (NR-TCC)

- Conduct and document the training analysis requirements for O&M/Engineering, etc. on modifications and procedure changes;
- Update NR TCC database for tracking each Master Engineering Change;
- Run compliance reports for action tracking to ensure milestones are on track;
- Design Technical Updates briefings to inform personnel whose skills will be not be affected by the modification, as required;
- Review training plans received from vendor and accept on behalf of OPG;
- Review training materials received from Vendors and accept on behalf of OPG;
- Issue revised vendor-developed training materials as approved OPG training materials in Asset Suite;
- Provide incremental development and delivery as required, based on vendor capabilities (e.g. simulator-based training) as required.

### 3.7 Learning & Development Division

- Provide incremental development and delivery as required, based on vendor capabilities (e.g. simulator-based training).



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## 4.0 DEFINITIONS AND ACRONYMS

### 4.1 Definitions

None.

### 4.2 Acronyms

- **EPC**                      Engineering Procurement Constructor
- **ESMSA**                  Extended Services Master Service Agreement
- **OHSA**                    Ontario Health and Safety Act
- **PgMP**                    Program Management Plans
- **TQD**                     Training Qualification Description

## 5.0 REFERENCES

- [R-1] N-TQD-901-00001, Nuclear Projects Training and Qualification Description
- [R-1] N-GUID-09701-10118, Nuclear Refurbishment Training Change Control
- [R-2] N-GUID-09701-10122, Guideline for Nuclear Refurbishment - Training Plan Development
- [R-3] N-PROC-TR-0002, Control of Vendor-Supplied Training
- [R-4] N-PROC-TR-0008, Systematic Approach to Training
- [R-5] N-PROC-TR-0021, Training and Qualification Description Development, Approval and Implementation
- [R-6] N-PROC-TR-0044, Training Demand Scheduling for Cancellation Process
- [R-7] NK38-GUID-09701-10021, Guideline for Training Oversight (Refurbishment)
- [R-8] NK38-PLAN-09701-10007, Darlington Refurbishment – Project Training Work Plan

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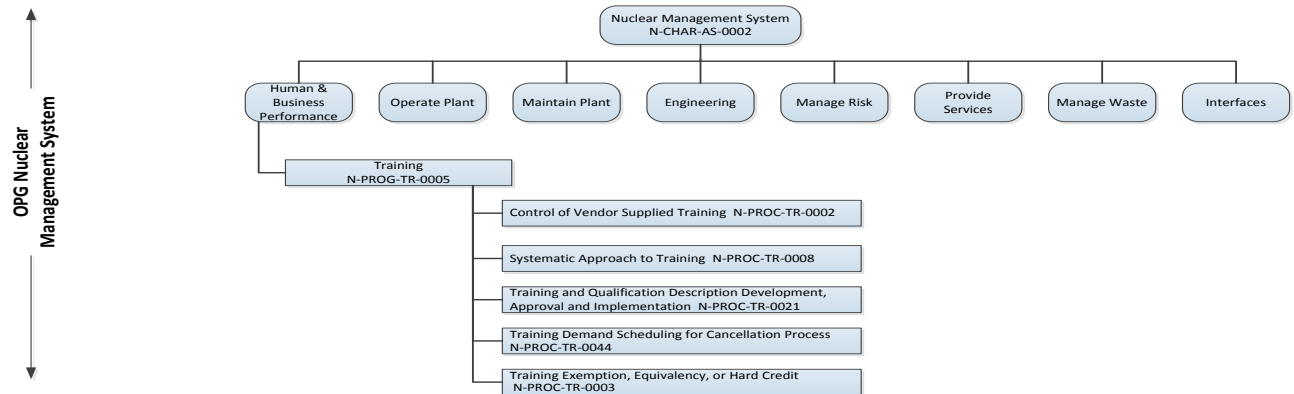
[R-9] N-TQD-510-00001 Supplemental BTU Direct Hire And Contract Management Training And Qualification Description

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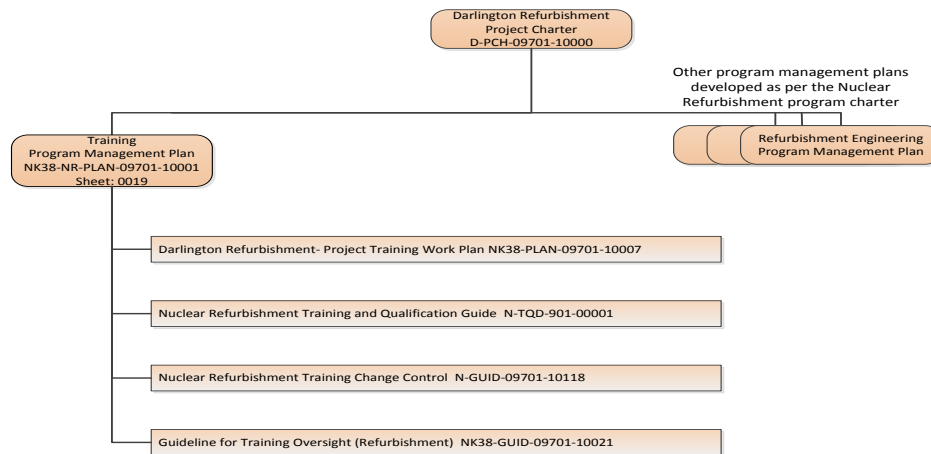
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## Appendix A: Nuclear Refurbishment – Darlington Refurbishment Training Process Documents

### Nuclear Refurbishment – Darlington Refurbishment Training Process Documents



Process Support Documents developed to support Refurbishment Program (additional to OPG Nuclear Management System)



#### NOTE:

Darlington Refurbishment Program structured to address three major project training areas:

1. Contractor on-boarding Training
  - (a) EPC Contractor Employee on-board Training
  - (b) ESMSA Contractor Employee on-board Training
2. Contractor Project/Job Specific Training
3. OPG Personnel Training
  - (a) Operations and Maintenance Personnel Training
  - (b) Engineering Training
  - (c) Modifications and Return to Service Training.



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**NUCLEAR REFURBISHMENT HUMAN PERFORMANCE MANAGEMENT PLAN**

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**Nuclear Refurbishment  
Human Performance Management Plan**

**NK38-NR-PLAN-09701-10001-Sht 0020-  
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2016-09-23

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### Revision Summary

Revision Number	Date	Comments
R000	2015-09-11	Initial issue
R001	2016-08-15	Major revision



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## 1.0 PURPOSE

The purpose of this Darlington Nuclear Refurbishment (NR) Human Performance (Hu) Management Plan is to improve human performance by developing an execution strategy that stipulates Hu initiatives, requirements and processes specific to the Darlington Nuclear Refurbishment Project.

With the successful execution of this strategy, it is anticipated that error-likely situations shall be reduced and potential challenges identified and addressed by establishing, promoting and reinforcing positive behaviours, while operating with a defense-in-depth philosophy.

### 1.1 Vision

Nuclear Refurbishments vision is to achieve Excellence in human performance by proactively minimizing the severity of events through the rigorous use of error prevention techniques, with a defense-in-depth philosophy.

## 2.0 REQUIREMENTS

This Hu plan aligns with N-PROG-AS-0002, 'Human Performance Program' and the 2016 – 2018 Fleet Human Performance Excellence Plan N-PLAN-09030-10000, which provides the foundation to guide OPGN toward Hu Excellence. For the 2016-2018 Business Plan, OPG is targeting a significant improvement in Hu by achieving reductions in human errors by focusing on three vital Hu strategic focus areas to drive improvements across the OPGN fleet.

The key initiatives described herein support and are built on the same three strategic foundations with detailed actions specific to the Refurbishment functional area;

### 1. Leadership Accountability

- Leaders understand, and model the behaviours expected from all staff, and continuously communicate and reinforce expectations.
- Leaders effectively communicate to the organization with a strong bias for safety and quality as opposed to results only.
- Leaders consistently use Human Performance and Lessons Learned to gain understanding, and ensure individuals', supervisors' and organizational learning.

### 2. Supervisor Effectiveness

- Supervisors set and communicate clear expectations to positively influence Hu behaviours and appropriate use of Hu tools.

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- Supervisors value the time spent with staff "in their field", and provide quality coaching.

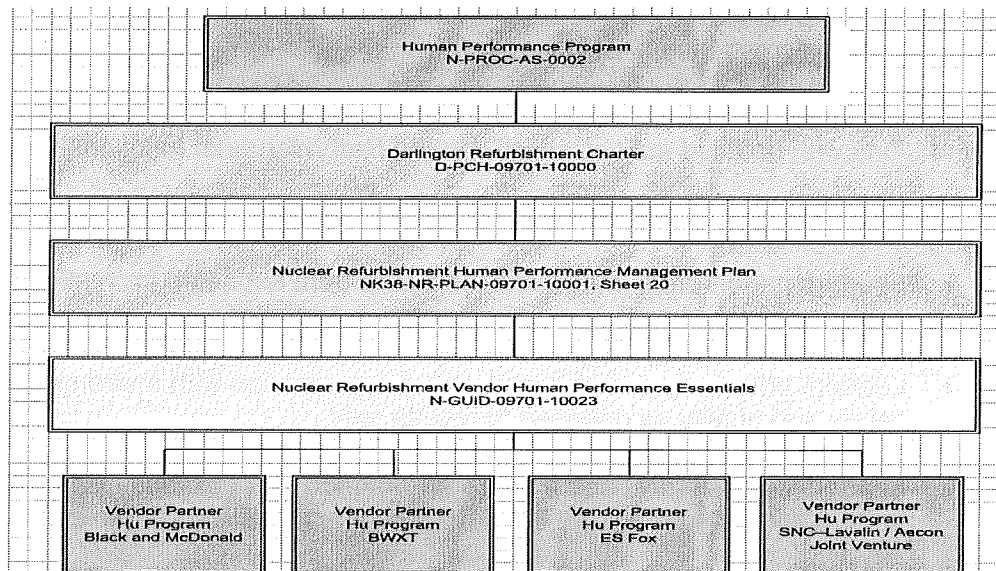
### 3. Procedure Use and Adherence

Supervisors create and maintain a culture where:

- Individuals at all levels value, and follow procedures to prevent events.
- Individuals understand the procedure's intent and purpose.
- If the procedure cannot be followed as written then the individuals STOP and have it corrected.
- Procedures are fixed rapidly, and are available for next use.

The Nuclear Refurbishment Hu Manager shall receive and review any requests for governance revisions to support the program. These document reviews and potential revisions shall follow N-PROC-AS-0001, 'Managed Systems', OPG-PROG-0001, 'Records and Document Control' and any other appropriate governance.

**Figure 1**  
**Hu Governance Framework for the NR Project.**



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## **2.1 Hu Governance Specific to the NR Project**

This Hu Management Plan applies to all OPG and Vendor Partners working on the Darlington Nuclear Refurbishment Project.

Nuclear Refurbishment Construction Execution in conjunction with Vendor Partner Senior Leadership has the overall accountability for ensuring Hu initiatives are in place and implemented effectively for the NR Project.

The Project Bundles that comprise the aggregate of the NR Project are as follows:

1. Shut down, Lay-up and Services
2. Islanding
3. Fuel Handling
4. Retube and Feeder Replacement
5. Turbines and Generators
6. Steam Generators
7. Balance of Plant

Additionally, Refurbishment AISC Projects executed by Projects & Modifications will be supported by the NR Project.

## **2.2 Hu Alignment with OPGN Fleet**

The Hu Manager for the NR Project is an active member of the OPGN Hu Peer Team and is aligned with Hu Corporate Functional Area Manager (CFAM) on the program dashboard and improvement initiatives; understands and executes Peer Team long-term goals and plans, and maintains open communication with Functional Team and fleet peers.

## **2.3 Hu Alignment with Darlington Nuclear Generating Station (DNGS)**

The Hu Manager's for DNGS and NR Project will meet regularly and conduct periodic walk-downs to demonstrate integration and collaboration. As Hu professionals continually strive to ensure open and effective communication and strategically cross pollinate and support Hu initiatives where required.

NR Project will ensure the Hu Manager or delegate attends the DNGS Hu Steering Committee Meeting and the Journey of Excellence meetings.

Additionally, the Hu Managers will participate in significant event investigations, and work seamlessly to ensure alignment and appropriate lessons learned are utilized across DNGS.

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## **2.4 Nuclear Refurbishment and Vendor Partner Integration**

A Nuclear Refurbishment and Vendor Partner Integration strategy is required to foster 'One Team', alignment and to assist in achieving excellence in Hu throughout the NR Project.

In support of this integration strategy, the NR Leadership 'One Team' comprised of OPG and Vendor Partners will demonstrate alignment and focus on Hu initiatives, trends and subsequent metrics at the monthly Project Steering Committee and Vendor Summit meetings to strive for Excellence in Hu.

## **2.5 Leadership Accountability**

Managing Hu proactively requires accountability and ownership with a desire by management, including vendor partners' management to improve Hu throughout the NR Project.

Leadership behaviours shall demonstrate and model the desired behaviours that are expected of all personnel working on the NR Project and at Darlington Nuclear Generating Station.

Leaders are consistently communicating and reinforcing desired behaviours and expectations with a strong bias for the NR Project Pillars; Safety, Quality, Schedule and Cost. 'At Risk' behaviours are immediately corrected by on the spot coaching.

## **2.6 Performance Measures**

Common performance measures create the ability to make some comparisons of changing performance through trending and analysis of data. This will be accomplished utilizing data from the Vendor Partners Event Free Day Reset (EFDR) and Observation and Coaching (O&C) programs.

These metrics will be used internally and shared externally to identify trends, whether positive or adverse and will be reviewed for subsequent corrective actions. The vendor will discuss, on a regular basis, the corrective actions and their effectiveness.

OPG will conduct or request at least annually from its Vendor Partners, focused self assessments around the health of their HU program to gauge effectiveness of their HU Program implementation, culture and to identify Areas for Improvement (AFI's) and to ensure the overall Program Management Plan (PgMP) requirements are met. (NK38-NR-PLAN-09701-10001 Sht. 1)

### **2.6.1 EFDR Targets**

These targets are subject to change based on analysis of performance.

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Additionally, when Unit 2 is defueled and declared a 'Construction Island' the EFDR Criteria (N-INS-09030-10002) will be changed and updated to reflect the construction focus unique to the NR project activities.

The following measures will be used to evaluate the overall health, reliability and robustness of our NR Hu Management Plan:

a) Nuclear Refurbishment Project EFDR Target

NR Project Targets	2016	2017	2018	2019
(NR P-EFDR)	1	3	2	1

b) Department EFDR Targets: Number of days between resets and Average number of days between resets will be tracked.

\*Targets subject to change on next revision to this Plan.

NR Project Department Targets	2016	2017	2018	2019
Shut down, Lay-up and Services	1	2	2	1
Islanding	4	4	2	-
Fuel Handling	6	10	2	-
Retube and Feeder Replacement	4	30	25	20
Turbines and Generators	2	15	10	2
Steam Generators	2	10	10	2
Balance of Plant	2	25	18	15
Operations	4	14	14	8
Maintenance	4	20	18	14
Radiation Protection	2	20	18	14
Project Office	2	5	5	3
Construction Oversight	1	5	5	3
Engineering (not Bundle related)	3	7	7	5

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- c) Crew Event Free Day Reset – Steering Committee Meetings / Vendor Summit
- d) At least annual Self Assessments of Hu Program

Additional metrics will be used to monitor and evaluate Hu trends for the NR Project.

#### 2.6.2 Event Free Day Reset Structure

The Event Free Day Reset (EFDR), also referred to as 'Clock Reset', is an essential Hu component that shall measure the NR Projects' human performance and evaluate performance (adverse) trends that will enable the team to pursue Excellence in human performance by proactively implementing corrective actions to prevent recurrence. (INPO 08-004)

In the spirit of 'ONE Team', if an event triggers the EFDR Criteria (N-INS-09030-10002) an EFD Reset will be appropriated, regardless of the contributing organization. EFD Reset will be structured as follows for the NR Project:

#### 2.6.3 Station Level Threshold:

- NR Project will be set at the OPGN Station Level threshold to capture (potential) significant events and will be managed by NR Senior Leadership with support from the Hu Manager.
- NR Project stoplights will be strategically placed throughout the NR Project to provide a visual aid to all personnel on performance status. These stoplights will vary and be distinctive to DNGS to avoid confusion and will be appropriately identified as NR Project.

#### 2.6.4 Department Level Threshold:

- Project Bundles along with supporting departments will administer their own EFD Reset. The criteria will be set at the OPGN Department Level threshold, and will be managed by the Project Director with support from the Hu Manager.

#### 2.6.5 Crew Level Threshold:

Low level reporting is crucial to minimizing the frequency and severity of consequential events, and supports a Just Culture, where individuals report near miss incidents and this desired behaviour is reinforced by the organization.

- Vendor Partners who have the lion share of higher risk work activities shall implement crew level EFDR criteria to mitigate and eliminate significant and consequential events.

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## **2.6.6 DNGS Station Event Free Day Reset:**

- The DNGS Station resets will be observed by the NR Project and subsequent lessons learned will be disseminated throughout the NR Project, to prevent recurrence of similar events.

## **2.7 Event Communication Protocol**

NR Projects Hu reporting protocol will utilize the OPG Human Performance Lessons Learned (HuLL) process (N-INS-09030-10001) when significant issues or events occur, and as requested by Senior Leadership.

Line will lead the development and communication efforts in conjunction with robust and SMART corrective actions to prevent recurrence of events.

## **2.8 Lessons Learned / Operating Experience**

As a learning organization, Operating Experience (OPEX) is a vital component to ensure event free performance. Relevant OPEX shall be incorporated and embedded into planning, training and execution of work activities via comprehensive work packages.

Human Performance Lessons Learned (HuLL's) as indicated above, will be the basis for internal OPEX to prevent recurrence of events.

## **3.0 ROLES AND ACCOUNTABILITIES**

### **3.1 Nuclear Refurbishment Leadership (Including Vendor Partners)**

The Nuclear Refurbishment operates as ONE TEAM, and the NR Leadership shall advocate OPG corporate behaviours, values and nuclear safety traits to create an environment that promotes, encourages and rewards Excellence in human performance.

### **3.2 Project Bundle Directors and Managers**

- Promote Hu and defense-in-depth throughout all work evolutions
- Evaluate Hu events based on significance and determine applicability to EFDR criteria
- Support and endorse Hu at Steering Committee and Vendor Summit forums
- Actively support Hu Advocates in their roles

### **3.3 Human Performance Manager**

Refurb Execution Human Performance

- Develops, implements, and maintains NR Hu governance



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- Provides oversight to ensure consistency across Project Bundles
- Develop Hu strategic initiatives, to align with overall Hu Excellence Plan, action plans, performance measurements, and oversight to accomplish goals aimed at improving human performance, especially for risk-important systems and related activities
- Monitors and assesses station trends in Hu for relevant OPEX to share with NR
- Integrates and Collaborates with vendor partners, CFAM Hu, DNGS Hu
- Industry benchmarking
- Executing the programs, processes and procedure outlined in governance
- Aligning with the Hu CFAM on the program dashboard and improvement initiatives

### 3.4 Nuclear Refurbishment Personnel

Consciously and rigoursly utilize event free tools with robust defenses when performing work activities to mitigate human error and prevent events.

### 3.5 Hu Working Committee

Hu Advocates and Hu Professionals will meet regularly to integrate and collaborate on key Hu initiatives to improve Hu across NR Project.

## 4.0 DEFINITIONS AND ACRONYMS

### 4.1 Definitions

**Behaviour:** Observable (movement, speech) and non-observable (perception, thought, decision, emotional response and activity) by an individual. The mental and physical efforts to perform a task.

**Coaching:** The purpose of facilitating changes in behavior of another person through direct interaction, feedback, collaboration and positive relationships.

**Defense-in-Depth:** The physical plant's and administrative system's built-in capacity to detect or prevent errors without suffering undesirable consequences; the multiple functions and associated techniques existing within the human performance system to protect people from error and protect the physical plant from people's actions.

**Defense:** A measure, including expected behavior that protects against various hazards or mitigates the consequences of a hazard.

**Event:** An unwanted, undesirable consequence/change in the state of plant structures, systems or components or human/organizational conditions that exceeds established significance criteria and involves human action or inaction in the causal chain.

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### Human Performance:

**1) Individual Sense** – A series of behaviours executed to accomplish specific task objectives.

**2) Organizational Sense** – The sum of what people (individuals, leaders, managers) are doing and what people have done; the aggregate system of processes, influences, behaviours, and their ultimate results that eventually become manifest in the physical plant. (Note: What some people have done affects what others will be doing later; a “result” for one person may be a “factor” for another)

**Near Miss:** Any occurrence that could have resulted in undesirable consequences but did not; ranging from minor breaches in defenses to incidents where all available safeguards were defeated, but no actual losses were sustained.

**Procedure Adherence:** The expectation that approved written guidance is followed as written and as intended.

**Vendor Partner(s):** Contractor organizations procured for the purposes of Engineering, Procurement, and / or Construction services for the Nuclear Refurbishment Project.

## 4.2 Acronyms

AFI	Area for Improvement
AR	Action Record
CFAM	Corporate Functional Area Manager
DNGS	Darlington Nuclear Generating Station
EFDR	Event Free Day Reset
Hu	Human Performance
HuLL	Human Performance Lessons Learned
NR	Nuclear Refurbishment
O&C	Observation and Coaching
OPG	Ontario Power Generation
OPEX	Operating Experience
PgMP	Program Management Plan

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## 5.0 REFERENCES

- [R-1] N-PROG-AS-0002 - Human Performance
- [R-2] N-INS-09030-10002 - Site & Department Level Event Free Day Resets
- [R-3] N-INS-09030-10001 - Human Performance Event Communication And Analysis
- [R-4] N-PLAN-09030-10000 – OPGN Human Performance Excellence Plan
- [R-5] NK38-NR-PLAN-09701-10001 Sht. 1 – Darlington Refurbishment Program Management Plan Structure
- [R-6] D-PCH-09701-10000 – Darlington Refurbishment Charter
- [R-7] INPO 08-004 – Human Performance Key Performance Indicators
- [R-8] INPO 06-003 - Human Performance Reference Manual
- [R-9] CORE 4 - Recognize Risk - Focus on Fundamentals

## 6.0 HUMAN PERFORMANCE INITIATIVES FOR NUCLEAR REFURBISHMENT

The path to Hu Excellence is an iterative process, and this Hu Management Plan will be a living document. The following Hu initiatives tabled below are paramount to achieving Excellence in Hu for the NR Project, and support the OPGN Excellence Plans' three strategic foundations; Leadership Accountability, Supervisor Effectiveness and Procedure Use and Adherence.

Many of these actions are in progress and will be tracked using a Hu Metrics Dashboard in conjunction with self assessments.

Hu Initiatives	Action / Description	Date Required	Owner
Human Performance Working Committee	Comprised of Hu leaders and Hu Advocates Meets as per ToR with Quorum <ul style="list-style-type: none"> <li>Quorum metrics tracked for Project Steering Committee meetings</li> </ul>	Established - Ongoing	K. Brining
Hu at Project Steering Committee meetings	Project Steering Committees meetings agenda will be updated to include Hu <ul style="list-style-type: none"> <li>Share metrics and Hu initiatives</li> </ul>	Established - Ongoing	Leadership
Darlington 'Station' Hu Steering Committee -	Hu Manager for Refurb to participate at Darlington Hu Steering Committee and added as Quorum. <ul style="list-style-type: none"> <li>Alignment</li> </ul>	Established - Ongoing	J. Thompson / K. Brining / S. Sanders (CFAM)
OPGN Hu Peer Team	Hu Peer Team meets monthly for fleet integration and collaboration on Hu initiatives detailed in the Hu Excellence Plan	Established - Ongoing	Hu Peer Team (Fleet)

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Hu at Vendor Summit meetings	Vendor Summit meetings will include Hu on agenda	Established - Ongoing	Leadership
Strategic Project Bundle Hu Plans for 2017	Three Hu Initiatives Examples could be: -Supervisor Effectiveness -Paired O&C's -Focus on Core 4 EFT -Consistent HuLL process -Hu Trending and Metrics	December 31, 2016	Project Bundle Directors
Strategic Vendor Partner Hu Plans	Hu Plans to be developed to support their respective Hu Programs and Hu Initiatives detailed in this Plan, while considering the Excellence Plans' three strategic foundations: Leadership Accountability, Supervisor Effectiveness and Procedure Use & Adherence.	October 31, 2016	Vendor Partners Hu and Leadership
Meeting Critique focusing in on OPG Behaviours: Say It, Do It / Tell It as It Is / Simplify It	You can't change what is not evaluated and measured. Knowledge workers are required to demonstrate accountability to our OPG Behaviours through the Meeting Critique Form. (Kathy to send rollout to vendor partners) <ul style="list-style-type: none"> <li>Identify required meetings to be critiqued</li> <li>Trend the data</li> <li>Communicate compliance and trends</li> </ul>	Established - Ongoing	OPG and Vendor Partners
Vendor Senior Leadership Walk-downs	Vendors' Senior Leaders conduct field visits to establish rapport with workers and reinforce expectations. Frequency TBD	Established - Ongoing	Vendor Partners Senior Leadership
Positive Reinforcement (R+)	'Pay It Forward' Campaign – Community Charity Fundraisers <ul style="list-style-type: none"> <li>Bi-Annual charity campaigns with all vendor partners.</li> <li>Have a trade worker with their vendor leader and OPG leader present the donation to the charity</li> </ul>	Established - Ongoing	Senior Leadership
	Lunch with Mike and / or Bill <ul style="list-style-type: none"> <li>Monthly recognition for trades based on good catch, peer to peer</li> </ul>	October 2016	Senior Leadership
	Good Catch / Good News <ul style="list-style-type: none"> <li>Feature good catch / good news in the tailboards and 'The Pulse'</li> <li>R+ Parking Spot for the week</li> </ul>	Established - Ongoing October 2016	Leadership
	Vendor Partners Positive Reinforcement (R+) Programs <ul style="list-style-type: none"> <li>Monitor R+ through vendor reporting</li> </ul>	October 2016	Vendor Partners / Construction Oversight
Paired O&C's (Vendor Leadership with Vendor Supervisor)	Coach the Coach <ul style="list-style-type: none"> <li>Vendor Partners to qualify supervisors O&amp;C skills through paired O&amp;C's to improve Hu</li> </ul>	Established - Ongoing	Vendor Partners
Joint O&C's (OPG and Vendor)	For alignment and as ONE TEAM, OPG and Vendor Partners shall conduct joint O&C's to reinforce integrate & collaborate, and build rapport with trades and improve Hu	Established - Ongoing	Construction Oversight
Safety Ambassador	One trades person appointed to be the Safety Ambassador of the day/week for the Refurb Project <ul style="list-style-type: none"> <li>Peer to Peer Coaching</li> <li>Reinforcing Hu Event Free Tools</li> <li>Upholding standards and expectations</li> </ul>	September 2016	Hu Working Committee
Peer to Peer O&C	Worker led O&C program (peer to peer)	2017	Vendor Partners
New to Nuclear	At on-boarding, vendor partners to establish workers new to nuclear (NTN). NTN is determined by < 6	Established - Ongoing	Vendor Partners

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	Months in the nuclear industry <ul style="list-style-type: none"> <li>NTN sticker given at On-boarding</li> <li>Vendor partners to ensure NTN process is established in their programs</li> <li>Supervision to constantly assess, guide and mentor the workers NTN</li> </ul>		
Hu Metrics	O&C trends, Senior Leadership Walk-downs, Positive Reinforcement, Self Assessments, Quorum of HuWC EFDR, SCR's/AR's adverse trends (i.e. Near Miss, PU&A non-compliance)	October 2016	Vendor Partners
Refurb EFDR	<u>Project Bundle EFDR Criteria</u> -vendor partners will feed into EFDR (Vendor Partners encouraged to continue with their own EFDR at a crew level threshold) <u>Metric</u> Average number of days between resets Goals to be established (IP) <u>Communication of HuLL</u> Rapid communication within 24hrs of an event to get the immediate lessons learned to all of NR <b>See Section 3.6.1</b>	September 2016	Project Directors with support from K. Brining
Refurb Handbook	Trades Focus Group – what would they use?	Completed	K. Brining / M. MacDonald
	Nuclear Safety Traits Commitment <ul style="list-style-type: none"> <li>Personal commitment aligned to the Nuclear Safety Traits are to be signed off by all workers when they receive their books</li> </ul>	October 2016	All Workers
	Team compiling Refurb Handbook (Nuclear Safety, Communications, Construction Oversight)	October 2016	B. Hanrahan w/ team
Human Performance Training and Communication	Fundamental Human Performance Training '101' training – 2 to 4 hour classroom	-At on-boarding -Existing employees by December 2016	Vendor Partners
	Mock-up Training Training and rehearsals emulate Nuclear Safety and field requirements	September 2016 and Ongoing	Construction Oversight with Vendor Partners
	Dynamic learning activities focusing on human performance tools (i.e. Procedure Use and Adherence, Place Keeping, Verification Practices, SA etc.) <ul style="list-style-type: none"> <li>Incorporate for Supervisors at NCSA</li> <li>Worker DLA</li> </ul>	October 2016 - Ongoing	Vendor Partners
	Conduct regular proactive HU Stand-ups at OPG's request OR self-identified, when adverse trends are evident, and if there is a significant event, and at OPG's request <ul style="list-style-type: none"> <li>Sign-off sheets may be required</li> </ul>	Established - Ongoing	OPG / Vendor Partners
	Communicate HU trends and initiatives throughout the organization – to the shop floor. *Consider roll-up of trend information and subsequent corrective actions rather than constant messaging and rollouts. <ul style="list-style-type: none"> <li>Assess during field O&amp;C's with the HuWC</li> </ul>	Established - Ongoing	OPG / Vendor Partners

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## 7.0 HUMAN PERFORMANCE PHASES (FOCUS AREAS)

As we progress into the NR Project, there will be key phases to ensure that all personnel are re-calibrated to ensure individual and organizational behaviours are maintained to standards and expectations.

Below are proposed phases that are subject to change due to performance indicators, such as EFDR and Observation & Coaching trends:

### 7.1 Phase 1

October to December 2016:

- Senior Leadership Joint Walk-downs
- Rapid Trending to CORE 4
- Communications (Stand-ups, Signage) supporting rapid trending
- Safety Ambassador with strong Hu Advocacy focus)
- Construction Oversight -continuous throughout U2 NR

### 7.2 Phase 2

January to March 2017:

- Why I work safely campaign
- Situational Awareness (D1711)
- Peer Checking
- Increased Field Supervision with Paired O&C's

### 7.3 Phase 3

April to July 2017

- Campaign focused on lessons learned to date (TBD)
- Situation Awareness (D1711)
- Peer Checking and Co-worker coaching
- Increased Field Supervision

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## 7.4 Phase 4

(August - TBD)

- Determine focus areas based on lessons learned from previous Hu phases

## 8.0 HUMAN PERFORMANCE CAUTIONS

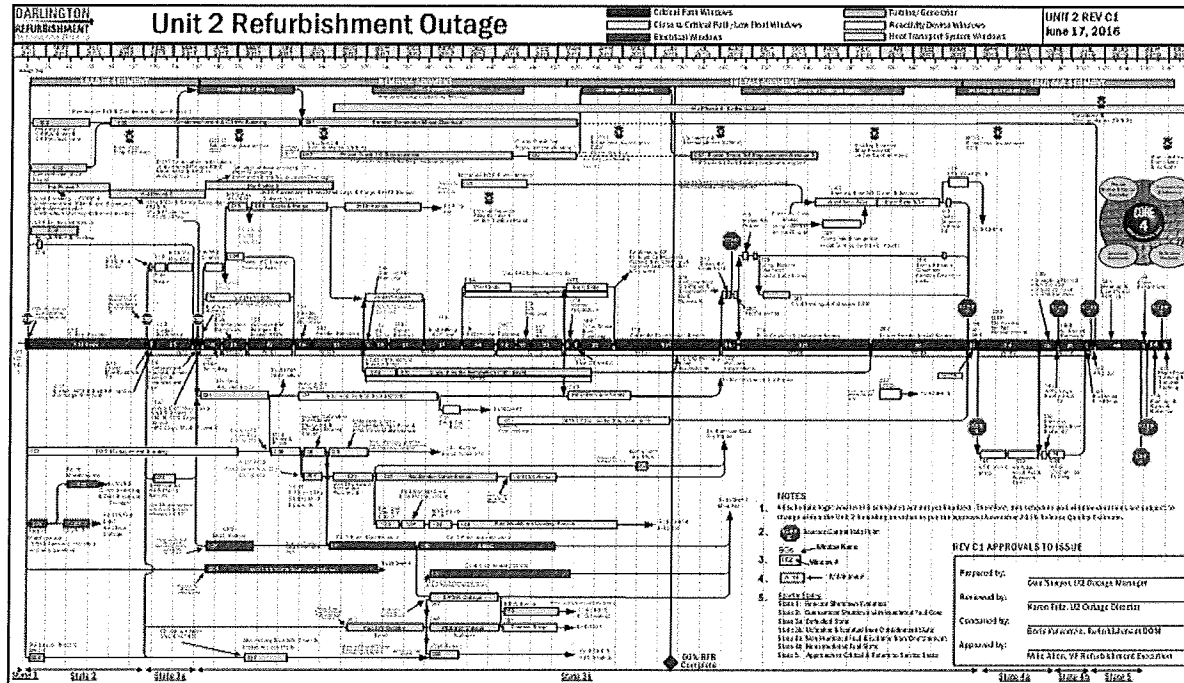
Hu Cautions are a visual aid (Yellow Stoplight) along with Leadership presence to alert workers to potential error-likely situations. When workers consciously and rigoursly utilize various error prevention tools and techniques events will be mitigated.

The following proposed cautions are deliberately embedded into the schedule and subject to change depending on focus areas, adverse trends and NR Leadership discretion.

1. December 21, 2016 to January 4 2017: Holidays and New Year (Situational awareness (SA), eliminating distractions)
2. March 2017: D1711 (Importance of SA and Correct Component Verification (CCV))
3. June 30, 2017: Canada Day long weekend, changes in weather, and vacation schedules (Focus on Teamwork and implementing Heat Stress lessons learned)
4. December 22, 2017 to January 2, 2018: Holidays and New Year (Situational awareness (SA), eliminating distractions)
5. March 2018: D1831(Importance of SA and Correct Component Verification (CCV))
6. June 30, 2018: Canada Day long weekend, changes in weather, and vacation schedules (Focus on Teamwork and implementing Heat Stress lessons learned)
7. December 22, 2018 to January 2, 2019: Holidays and New Year (Situational awareness (SA), eliminating distractions)
8. March 2019: D1941(Importance of SA and Correct Component Verification (CCV))
9. June 28, 2019 Canada Day long weekend, changes in weather, and vacation schedules (Focus on Teamwork and implementing Heat Stress lessons learned)
10. September 2019: Summit Fever (Complacency and shortcuts)

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## Appendix A:



Proposed Hu Phases and subsequent Cautions within the Level 1 NR Project Schedule







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**DARLINGTON REFURBISHMENT PROGRAM QUALITY PLAN**

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**Darlington Refurbishment Program  
Quality Plan**

**NK38-NR-PLAN-09701-10001-0023-R001**  
2016-09-13

Order Number: N/A  
Other Reference Number: N/A

**Internal Use Only**

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### Revision Summary

Revision Number	Date	Comments
R001	2016-09-13	<ul style="list-style-type: none"> <li>• Incorporated DCR 134210 (updated Section 2.5.2, 2.7, 3.1,) and DCR136725 (updated Section 2.11)</li> <li>• Updated Section 2.1 text on background.</li> <li>• Updated Section 2.2 outage dates.</li> <li>• Updated Section 2.4 to change reference from CSA N286-05 to CSA N286-12</li> <li>• Updated Section 2.5.2 to include work stoppage.</li> <li>• Moved Section 2.16, Quality Surveillance to 2.5.2.1 and updated section to indicate surveillance activities and records generated are outlined in NK38-GUID-09701-10038, Darlington Refurbishment Program Quality Surveillance Guide</li> <li>• Added Section 2.5.2.2, Project Priority List and Surveillance Schedule</li> <li>• Added Section 2.5.2.3, Quality Management Metrics and Reporting</li> <li>• Added Section 2.5.2.4, STOP Work Authority</li> <li>• Added Section 2.5.2.5, Escalation of Issues</li> <li>• Updated Section 2.7 to include reference to the Refurbishment Project Division of Responsibilities (DoR) outlining interfaces with other oversight groups</li> <li>• Updated Section 2.11 to include reference to NK38-GUID-09701-10042, Darlington Refurbishment, Guideline for OPG Processing of EPC Vendor ITP's</li> <li>• Deleted section 2.14, Monitoring and Measurement; covered by new section 2.5.2.3</li> <li>• Updated Section 3.1 to enhance responsibilities of Quality Management Director</li> <li>• Added Section 3.2, Manager, Field Execution Surveillance &amp; Completion Assurance</li> <li>• Updated Figures 1 to 4</li> <li>• Added Figure 5</li> <li>• Updated Table 1 to include SNC/Aecon JV under ESMSA</li> <li>• Added Appendix C and D</li> <li>• Minor other editorial changes</li> </ul>
R000	2015-08-11	Initial issue

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### 1.0 PURPOSE

The purpose of this Quality Plan (QP) is to address the quality requirements as they relate to the Darlington Refurbishment Program (DRP) per D-PCH-09701-10000, Darlington Refurbishment Charter. The objective of this QP is to outline continuous quality surveillance that will be conducted on a sampling basis to address the quality and regulatory requirements through all of the DRP phases, provide assurance that project completion assurance is obtained and to interface with the project staff and regulator.

This QP provides a link between the Ontario Power Generation's (OPG) Nuclear Management System and the quality systems of the contractors engaged in the DRP. Figure 1 depicts the overall quality management system hierarchy as implemented in OPG.

Work performed for the DRP will be subject to additional quality surveillance to ensure requirements of the Darlington Refurbishment Charter (D-PCH-09701-10000) are met. See Figure 2.

The preparation, approval, issue, distribution and revision of this QP is in accordance with OPG's Nuclear Management System. This QP, referenced OPG processes and Refurbishment procedures collectively meet the applicable requirements of CSA Standards and ISO (the International Organization for Standardization).



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## 2.0 REQUIREMENTS

### 2.1 Background

OPG's Board of Directors and the Ontario Government approved the Refurbishment of the Darlington Nuclear Generating Station. The refurbished Darlington station will provide 30 plus years of clean, reliable, base load power, at a cost lower than other alternatives considered.

The Darlington Refurbishment Project (DRP) has applied industry experience on the planning and execution of major projects, including considerable project management expertise of other OPG operation groups.

Major contracts have been awarded using a commercial strategy as follows:

- There is more than one prime contractor. OPG has a separate contract for each prime. They are responsible for the completion of work under their particular contract.
- OPG is the integrator between the prime contractors and is responsible for the entire project.
- OPG and the contractors are aligned on common goals.
- OPG retains project management responsibility and design authority for the DRP.

### 2.2 Objectives

The objectives of the DRP are:

- i. Refurbish the Darlington Nuclear Generation Station to extend its operational life 30 years.
- ii. Complete preparations for the Refurbishment planned outages as follows:
  - Unit 2 – October 2016 to September 2019 (35 months)
  - Unit 3 – October 2019 to August 2022 (34 months)
  - Unit 1 – January 2021 to October 2023 (33 months)
  - Unit 4 – September 2022 to May 2025 (32 months)
- iii. Complete all Refurbishment Outages within the planned period with appropriate consideration to all aspects of the management of the facility

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including health, safety, environment, security, economics, quality and regulatory compliance.

- iv. Complete the DRP within the planned budget as approved by the OPG Board of Directors.
- v. Complete all Refurbishment Outages with zero lost time accidents or restricted work injuries.

DRP requirements are:

- i. Refurbishment activities will be conducted in accordance with applicable federal, provincial and OPG requirements.
- ii. All refurbishment deliverables shall meet applicable Canadian Nuclear Safety Commission (CNSC) licensing requirements.
- iii. Environmental releases will be minimized and acceptable under all normal, abnormal and accident conditions in accordance with approved requirements.
- iv. Personnel exposures will be As Low as Reasonably Achievable (ALARA) through all phases (i.e., design, construction, commissioning, available for service and unit readiness) in accordance with Radiation Protection requirements.
- v. An integrated project schedule will be developed and maintained through the entire life of the DRP to ensure project design, verification, licensing, purchasing, fabrication, installation, construction, testing, commissioning and turnover activities are completed as scheduled.
- vi. The QP will be implemented to ensure all elements of the overall DRP are carried out as required and additional surveillance is conducted on the Refurbishment work.

## 2.3 Policy

To ensure refurbishment is completed in a safe, timely, economic sound manner and to the required quality expectations, the DRP implements the Darlington Refurbishment Charter (D-PCH-09701-10000) to perform work in accordance with the managed systems defined in:

- OPG-POL-0033, OPG Business Model,
- N-POL-0001, Nuclear Safety Policy,
- N-CHAR-AS-0002, Nuclear Management System.

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All DRP project work will be conducted under the authority of OPG consistent with the licensing basis and in accordance with the OPG Nuclear Management System.

## 2.4 Licence Requirements

Per the Darlington Nuclear Generating Station Nuclear Power Reactor Operating Licence (PROL), the licensee is required to implement and maintain a management system in accordance with Canadian Standards Association (CSA) Standard N286-12, Management System Requirements for Nuclear Facilities. Figure 3 provides an overview of the regulatory requirements, project governance, and project executable processes.

For each Licence Condition (LC) in the PROL, the Licence Conditions Handbook (LCH) provides mandatory compliance verification criteria that the licensee must follow to meet the conditions in the licence, operational limits and information regarding delegation of authority and applicable version of documents referenced in the licence.

N-LIST-08130-10025, CSA N286-12 to OPGN Governance Cross Matrix provides a mapping of OPG Nuclear (OPGN) governance to CSA N286-12 to demonstrate the Nuclear Management System (N-CHAR-AS-0002) compliance.

## 2.5 Organization

### 2.5.1 Project Organization

The Darlington Refurbishment Project Organization structure is described in the DRP Charter (D-PCH-09701-10000).

### 2.5.2 Project Quality Management Organization

The Project Quality Management Organization is depicted in Figure 4. This group will perform the following:

- Develop, maintain and implement a DRP Quality Plan that ensures the quality and management system requirements for the DRP are executed and completed.
- Establish and execute a project Quality Management Organization that:
  - a. Monitors, observes and performs continuous quality surveillance on each phase of DRP as a matrixed organization.
  - b. Provides assurance through the continuous quality surveillance activities that Project Completion Assurance is obtained.
  - c. Can escalate and implement corrective actions for critical issues.
  - d. Can stop or direct stoppage of work.

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e. Interfaces with other DRP internal and external independent assessment activities to coordinate and optimize the required quality surveillance activities for DRP.

- Establish metrics and reporting requirements that assess effectiveness of the DRP Quality Plan and surveillance activities performed.
- Oversee management of records of changes to the units during refurbishment.

The Darlington Refurbishment Program Quality Management Organization Functional Management Plan (NK38-PLAN-09701-10223 SHT 0014) details the scope, responsibilities and staffing plan for the Quality Management Organization. See Figure 5 for Quality Management organization process documents.

### 2.5.2.1 Quality Surveillance

The Project Quality Management Organization will conduct continuous quality surveillance activities based on sampling and oversight of the Refurbishment projects during the following phases (See Figure 6):

1. Shutdown/Layup
2. Design
3. Procurement
4. Construction
5. Commissioning
6. Available for Service
7. Unit Readiness
8. Closeout

Details associated with the above surveillance activities and records generated are outlined in NK38-GUID-09701-10038, Darlington Refurbishment Program Quality Surveillance Guide.

### 2.5.2.2 Project Priority List and Surveillance Schedule

The focus areas for surveillance performed by the Quality Management organization are as follows:

- (a) Safety Significant Items
  - i. Systems Important to Safety (SIS)
  - ii. Safe Operating Envelope (SOE) Systems

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- (b) Regulatory Items
  - i. Safety Improvement Opportunities (SIOs)
  - ii. Integrated Implementation Plan (IIP)
  - iii. Regulatory Hold Points
- (c) Other Production and Reliability related project items
  - i. Restart Hold Points
  - ii. Impediments to Breaker Open and Breaker Closed
  - iii. Project Risk and issues

Based on these focus areas, the project quality surveillance prioritization is established using a risk graded approach. This approach takes into account the focus areas, vendor performance, cost, schedule and nature of work (First of a Kind and First in a While). Details of the process and list of priority projects are outlined in NK38-CORR-09701-0598247, Quality Management - Unit 2 Refurbishment Project Priority List.

The Quality Management organization will utilize the priority list of the projects to schedule Quality Management surveillance activities. Surveillances will be performed on the identified projects in the Engineering, Procurement and Field Execution areas; including review of required documents.

Quality Management surveillance schedule will be reviewed by the Quality Management organization on a regular basis and is subject to change to take into account changes in the project schedule, any risks, issues, Quality Management metrics and other oversight activities

### 2.5.2.3 Quality Management Metrics and Reporting

Surveillance observations and findings will be reviewed by the Quality Management organization on a regular basis. The assessment of the data will be documented as metrics and reported to the project. The process for developing issuance of Quality Management Metrics (including trending) and Reports are outlined in NK38-GUID-09701-10050, Darlington Refurbishment Quality Management Metrics Trending and Reporting Guide.

### 2.5.2.4 STOP Work Authority

Stop work authority for refurbishment is designed to provide employees and contractors with the responsibility and obligation to **stop work** when a perceived unsafe condition or behaviour may result in an unwanted result or event. See Appendix C for details.

### 2.5.2.5 Escalation of Issues

Escalation of issues by Quality Management organization related to the Darlington Nuclear Refurbishment (DNR) Project will be initiated after the issue has been approved for escalation by the Director Quality Management. Appendix D outlines the implementing process for escalation of issues.

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## 2.6 Personnel Capability

This work will be implemented by utilizing qualified OPG staff, contractors and subcontractors in accordance with N-TQD-901-00001, Nuclear Refurbishment Training and Qualification Description.

OPG has contracted a number of Engineering, Procurement and Construction Contractors for portions of the project scope. Consistent with OPG-POL-0033, OPG Business Model, all Contractors are on OPG's Approved Supplier's List (ASL).

## 2.7 Project Interfaces

The refurbishment project interfaces will occur between various organizations and contractors. The project shall develop a project execution plan, specific procedures, instructions, and guides, etc. to control the interfaces.

Interfaces will occur between:

- Refurbishment Project Team
- Darlington Station Organization
- OPG Nuclear Engineering
- Contractors
- Regulator (CNSC, TSSA, MOE, MOL etc.)
- Other utilities (Bruce Power, New Brunswick Power, etc.)

The Division of Responsibilities (DoR) outlining the interfaces with the various oversight groups will be documented in the "Refurbishment Project – DoR Execution Activities – Post Breaker Open" and is being tracked via an action in the Risk Management and Oversight Tool (RMO Action 00008847).

In accordance with the Contract Agreement, interface requirements between OPG and the Contractor are outlined in the Contractor Owner Interface Requirements (COIR). The following lists the key COIR documents associated with the DRP:

- N-COI-00120-0001, Contractor Owner Interface Requirements for Nuclear
- NK38-DAI-09701-10008, Retube Feeder Replacement Project Contractor Owner Interface Requirements

Any deviations to the interface agreement will be processed in accordance with OPG Nuclear Management System.

Table 1 outlines the contractors supplying services related to the DRP.

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## 2.8 Documentation and Data Control

### 2.8.1 Records and Documentation Control

OPG's process for management of nuclear records and documents throughout their life cycle is addressed in OPG-PROG-0001, Information Management.

The intention is to use existing OPG processes as required. Quality Records prepared by the Contractor will be provided to OPG in accordance with the Contract Agreement. Vendor technical documents will be processed according to N-PROC-MP-0078, Specification Review, Acceptance and Use of Vendor Technical Documents.

### 2.8.2 Information Management

The OPG process for management of OPG's information is addressed in OPG-PROG-0001, Information Management.

## 2.9 Business Planning

OPG-POL-0033, OPG Business Model defines how OPG operates its business. The business planning framework to ensure compliance with OPG Nuclear Management System is identified in N-PROG-AS-0005, Business Planning. This program ensures organization alignment and defines desired results in sufficient detail to support accountability, and ensures constrains, the availability of resources, and business risks are adequately addressed.

## 2.10 Communication

Communication of this plan will be implemented in accordance with the Darlington Refurbishment Charter (D-PCH-09701-10000).

## 2.11 Design and Development

The framework for assurance that design and procedure changes are consistent with the plant design and licensing bases is outlined in N-PROG-MP-0009, Design Management.

The process for plant modification from the engineering change request through installation, commissioning and closeout is defined in N-PROG-MP-0001, Engineering Change Control.

As part of the detailed design process, the need for Inspection and Test Plans and regulatory control points (Verification, Witness and Hold) are required to be defined. Guideline providing the process to be followed by OPG in the review, acceptance and field execution of Inspection and Test Plans (ITPs) prepared by the Engineering Procurement and Construction (EPC) vendors using their Quality Assurance Program and Certificate of Authorization in executing work on the Darlington Refurbishment Project is outlined in NK38-GUID-09701-10042.

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The Contractor will conduct design, modification, installation, support commissioning and closeout activities in accordance with the contract agreement.

### 2.12 Materials Management (including identification and traceability)

For material procured by OPG to meet the DRP scope requirements, the general identification and traceability control is provided in OPG-PROG-0009, Items and Services Management.

For materials procured by the Contractor, the requirements for material identification, shipping and traceability are in accordance with the Contract Agreement.

### 2.13 Corrective Action

The process to ensure that deficiencies, nonconformance, weakness with a process, document or service or conditions that adversely impact, or may adversely impact plant operation, personnel, Nuclear safety, the environment or equipment and component reliability are promptly identified and corrected is addressed in N-PROG-RA-0003, Corrective Action.

This program also provides the process to ensure in-house and external Operating Experience (OPEX) evaluation and assessment including actions to improve plant safety and reliability. Effective self-assessment and benchmarking process are also implemented by this program to promote continuous performance improvement.

Contractors will manage corrective actions in accordance with the Contractor Agreement.

### 2.14 Independent Assessments

N-PROG-RA-0010, Independent Assessments provides the processes for performing comprehensive and critical evaluation of all activities affecting Nuclear facilities (i.e., independent assessments performed by Nuclear Oversight and Nuclear Safety Review Board). The Program is owned and implemented on behalf of the Chief Nuclear Officer (CNO) by the Nuclear Oversight organization in accordance with N-PROC-RA-0048.

External assessments are also performed by groups outside of OPG such as WANO, CNSC, Refurbishment Construction Review Board (RCRB), Ministry of Labour (MOL), Ministry of Environment (MOE) etc.



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### 3.0 ROLES AND ACCOUNTABILITIES

This QP identifies the Director, Quality Manager's role and responsibilities. Further details of project team roles and responsibilities are contained in approved role documents, project execution plans and other project documents.

Contractors will manage responsibilities in accordance with their contract agreement.

#### 3.1 Director, Quality Management

- Responsible for ensuring the oversight of quality and management system requirements for the DRP are executed and completed.
- Responsible for ensuring oversight by sampling of documentation related to configuration management.
- Responsible for ensuring continuous quality surveillance on a sampling basis is performed during each phase of DRP.
- Responsible for providing assurance through the quality surveillance activities that Project Completion Assurance is obtained.
- Can stop or direct stoppage of any work activity that in the Director's sole opinion creates an unacceptable business risk.
- Can escalate and implement corrective actions for critical issues.
- Responsible for the interfaces with other DRP internal and external assessment activities to coordinate and optimize the required quality surveillance activities for DRP.
- Communicate issues and findings as a result of surveillances with other Darlington Refurbishment Project Directors and leadership team.
- Establish and maintain interface with vendor Quality Assurance managers to communicate quality related issues and support required for resolution.
- Responsible for establishing metrics and reporting requirements that assess effectiveness of the DRP Quality Plan and surveillance activities performed.
- Can direct specific quality surveillance activities to prevent incidences based on risk and OPEX.
- Recruitment and staffing for the Quality Management organization.
- Budget for the Quality Management organization.

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### 3.2 Manager, Field Execution Surveillance & Completion Assurance

- Oversee the following Quality Management organization groups:
  - Field Execution Surveillance
  - Integration & Reporting
  - Documentation and Parts Oversight
- Interface with the following matrixed Quality Management groups in implementing the overall mandate of the organization:
  - Quality Engineering
  - Procurement Oversight
  - Refurbishment Licensing Support
- Plan, schedule and complete quality surveillance activities for the projects identified in the Project Priority List (NK38-CORR-09701-0598247) for the Field Execution Surveillance & Completion Assurance group.
- Ensure non-conformances related to quality surveillance are identified and critical issues are escalated to the Director, Quality Management.
- Recommend strategies for issue resolution and corrective actions related to quality surveillance activities.
- Take direction from Director, Quality Management.
- Integrate Quality Management Schedule.
- Oversee Records & Records Retrievably to ensure configuration management.
- Oversee preparation of all Quality Management reports and metrics.

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## **4.0 DEFINITIONS & ACRONYMS**

### **4.1 Definitions**

None

### **4.2 Acronyms**

ALARA	As Low as Reasonably Achievable
ASL	Approved Supplier's List
CNO	Chief Nuclear Officer
CNSC	Canadian Nuclear Safety Commission
COIR	Contractor Owner Interface Requirements
CSA	Canadian Standards Association
DNGS	Darlington Nuclear Generating Station
DoR	Division of Responsibilities
DRP	Darlington Refurbishment Program
ESMSA	Extended Services Master Service Agreement
EPC	Engineering Procurement and Construction
INPO	Institute of Nuclear Power Operations
ISO	International Organization for Standardization
ITP	Inspection and Test Plan
LC	Licence Condition
LCH	Licence Conditions Handbook
MOE	Ministry of Environment
MOL	Ministry of Labour
OPEX	Operating Experience
OPG	Ontario Power Generation

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OPGN	Ontario Power Generation Nuclear
PROL	Power Reactor Operating Licence
QP	Quality Plan
RCRB	Refurbishment Construction Review Board
RMO	Risk Management and Oversight Tool
TSSA	Technical Standards and Safety Authority
WANO	World Association of Nuclear Operators

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## 5.0 REFERENCES

### 5.1 Performance References

1. CSA N286-12, Management System Requirements for Nuclear Facilities.
2. N-COI-00120-00001, Contractor Owner Interface Requirements for Nuclear.
3. NK38-DAI-09701-10008 R002, Retube Feeder Replacement Project Contractor Owner Interface Requirements.
4. OPG-PROG-0001, Information Management.
5. N-LIST-08130-10025 R000, CSA N286-12 to OPGN Governance Cross Matrix.
6. N-TQD-901-00001, Nuclear Refurbishment Training and Qualification Description.

### 5.2 Developmental References

1. OPG-POL-0033, OPG Business Model.
2. N-POL-0001, Nuclear Safety Policy.
3. N-CHAR-AS-0002, Nuclear Management System.
4. D-PCH-09701-10000, Darlington Refurbishment Charter.
5. CAN/ISO 10005:2005, Quality Management – Guidelines for quality plans.
6. OPG-PROG-0001, Information Management.
7. OPG-PROG-0009, Items and Services Management.
8. N-PROG-AS-0007, Project Management.
9. N-PROG-AS-0005, Business Planning.
10. N-PROG-MP-0009, Design Management.
11. N-PROG-MP-0001, Engineering Change Control.
12. N-PROG-RA-0003, Corrective Action.
13. N-PROG-RA-0002, Conduct of Regulatory Affairs.
14. N-PROG-RA-0010, Independent Assessment.

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15. N-PROC-RA-0020, Preliminary Event Notification.
16. N-PROC-RA-0048, Conducting Performance Based Audits and Assessments.
17. Occupational Health and Safety Act.
18. INPO 09-007, Principles for Excellence in Nuclear Project Construction.
19. INPO 12-012, Traits of a Healthy Nuclear Safety Culture.
20. N-INS-08965-10016, Safety Hazard and Worker Safety Concern Resolution.

### 5.3 Others

1. NK38-GUID-09701-10042 R000, Darlington Refurbishment, Guideline for OPG Processing of EPC Vendor ITP's.
2. NK38-PLAN-09701-10223 SHT 0014, Darlington Refurbishment Program Quality Management Organization Functional Management Plan.
3. NK38-GUID-09701-10038, Darlington Refurbishment Program Quality Surveillance Guide.
4. NK38-CORR-09701-0598247, Quality Management - Unit 2 Refurbishment Project Priority List.
5. NK38-GUID-09701-10050, Darlington Refurbishment Quality Management Metrics Trending and Reporting Guide (To be Issued).
6. NK38-GUID-09701-10036, Nuclear Refurbishment Work Stoppage / Reporting and Recovery.

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## Appendix A: Figures

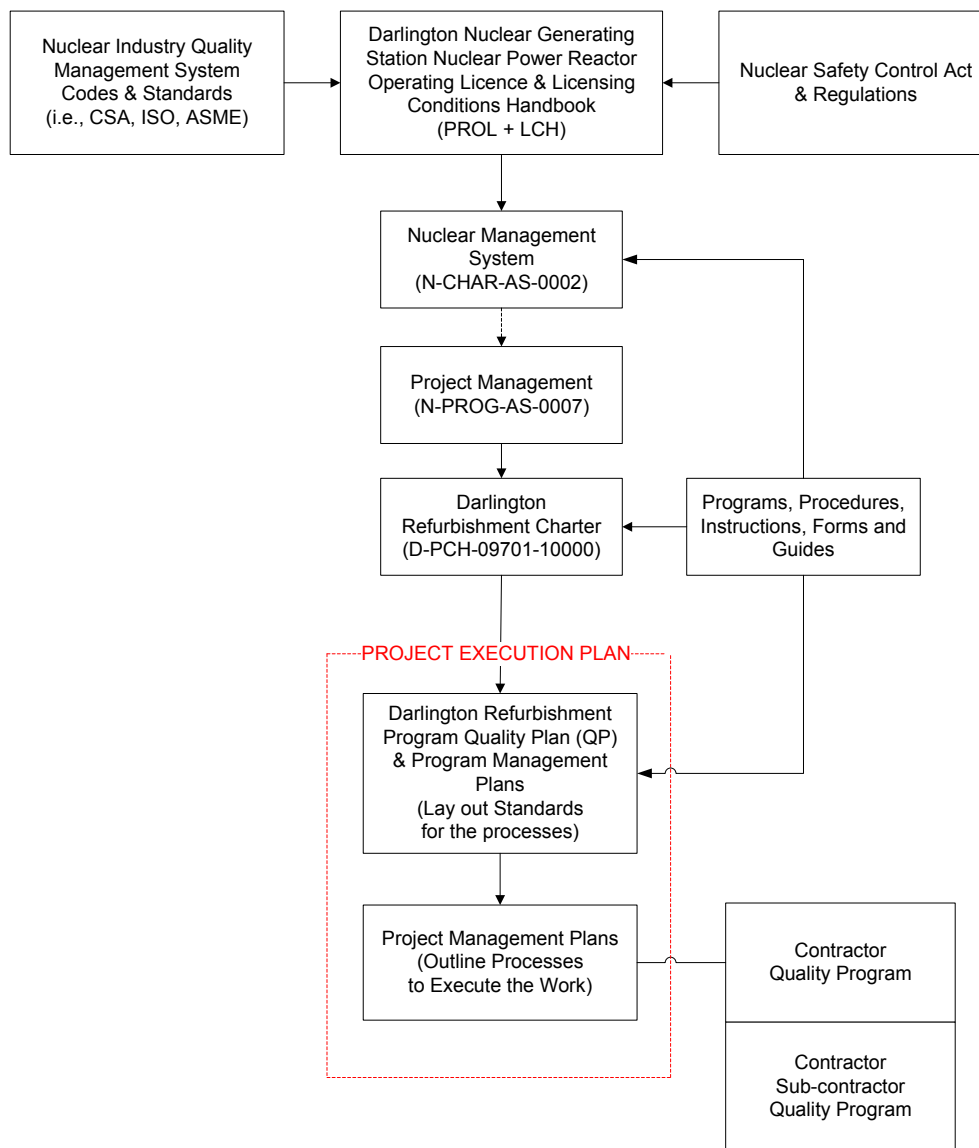
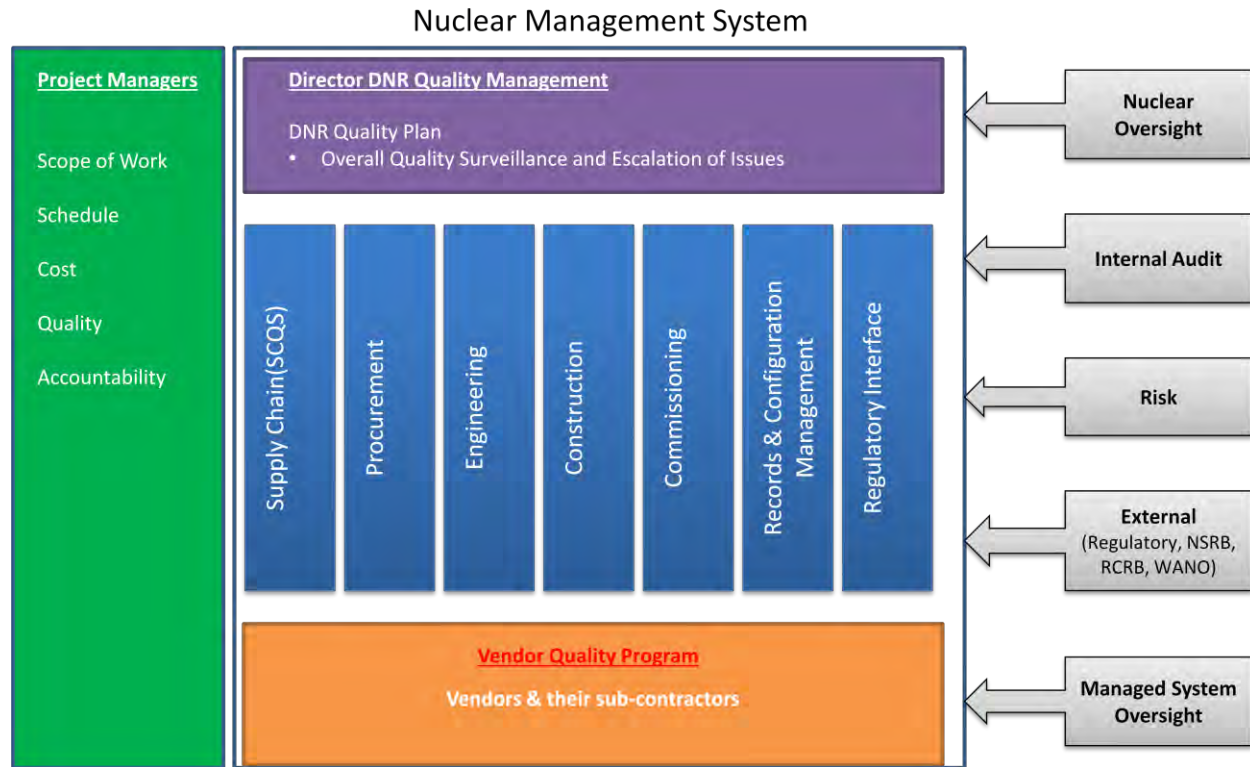


Figure 1: DRP Quality Management System Hierarchy

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**Figure 2: DRP Quality Management Overview**



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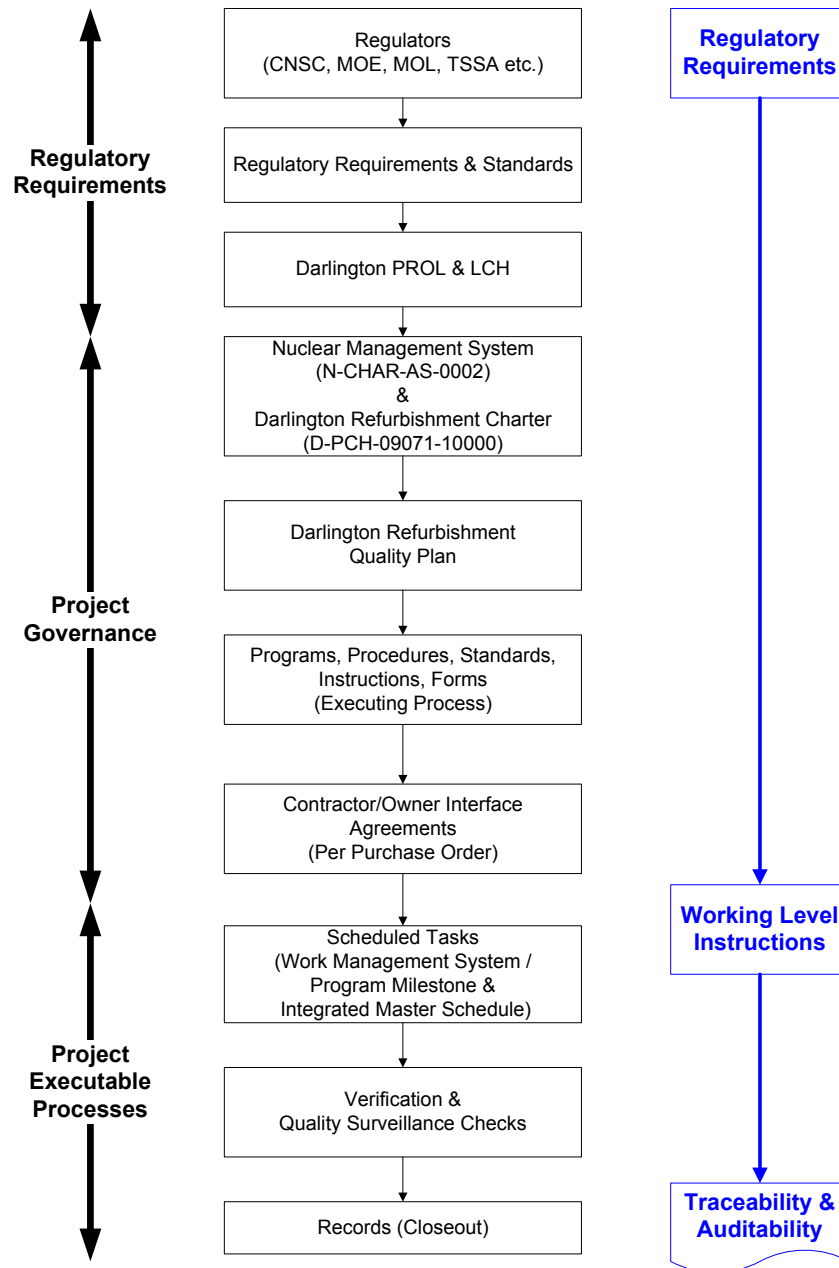


Figure 3: Overview of Regulatory Requirements to Executable Processes

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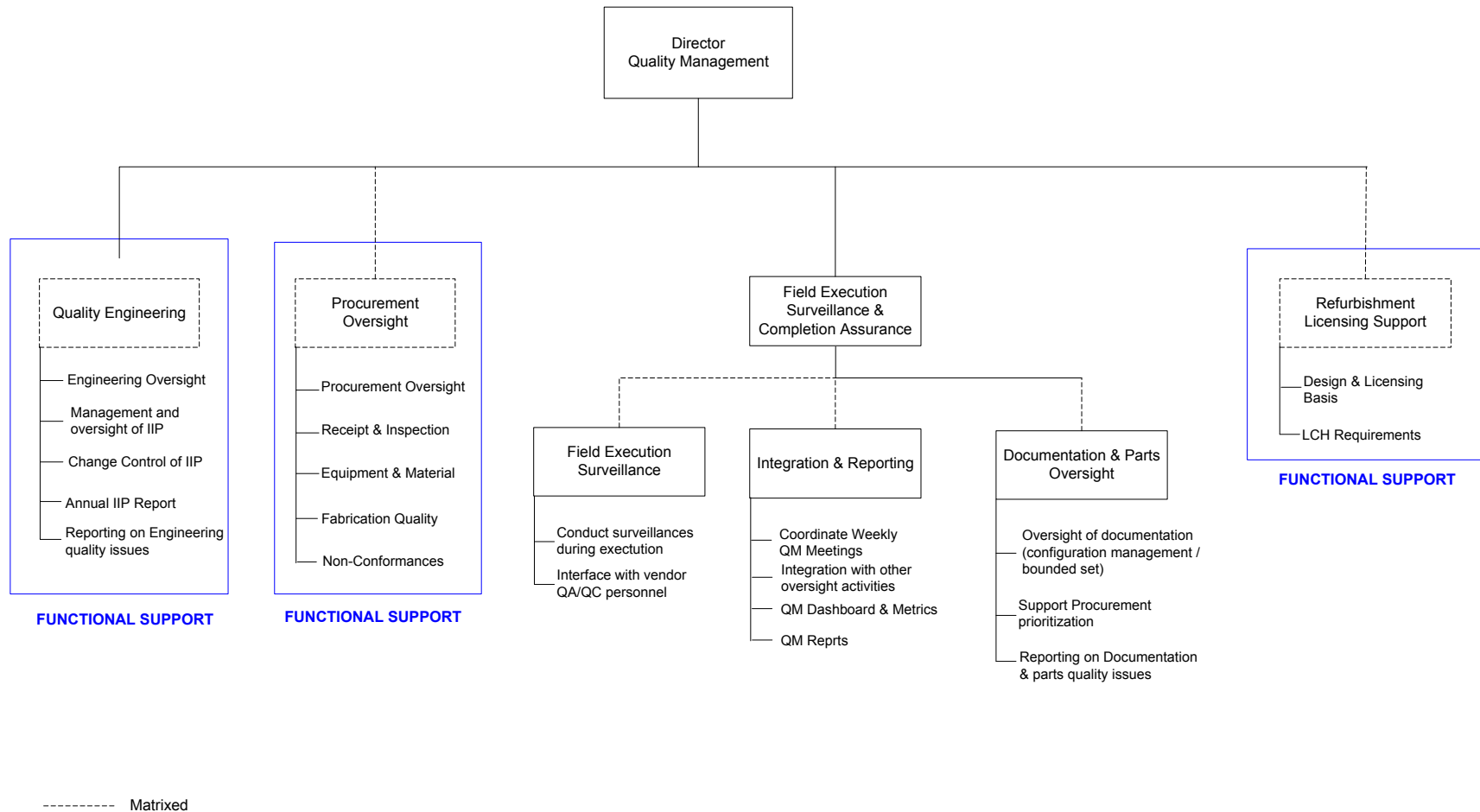


Figure 4: Quality Management Organization

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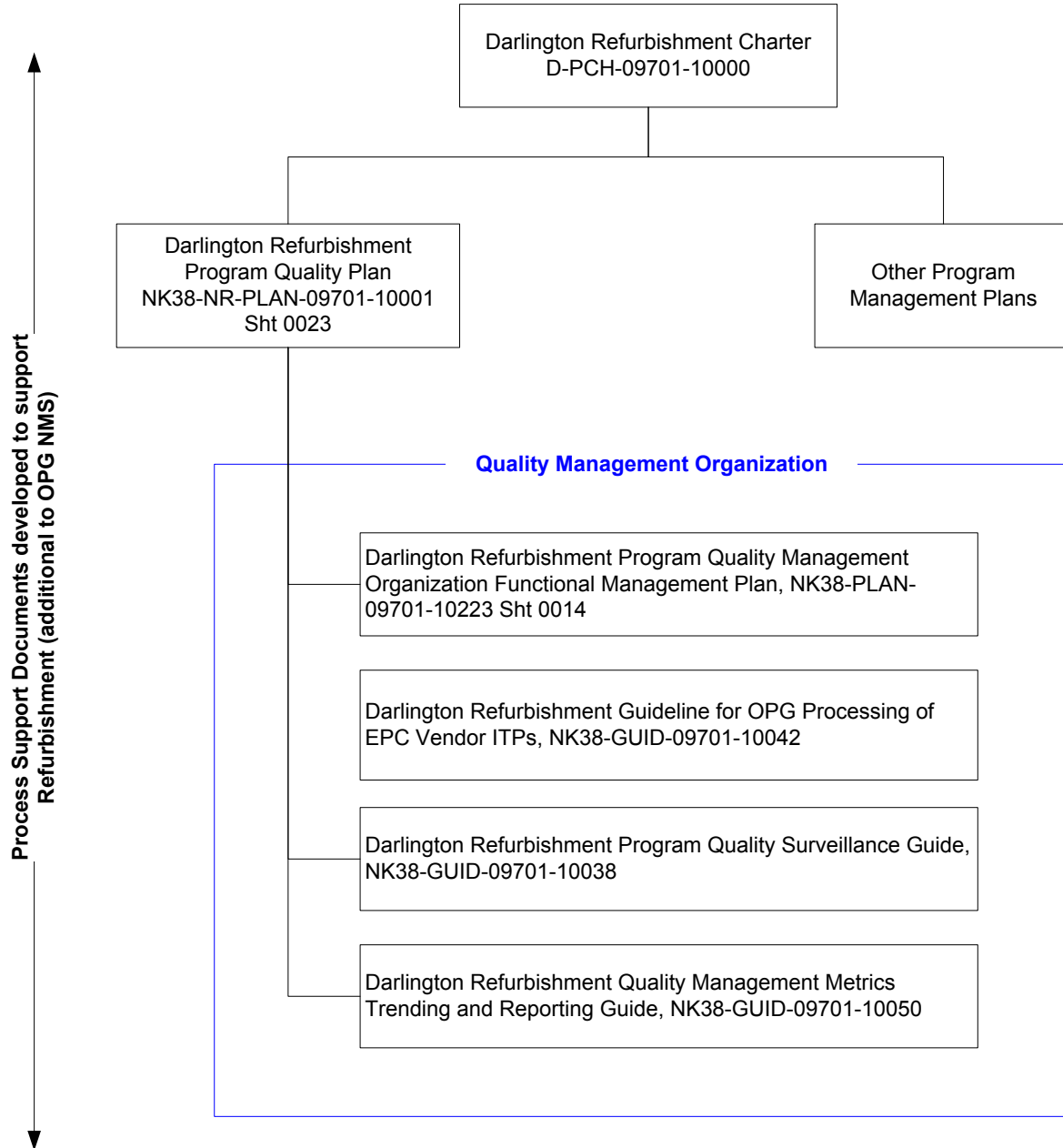


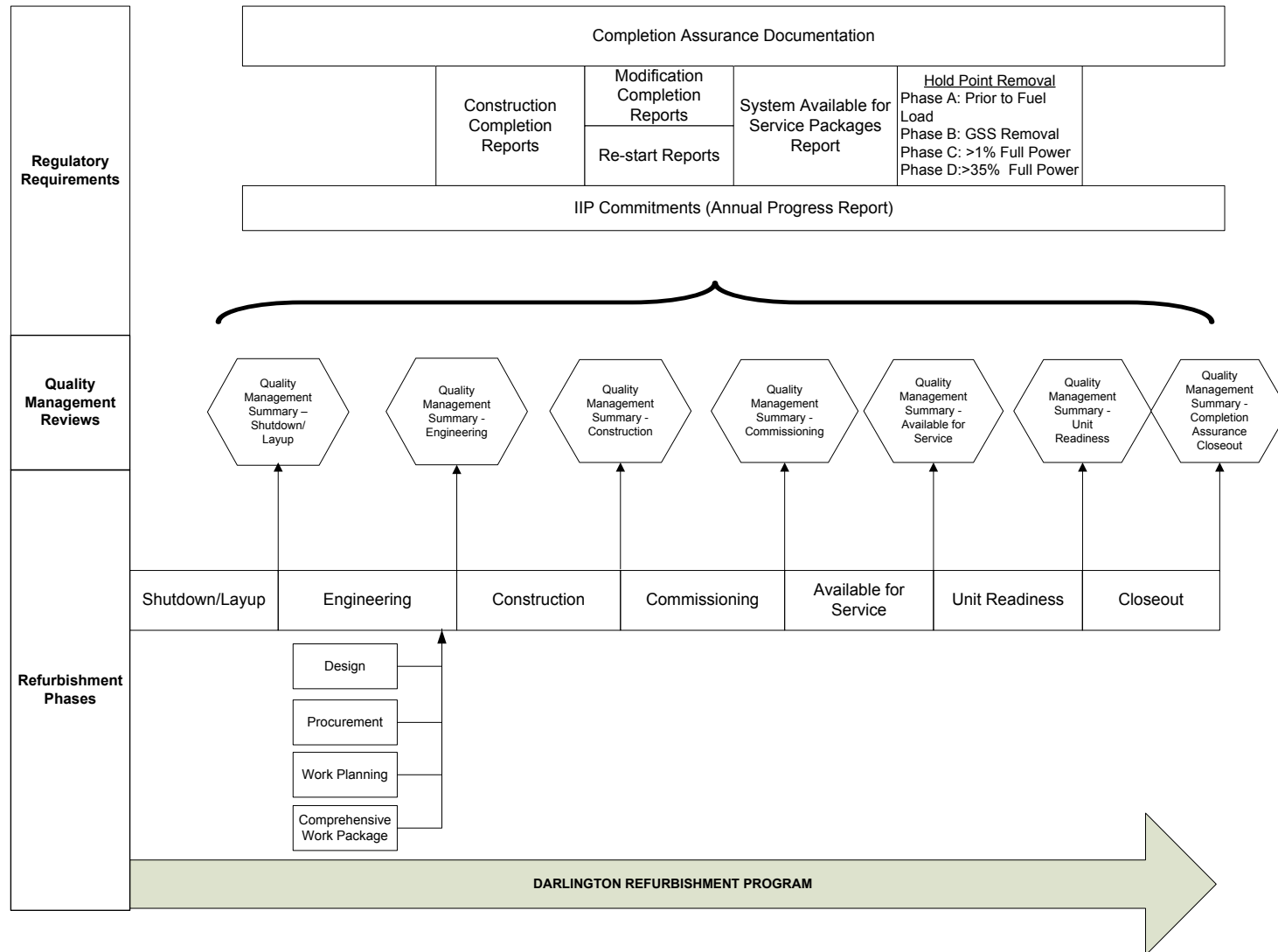
Figure 5: Quality Management Process Documents

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**Figure 6: Quality Surveillance for Regulatory Compliance**

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## Appendix B: Tables

The following table lists the contractors involved in the various phases of the DRP. Note, this list is subject to change.

**Table 1: Summary of Contractors**

Contractor	Project Bundle							
	Cyclic Maintenance	RFR	Fuel Handling	Turbine	Steam Generator	Unit Islanding	Shutdown Layout	Balance of Plant
<b>Engineering</b>								
CANDU Energy		X						
SNC-Lavalin Nuclear Inc.		X						
General Electric Hitachi			X					
Alstom				X				
SNC-Lavalin Nuclear Inc./Aecon				X		X	X	
Babcock & Wilcox					X		X	X
ESMSA (ES Fox, Black & MacDonald or SNC/Aecon JV)		X				X	X	X
Areva								X
AMECFW								X
<b>Procurement</b>								
General Electric Hitachi			X					
Alstom				X				
SNC-Lavalin Nuclear Inc./Aecon		X	X	X		X	X	
Babcock & Wilcox					X		X	X
ESMSA (ES Fox, Black & MacDonald or SNC/Aecon JV)		X				X	X	X
Areva								X
AMECFW								X
<b>Construction</b>								
Aecon		X				X		
SNC-Lavalin Nuclear Inc./Aecon			X	X			X	
Babcock & Wilcox					X		X	
ESMSA	X		X			X	X	X
<b>Commissioning (support as needed)</b>								
Aecon		X				X		
SNC-Lavalin Nuclear Inc./Aecon			X	X			X	
Babcock & Wilcox					X		X	
ESMSA (ES Fox, Black &		X	X			X	X	X

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Contractor	Project Bundle							
	Cyclic Maintenance	RFR	Fuel Handling	Turbine	Steam Generator	Unit Islanding	Shutdown Layout	Balance of Plant
MacDonald or SNC/Aecon JV)								
<b>Operation (support as needed)</b>								
SNC-Lavalin Nuclear Inc./Aecon		X	X	X		X	X	
Babcock & Wilcox			X		X		X	
ESMSA (ES Fox, Black & MacDonald or SNC/Aecon JV)		X				X	X	X

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## Appendix C: STOP Work Authority for Darlington Refurbishment

Stop work authority for refurbishment is designed to provide employees and contractors with the responsibility and obligation to **stop work** when a perceived unsafe condition or behaviour may result in an unwanted result or event.

### **SAFETY**

***Any employee or contractors have the right to stop work for unsafe work conditions or unexpected equipment conditions. See References below for details and conditions.***

### **QUALITY**

Similarly if an employee or contractor encounters a condition as described in the examples provided in (1) and (2) below, it should be brought to the attention of the applicable Project Director, Construction Execution Director, Engineering Design Authority, and the Director, Quality Management for stopping work.

In addition, any other work activity to items (1) and (2) noted below that in the Director, Quality Management sole opinion creates an unacceptable risk to the Project, will initiate a stop work in conjunction with the applicable Project Director and Construction Execution Director.

- 1) Significant Pressure Boundary deficiencies that;
  - a) Impact on system design integrity
  - b) Impact on overpressure protection requirements for the system
  - c) Violation of Pressure Boundary requirements per the Standards (CSA N285.0, ASME Section III, NCA-4000)
- 2) Significant Configuration Management deficiencies;
  - a) Inadequate or incorrect installed components in a safety system that pose an immediate threat to the safe continuation of installation or commissioning of a modification / repair, or results in an unsafe operation.
  - b) Discrepancies with documentation and field installation that impact the license condition and/or return to service requirements.

In the event a stop work decision is made per the conditions noted above for either Safety or Quality, the event response, reporting and recovery requirements are provided in NK38-GUID-09701-10036, Nuclear Refurbishment Work Stoppage / Reporting and Recovery. A SCR will be raised as required per Section 3.2 of NK38-GUID-09701-10036. In addition the appropriate internal and external notification(s) will be made dependent on the event as directed by N-PROC-RA-0020, Preliminary Event Notification.

As important as it is to stop work for said reasons, it is extremely important for OPG and the affected Contractor to rectify the situation to enable timely progression of work in a safe and quality manner.

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The decision to resume work will involve the stakeholders mentioned above (Construction Director, Project Director, Engineering Design Authority and Director Quality Management) via the Project Control Centre (PCC).

### References:

COIRs (N-COI-00120-00001 and NK38-DAI-09701-10008)

The safety of OPG's personnel, the Contractor's personnel, individuals at or near the Sites, and the public is of paramount concern to OPG. **OPG will require that Contractors and their Subcontractors maintain a level of safety equivalent to that of OPG employees while at OPG workplaces.**

### Corporate Safety Rules

All employees have accountability for Health and Safety. This includes making conservative decisions regarding our operations as they relate to the health and safety of our employees, contractors and the public. Also accountable for maintaining or taking positive steps to achieve a state of health that is consistent with the demands of his/her occupation. They are also **accountable for performing work safely and for identifying, communicating and, where appropriate, correcting workplace hazards in order to protect themselves, their co-workers, or the public from harm.**

**Authority to Stop Work - where a workplace is unsafe, or where "dangerous circumstances"\* exist** (Dangerous Circumstances: as defined by the Occupational Health and Safety Act, Section 44).

N-INS-08965-10016, Safety Hazard and Worker Safety Concern Resolution, Section 1.1.3

All *workers* have a responsibility to ensure they do not perform work in an unsafe manner and to identify and report:

- Unsafe conditions and work practices
- Defects in any equipment of which the *worker* is aware
- Contraventions of the OHSA and Regulations
- Existence of any hazard of which the *worker* is aware

### INPO 12-012, Traits of a Healthy Nuclear Safety Culture

Principle QA.2 (e) – Individuals stop work activities when confronted with an unexpected condition, communicate with supervisors, and resolve the condition prior to continuing work activities. When appropriate, individuals consult system and equipment experts.



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INPO 09-007, Principles for Excellence in Nuclear Project Construction

Principle 6 – Personnel Safety Is Highly Valued, Attribute – All employees have stop-work authority for immediate safety concerns on their jobs. Immediate work stoppages are used to correct unsafe conditions. These can be site wide when so warranted by severe situations.

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## Appendix D: Escalation of Issues by Quality Management

Escalation of issues by Quality Management department related to the Darlington Nuclear Refurbishment (DNR) Project will be initiated after the issue has been approved for escalation by the Director Quality Management.

Issues that potentially require *escalation* include, but not limited to:

1. **Items related to records issues, significant safety** (Nuclear, Radiological, Environmental or Conventional), **regulatory or quality issues**.
2. **Failure to implement or untimely implementation** of corrective actions.
3. **Significant recurring deficiencies (i.e., Level 2 Station Condition Record (SCR)) or management's inability to correct** adverse performance trend(s). For example:
  - a) Continuing non-compliance with Nuclear Management System requirements.
  - b) Identification of substantial deficiencies that result in a determination that DNR Project can no longer be assured of effective implementation.
4. A concern that has been the focus of, or potentially can become a significant project operating experience (OPEX) or regulatory issue.
5. Other areas of concern deemed necessary by the Director, Quality Management.

### **Initiation of Escalation Notice:**

1. Once an issue has been identified for escalation, QM shall input an *Issue* in the Risk Management Oversight (RMO) Tool. The Issue Title should be input with the following preceding words "**QM ESCALATION ISSUE**".
2. QM shall:
  - a) Notify the accountable Project Manager and Project Director of the escalation issue via email. The email should contain:
    - Details of the issue (i.e., draft SCR).
    - RMO Issue ID Number.
  - b) Initiate an SCR.

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### **Response to an Escalation Notice**

1. The accountable Project Manager receiving the escalation notice shall prepare a response that includes the following:
  - a) Detailed corrective actions to be taken to address the escalated issue. The corrective actions shall include immediate and interim compensatory actions and long term solutions to address the issue.
2. Schedule for the corrective actions identified.

### **Escalation Monitoring and Reporting**

The Director, Quality Management shall monitor the status of corrective actions and the Project Director shall present status updates at the Refurbishment Issues and Opportunities Meeting.

**Board Staff Interrogatory #49**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh A2-1-1 Attachment 5, page 55

Ref: Exh D2-2-3, Attachment 6, RFR Contract, Article 16.2

Ref: Exh A1-6-1 Attachment 1, O. Reg 53/05, page 3

The first reference above provides the total commitments related to DRP, should OPG close the project, as \$284M. The second reference details the payments due by OPG to the RFR contractor should the contract be terminated early by OPG. The third reference is the regulation directing the OEB to ensure that OPG recovers firm financial commitments incurred with respect to DRP, if OPG makes the financial commitments prudently.

- a) Please provide details of what is included in the \$284M from reference one.
- b) Does the \$284M include all the payments to all contractors that OPG would be responsible for upon termination, such as those outlined in the second reference above?

**Response**

- a) The \$284M total commitments related to DRP, should OPG close the project, includes \$134M in accruals as at December 31, 2015. It also includes an estimate of \$150M as at December 31, 2015 for commitments not recorded as project costs. These include procurement commitments, costs to place the work in a safe state, as well as the costs of demobilizing the contractors from the DRP.
- b) The \$284M includes all the payments to contractors that OPG would be responsible for upon termination, consistent with the termination clauses in the contracts as at December 31, 2015.

**Board Staff Interrogatory #50**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Reference:**

Ref: Exh D2-2-3, Chart 1

**Interrogatory**

- a) Describe all “off ramps” for each major work bundle. What is the governing process for OPG to determine whether to exercise the off-ramps? How will this decision be communicated to all interested parties? What are the cost categories that will be payable to the contractors upon execution of each of the off-ramps?
- b) Describe what information OPG will gather, who will receive the information, when the information will be provided, and how the decision will be made whether to exercise the off-ramp during or after the completion of Unit 2. Provide the same information for all of the other units and the process OPG will use to assess whether to exercise the off-ramps throughout the project.
- c) Describe the governing process regarding the off-ramp for when a prime contractor is substantially below expectation. What does “substantially below expectation” mean? What information will this determination be based on? Who will have access to that information, when will it be provided, and who will make that decision?
- d) What actions must the contractors take to recover in the event of a project schedule delay for which the contractor is responsible?

**Response**

- a) OPG has incorporated both a termination for convenience and a termination for default clause in each of its major work bundle contracts. This allows OPG to take an “off ramp” at any time and terminate its contracts:

**Termination for Default:** If the contractor defaults, OPG will be entitled to terminate the agreement and exercise a number of self-help remedies. Termination for default would permit OPG to make a claim against the contractor for full contractual damages (subject to a percentage cap formula that is linked to the total contract price and certain other amounts).

**Termination for Convenience:** The agreement permits OPG to terminate the agreement for convenience at any time. Certain types of direct damages (but not full contractual

1 damages) will be payable by OPG to the contractor in such circumstances. Examples of  
2 direct damages under the contracts (with some variation between the contracts) are:

- 3
- 4 • work that has been performed to the date of the termination and for which OPG has
  - 5 not yet made payment;
  - 6 • an equitable portion of any fees which would have otherwise been payable on the
  - 7 next milestone date;
  - 8 • any contractor costs incurred in providing any work in progress; and
  - 9 • reasonable extra direct damages suffered by the contractor arising from the
  - 10 termination (such as out of pocket costs for demobilization).
- 11

12 Each circumstance will be dealt with as appropriate based on the facts. There is no  
13 special governance process required other than compliance with the contractual terms.  
14 Formal communications will be made in accordance with the contract terms; additional  
15 communications will be made as appropriate. Prior to terminating any contract, the OPG  
16 Project Manager will request a review by OPG's Senior Management team, which  
17 includes Finance, Law and Supply Chain.

18  
19 Upon decision to terminate for convenience, OPG is to provide written notice to the  
20 contractor, as set out in the contracts.

- 21
- 22 b) As discussed in L-4.3-1 Staff-44, beyond being guided by the 2013 LTEP principles for  
23 nuclear refurbishment, OPG has no insights into what factors the Government of Ontario  
24 would consider in making a decision to direct OPG to take an off-ramp.

25  
26 Internally, if Unit 2, or any other Unit, was forecasting to be over budget beyond a certain  
27 threshold, OPG would be required to issue a superseding business case summary. The  
28 superseding business case summary would include information such as updated cost  
29 estimates, LUEC, and alternative proposals. The option to take an off-ramp may be one  
30 of many considered alternatives. Approval of any superseding business case summary  
31 would be sought from OPG's Board of Directors.

- 32
- 33 c) If a contractor is performing "substantially below expectation", OPG likely would terminate  
34 the agreement for default as opposed to termination for convenience.

35  
36 Performance that is "substantially below expectation" will be determined on a case-by-  
37 case basis, but will include evaluation of the contractor's performance on safety, quality,  
38 schedule and cost aspects of the work being undertaken as well as their actions, or lack  
39 of action, taken to recover the performance gap.

- 40
- 41 d) OPG expects contractors to be on plan for their work. Recovery plans are required if a  
42 contractor deviates from plan and a milestone is at risk of being missed. Steering  
43 Committees consisting of senior management from both OPG and the contractor provide  
44 oversight on all aspects of contractor performance. OPG expects all defective parts of the  
45 project to be corrected at the contractor's cost. In some contracts, a schedule

1 incentive/disincentive regime is in place to encourage the contractors to be on or ahead  
2 of schedule.

**Board Staff Interrogatory #51**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-3, Chart 2

The above reference provides an overview of the Major Work Bundles for DRP. For those contracts that use a pricing model of a target price:

- a) Please confirm that no overheads are included in the estimated costs, and
- b) Please explain how OPG will ensure that no overheads are included in the actual costs.

**Response**

- a) Contractor overheads are included in the estimated costs set out in Chart 2 of Ex. D2-2-3. This Chart includes the total "Value of Contract" for each contract.
- b) OPG's target cost contracts include a cost allocation table that sets out the allowed and disallowed costs that a contractor may seek reimbursement from OPG for as actual costs. During the invoicing process, OPG reviews each invoice and compares the contractor's charges to the cost allocation table to determine if the charges are allowable and appropriate.

The target price contracts also require the contractors to provide OPG with full and open access to all financial and other records relating to the Darlington Refurbishment Program. In addition, the contracts provide OPG with extensive audit rights for all financial and other records that relate to work that is being prepared on a reimbursable cost basis, with few restrictions on the lookback periods for audits and readjustment of contractor cost claims. OPG has exercised these rights and will continue to do so to ensure that contractors comply with the contracts.



**Board Staff Interrogatory #52**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-4, page 3

The above reference indicates that OPG reviewed past CANDU and other nuclear refurbishments such as Point Lepreau refurbishment, OPG's Pickering 'A' return to service and safe storage projects, Bruce Power's Unit 1 and 2 refurbishments, and Korea Hydro & Nuclear Power's Wolsong-1 refurbishment.

Please describe, in general terms, the similarities and differences between the DRP and these other refurbishment projects.

**Response**

In. Ex. D2-2-4, p. 3, OPG indicates that, other than nuclear refurbishments, OPG's planning efforts included operational experience from OPG's nuclear and hydroelectric projects. OPG's Pickering A Return-to-Service and Pickering Safe Store were not refurbishment projects and are, therefore, quite different from the other projects cited.

The primary similarity between the Pt. Lepreau, Bruce Power Units 1 and 2, Korean Hydro and Nuclear Power's (KHNP's) Wolsong 1 refurbishment and the Darlington Refurbishment Program (DRP) is that the core scope included replacement of the fuel channels and all or most of the feeder pipes.

Bruce Units 1 and 2 are the most similar to DRP in that they are part of a multi-unit station. However, these units had been cold and defueled for several years prior to commencement of refurbishment in 2005. These two units, which form a Unit Pair, were effectively refurbished in parallel. The number of fuel channels is the same as at Darlington (480 fuel channels per reactor). Other similar scope included refurbishment of the turbine-generator sets and significant balance of plant work. Steam generators were replaced at Bruce Units 1 and 2, which is a significant difference from DRP. Islanding challenges were not as significant as at DRP because at DRP a unit under refurbishment will be immediately adjacent to an operating unit in that unit pair (see Ex. L4.3-1 Staff-59).

Pt. Lepreau is a single unit station (known as the CANDU 6 design) with a smaller reactor core (380 fuel channels) than the Darlington and Bruce units. Islanding of the unit was not

1 required. OPG's understanding is that there was minimal balance of plant scope carried out  
2 at Pt. Lepreau.

3  
4 Wolsong Unit 1 is a CANDU 6 design with the same number of fuel channels as Pt. Lepreau.  
5 Although it is part of a multi-unit station, the CANDU 6 design has its own dedicated fuelling  
6 machines, therefore the islanding challenges (discussed in Ex. L-4.3-1 Staff-59) were not as  
7 significant as at DRP.

8  
9 The timing of the refurbishment of the units is also a difference. Bruce Units 1 and 2 were  
10 completed over the period of 2005 to 2012. The Pt. Lepreau refurbishment was completed  
11 over 2008 to 2012 and the Wolsong refurbishment was completed over the period of 2009 to  
12 2011.

13  
14 To OPG's knowledge, the Bruce Units 1 and 2 and Pt. Lepreau projects employed a general  
15 contractor to co-ordinate all sub-contractors. OPG's multi-prime contracting model for the  
16 DRP, where the owner retains control and is the general contractor, is a further difference  
17 compared to these two projects.

**Board Staff Interrogatory #53**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-4, page 3

- a) Please provide information the OPG team reviewed during the Planning Phase regarding the following projects: Point Lepreau Nuclear Generating Station, Bruce Nuclear Generating Station, Pickering Nuclear Generating Station, Wolsong Generating Station, Vogtle Electric Generating Plant, Watts Bar Nuclear Generating Station, London Olympics, and Heathrow International Airport.

**Response**

- a) The attached table provides details on information the OPG Team reviewed regarding the Point Lepreau Nuclear Generating Station, Bruce Nuclear Generating Station, Pickering Nuclear Generating Station, Wolsong Generating Station, Vogtle Electric Generating Plant, Watts Bar Nuclear Generating Station, London Olympics, and Heathrow International Airport during the Planning phase of the Darlington Refurbishment project.

**Attachment to L-4.1-1 Staff 53**

Facility	Information Reviewed
Pickering Nuclear Generation Station	<ul style="list-style-type: none"> <li>• Work management</li> <li>• Organizational design considerations</li> <li>• Transition and turnover plans</li> <li>• Commissioning and return to service</li> <li>• Radiation protection</li> </ul>
Point LePreau Generating station	<ul style="list-style-type: none"> <li>• Work management, organizational design considerations, transition and turnover plans, commissioning and return to service, and radiation protection</li> <li>• Plant status control during restart activities post refurbishment stage</li> <li>• Preparation and readiness of Operations and Maintenance</li> <li>• Effective communication with and oversight of contractor staff with respect to chemistry requirements and a managed system for control of chemical products brought on site</li> <li>• Various aspects of Turbine Generator refurbishment project including contract management and oversight, engineering process and vendor quality assurance programs</li> <li>• Radiation protection, As Low As Reasonably Allowable (ALARA), Constructability, Operability, Maintainability, and Safety (COMS), Tooling</li> <li>• Refurbishment of Steam Generators</li> <li>• System-heat conditioning for post-refurbishment restart of reactors</li> <li>• Project management, corrective action program</li> <li>• Interface with the regulator, quality management and project oversight, record management, relationship with contractors and post-refurbishment experience</li> </ul>

Facility	Information Reviewed
Bruce 1 & 2	<ul style="list-style-type: none"> <li>• Fuel Handling (FH) Refurbishment (FH scope defined for life extension, execution strategy and schedules, contract strategies vs. Original Equipment Manufacturer (OEM), challenges/lessons learned)</li> <li>• De-fueling (de-fuel method, options considered, decision criteria, contingencies, challenges/lessons learned)</li> <li>• Training</li> <li>• Work management, organizational design considerations, transition and turnover plans, commissioning and return to service, and radiation protection.</li> <li>• Effective communication with and oversight of contractor staff with respect to chemistry requirements and a managed system for control of chemical products brought on site</li> <li>• Refurbishment of Steam Generators</li> <li>• Various aspects of their approach to heavy water management</li> <li>• Licensing process</li> <li>• Radiation protection, As Low As Reasonably Allowable (ALARA), Constructability, Operability, Maintainability, and Safety (COMS), tooling</li> <li>• System-heat conditioning for post-refurbishment restart of reactors</li> <li>• Refurbishment project, with focus on design engineering, system engineering, nuclear safety, and quality engineering</li> <li>• Corrective action plan for construction activities at conference</li> <li>• Review of benchmarking of refurbishment Engineering Change Control (ECC) process with "Bruce Power's Engineering Change Control Management</li> <li>• Engineering strategies and processes between the Darlington Refurbishment Program and Bruce Power with a focus on large projects. Capitalize on opportunities to share best practices and realize returns for both companies by improving efficiencies</li> </ul>
Wolsong Generating Station	<ul style="list-style-type: none"> <li>• Effective communication with and oversight of contractor staff with respect to chemistry requirements and a managed system for control of chemical products brought on site</li> <li>• System-heat conditioning for post-refurbishment restart of reactors</li> </ul>

Facility	Information Reviewed
Vogtle Electric Generating Plant	<ul style="list-style-type: none"> <li>• Oversight, interaction with Operating Plant</li> <li>• Project Controls and reporting</li> <li>• Corrective action program, procurement, strengths, document management</li> <li>• Transition from Readiness for Service to placing systems in service, and use of digital equipment</li> </ul>
Watts Bar Generating Plant	<ul style="list-style-type: none"> <li>• Schedule integration and processes to improve refurbishment work control</li> <li>• Refurbishment Construction Organization structure</li> </ul>
London Olympics	<ul style="list-style-type: none"> <li>• Program structure, including use of a Delivery Partner with experience in large-scale construction projects</li> <li>• Effectiveness of health and safety communication</li> </ul>
Heathrow International Airport	<ul style="list-style-type: none"> <li>• British Airport Authority contractor model</li> <li>• Transparency on costs</li> <li>• Cultural commitment to focus on partnering, trust and co-operation</li> </ul>

**Board Staff Interrogatory #54**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-4, Figure 1

The above reference shows the total definition phase expenditures to be \$2.2B.

- a) Please provide a variance of the actual amount of \$2.2B to the budgeted amount for the definition phase.
- b) Please provide the amount of the \$2.2B that is attributable to Unit 2 versus supporting the entire four unit DRP.
- c) Please provide details, i.e. projects and amounts, of the \$2.2B that has been put in-service to the end of 2015.

**Response**

- a) The \$2.2B actual amount for the Definition Phase represents a variance of \$0.3B below the budgeted amount of \$2.548B, as shown in Ex. D2-2-8, Attachment 1, p. 5.
- b) All of the Definition Phase costs to be placed into service with Unit 2 (i.e. \$2.2B) relate to preparation and planning work which was required to allow OPG to be ready to refurbish Unit 2. Figure 1 of Ex. D2-2-4 shows that the \$2.2B Definition Phase expenditures were spent on the following:
  - RFR Mock-up and Tooling
  - Turbine Generator Parts
  - Vendor/EPC Definition Phase Planning
  - Facilities & Infrastructure (F&IP) and Refurbishment Support Facilities Projects
  - Safety Improvement Opportunities (SIO) Projects
  - OPG Definition Phase Planning and Support Services
  - Interest

Approximately \$1B, the largest portion of the \$2.2B, is associated with the Early In-service Projects, F&IP, and SIO. The Early In-service Projects are assets arising from work performed for the unit refurbishments that will be placed in service and included in rate base before the refurbishment of the first unit because they provide immediate benefit to the station ahead of the Unit 2 return to service. As committed within the Environmental Assessment and Integrated Implementation Plan, the SIO are to be

placed into service upon completion and are useful to OPG's current and future nuclear operations independent of whether the DRP is completed. The F&IP are pre-requisites for unit refurbishments and will be placed in service and included in rate base when they are used and useful to OPG. As discussed in Ex. D2-2-10, p. 7 and Ex. L-4.3-1 Staff-44, the F&IP are expected to be useful to OPG's current and future nuclear operations independent of whether the DRP is completed.

The planning costs for all subsequent units will be lower than that of Unit 2. Much of the planning for those units will be a replication of the work done for Unit 2. For example: (i) detailed design engineering packages will only need to be replicated with unit specific information for Units 3, 4, and 1; (ii) the database infrastructure which has been implemented to facilitate project controls will already be in place for subsequent units; and, (iii) the contracting strategy has been developed and contracts are in place for all four units.

- c) \$0.3B of \$2.2B has been put in-service to the end of 2015. The details are provided in the following table.

Project	LTD 2015 In-service Amounts
Heavy Water Facility	\$14.6M
Water & Sewer	\$43.7M
Darlington Energy Complex	\$82.5M
Retube Feeder Replacement Island Support Annex	\$1.7M
Refurbishment Project Office	\$94.3M
Electrical Power Distribution System	\$18.1M
Vehicle Screening Facility	\$4.1M
Third Emergency Power Generator	\$9.7M
Powerhouse Steam Venting System Improvements	\$5.2M
Emergency Service Water Buried Services	\$13.3M
IFB Heat Exchanger Plate Replacement	\$6.2M
Other Station Modifications	\$1.2M
<b>Total<sup>1</sup></b>	<b>\$294.8M</b>

<sup>1</sup> Consistent with Ex. B3-3-1 Table 1 line 16 column (e)



**Board Staff Interrogatory #55**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-8, Attachment 1 page 2

The DRP BCS states that “[t]he current target date to start the Refurbishment outage on Unit 2 is October 2016, prior to which management will complete a Unit 2 Execution estimate and seek further authorization and funding approval from the Board.”

- a) Please provide an update on the current start date for Unit 2
- b) On page 23 of Attachment 1 to Ex. D2-2-8, the overview identifies that funding release 5b is scheduled for mid-2016. Was the Unit 2 Execution estimate completed and approved by the Board (Release 5b)? If so, please provide a copy.

**Response**

- a) The current start date for Unit 2 remains October 15, 2016.
- b) The Unit 2 Execution Estimate was completed and approved by the Board of Directors in August 2016. Please see Attachment 1 (Attachment 1 is marked confidential but OPG has determined it is non-confidential in its entirety).



**OPG Confidential Exclusive**

**FOR APPROVAL by the Board of Directors**

**August 12, 2016**

## **DARLINGTON REFURBISHMENT - UNIT 2 EXECUTION**

### **DECISION REQUIRED**

The purpose of this memo is to provide a summary of the Darlington Refurbishment Program (DRP) Unit 2 cost and schedule estimates and key risks, and request approval for:

- Commencement of Unit 2 refurbishment in October 2016;
- The Unit 2 budget and schedule; and
- Release of additional funds in the amount of \$2,876 Million, which includes \$635 Million of contingency to execute the Unit 2 refurbishment.

### **ISSUE**

In November 2015, OPG's Board of Directors approved the Release Quality Estimate (RQE), representing the overall 4-unit high confidence budget, schedule and release strategy to refurbish the four Darlington units.

Since that time, as management continued with the detailed planning and preparations for execution of the Unit 2 refurbishment, management has further developed the Unit 2 cost estimate and schedule and performed an updated risk analyses. Consistent with the approved funding strategy, Management is now requesting Board approval to proceed with the refurbishment of Unit 2 starting in October 2016 and to release the required funding to complete the refurbishment of Unit 2.

### **ANALYSIS**

The current Unit 2 Execution Estimate (U2EE) is an update to RQE, which takes into consideration additional planning and work executed over the past 8 months, and incorporates the following:

- Revised estimates for scope that has progressed from a Class V or IV estimate to a Class III and II.
- Updated base cost estimates to reflect the development of comprehensive execution work packages and an enhanced understanding of the cost to perform the work, which is a direct outcome of estimate development and actual field work.
- Updated risk profile, and resultant contingency required for residual risks.
- Assessment of the actual costs to date and the estimate-to-complete (ETC) for all work packages.
- Review of the cash flow, including interest and escalation requirements, against the current schedule.

All of these items have been compiled into the current U2EE, as well as a review of the 4-unit overall cost estimate. The following sections summarize this analysis.

#### **1. Management is adequately prepared and ready to proceed with the execution of Unit 2.**

Management has provided an update on the status of the DRP to the Darlington Refurbishment Committee (DRC) at its August 11, 2016 meeting. In the report, Management indicates that the DRP remains on track to commence the execution and refurbishment of Unit 2 in October 2016.

Management is executing all pre-requisite projects in order to be ready to commence the refurbishment of Unit 2. Some of these projects are currently behind schedule; however, all critical projects required to enable the start of refurbishment are expected to be complete prior to their need date.

Management is focused on applying lessons learned from the Ready to Execute (RTE) test period, where processes for managing in-plant execution of work were tested and refined, to increase the productivity and schedule compliance of all work being performed in the field. Although many of the pre-requisite projects are not required for the start of refurbishment, management remains focused on the delivery of these projects as quickly as reasonably feasible while managing safety, quality, and cost.

**2. Unit 2 scope has been clearly specified, engineering is complete, and comprehensive work plans are in place.**

Since RQE, there have been no major scope changes to the DRP.

Detailed design engineering is substantially complete for all field work to be executed during Unit 2.

Management has focused on the completion of Phase 1 Comprehensive Work Packages (CWPs) that describe the details of the work to be executed in the field. The CWPs for all the project bundles are now essentially complete with a few minor exceptions. Completion of the CWPs took an additional month beyond what was planned due primarily to station interfaces for the Re-tube & Feeder Replacement (RFR) project not being fully understood by the vendor; however, they have been completed with quality, and provide the necessary information to complete field execution of all project work.

**3. Regulatory certainty has been achieved.**

The Integrated Implementation Plan (IIP) identifies the regulatory scope required to be completed during the refurbishment period, including work being done by the station.

The 51 Integrated Implementation Plan (IIP) tasks that have been committed to the Canadian Nuclear Safety Commission (CNSC) for completion in 2016 are on track. To date, 17 items are complete and field work for an additional 10 is complete with document closeout underway.

OPG has received all remaining regulatory approvals from the CNSC required to support the start of Unit 2 refurbishment. No additional approvals are required to commence refurbishment of Unit 2.

OPG has committed in the IIP to have the 3<sup>rd</sup> Emergency Power Generator (EPG) and Containment Filtered Venting System (CFVS) in-service prior to the start of the Unit 2 refurbishment, and continues to demonstrate to the CNSC that completion of these projects is a high priority. The CNSC is being kept informed of the project complexities, including commissioning and site integration of the 3<sup>rd</sup> EPG, and is aware of the potential risk to the in-service date. In the event that the IIP commitment cannot be achieved, the IIP Change Control Process will be initiated.

The regulatory hold-points for returning the units to service, after refurbishment, have been agreed to with the CNSC. Development of a decision and escalation protocol with the CNSC, to ensure scope and schedule commitments are effectively managed, is being considered.

**4. The Unit 2 high confidence schedule duration, consistent with RQE, remains at 40 months; the 4-unit schedule remains at 112 months.**

The Unit 2 high confidence schedule duration of 40 months remains consistent with RQE.

The only significant change to the high confidence 4-unit schedule since RQE was the de-lapping of Unit 3 from Unit 2, to be consistent with the Province's Long Term Energy Plan (LTEP) requirement to complete Unit 2 prior to commencing any subsequent units.

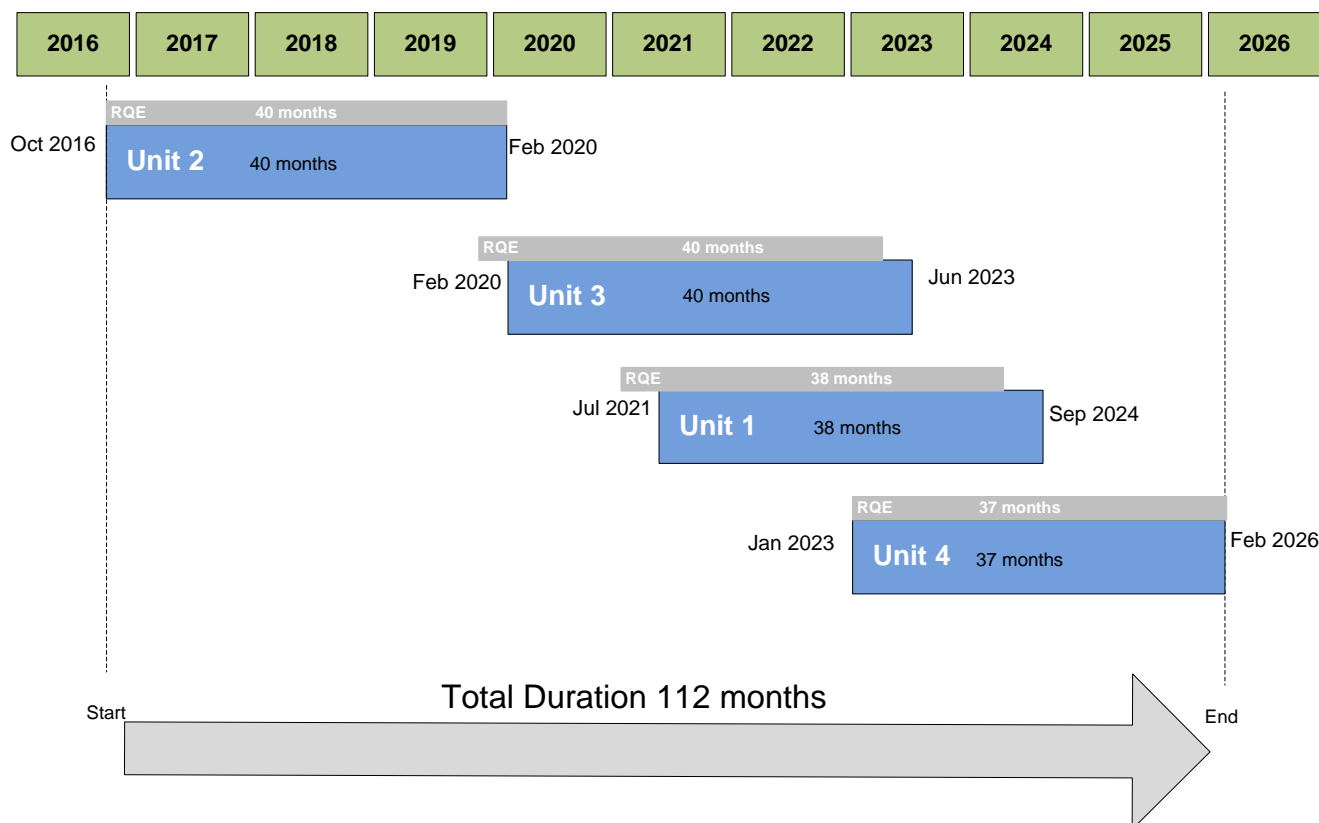
The overall 4-unit high confidence schedule duration remains at 112 months per Table 1 below:

**Table 1: Comparison of 4-Unit High Confidence Schedule (RQE vs. U2EE)**

Unit	High Confidence at RQE			High Confidence (U2EE)			Variance From RQE
	Start	Finish	Duration (Months)	Start	Finish	Duration (Months)	
Unit 2	15-Oct-16	15-Feb-20	40	15-Oct-16	15-Feb-20	40	0
Unit 3	15-Dec-19	15-Apr-23	40	15-Feb-20	15-June-23	40	0
Unit 1	15-Apr-21	15-Jun-24	38	15-Jul-21	15-Sep-24	38	0
Unit 4	15-Jan-23	15-Feb-26	37	15-Jan-23	15-Feb-26	37	0
<b>4 Units</b>	<b>15-Oct-16</b>	<b>15-Feb-26</b>	<b>112</b>	<b>15-Oct-16</b>	<b>15-Feb-26</b>	<b>112</b>	

The U2EE High Confidence schedule and comparison to RQE as noted above in Table 2, is illustrated in the following Figure A:

**Figure A: Refurbishment 4-Unit High Confidence Project Schedule**



High Confidence durations are shown above. Unit 2 project performance will however get managed against an aggressive planned outage duration (working schedule) of 35 months. Since RQE, detailed schedules have been further developed, and have resulted in a minor 10 day increase for activities within the removal and installation series. A copy of the Level 1 schedule is included as Appendix 1.

The planned outage duration is based on a detailed evaluation of the schedule risks for each segment of the critical path, including discrete technical risks such as a Primary Heat Transport pump motor failure during defueling and requirements for Primary Heat Transport system flush and Hot Conditioning on unit startup. Management is, and will continue to, look for opportunities to reduce schedule durations.

The high confidence schedule is the basis for the Release Quality Estimate, which is the program level control budget and this schedule is the schedule from which project success will be assessed. Management will report on the performance of the DRP to the DRC on a quarterly basis, against both the Unit 2 working schedule and the high confidence schedule, with clear indications of project status and contingency utilization.

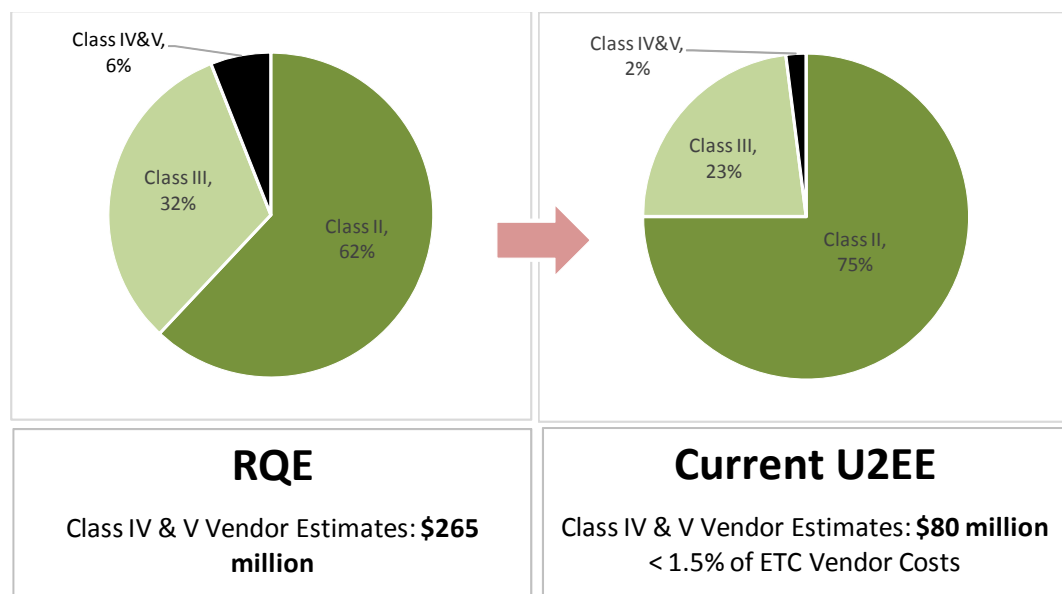
Final detailed schedule reviews are now underway in order to ensure all potential interferences between vendors are eliminated and labour resources are effectively balanced. The final baseline Unit 2 working schedule will be issued in mid September. This schedule will contain over 75,000 tasks for OPG and the vendors.

**5. A detailed review of Unit 2 execution phase risks and contingencies is now complete.**

Management has finalized its review of schedule and cost risks. Since the RQE analysis in October, a reduction in cost estimating uncertainty contingency requirements has been observed, which reflects the progression of project estimates and the integration of lessons learned from the Ready to Execute test period.

As shown in Figure B, the percentage of project costs where the estimate is at Class III or better has increased since RQE from 94% to 98%. For those projects not yet at Class III, adequate contingency has been carried to reflect the remaining uncertainty with these projects.

**Figure B: Estimate Classification Summary**



(1) Figures above represent 4-Unit estimates. Actions are already underway to finalize these estimates to Class III or II prior to work release and execution.

The contingency analysis summarized in Table 2 was derived through a detailed analysis and modeling of the current risk profile across the entire program. The assessed contingency is based on the residual risks contained within the DRP and excludes the \$61 Million of contingency allocated since RQE. In addition to the continuous monitoring of contingency draw-downs, a thorough assessment of the risk profile and impact on contingency will be performed quarterly.

The outcome of Management's contingency analysis yielded that, at a high confidence, the estimate should include \$2,006 Million of contingency for the DRP, including \$677 Million for Unit 2.

There is no significant change to the anticipated contingency calculated at RQE. For clarity, RQE consisted of \$1,706 Million of contingency in 2015 dollars, plus \$300 Million of inflation and interest,

which totals \$2,006 Million. Contingency on Unit 3 has increased due to a shift of risks from Unit 2 to Unit 3 related to the Turbine Controls installation on Unit 3.

Below, in Table 3, is a breakdown of the \$2,006 Million of contingency, by unit and contingency type.

**Table 2: 4-Unit Contingency Summary**

Unit	RQE (\$M)	Current U2EE (\$M)	Changes since RQE (\$M)
Campus Plan Program Total, *plus \$41mil of add'l contingency included with projects	32	18	-14
Unit 2 Total	690	677	-13
Unit 3 Total	516	557	41
Unit 1 Total	419	409	-10
Unit 4 Total	350	345	-5
<b>4-Unit Contingency (\$M)</b>	<b>2,006</b>	<b>2,006</b>	<b>0</b>

**Table 3: 4-Unit Contingency Summary by Type**

Level	Contingency Type	Updated 4-Unit Contingency (\$M)	Facility and SIO Projects (\$M)	U2 (\$M)	U3 (\$M)	U1 (\$M)	U4 (\$M)
<b>PROJECT</b>	<b>Project Discrete Risks</b> - Specific to Bundles	658	18	216	177	135	112
	<b>Project Level Estimating Uncertainty</b> - Project Bundles and Resources	192	-	67	54	38	33
	<b>Critical Path Schedule Contingency</b> - for the Working Schedule Duration	438	-	149	122	91	76
	<b>Critical Path Schedule Contingency</b> - to High Confidence Duration	192	-	66	55	38	33
<b>PROGRAM</b>	<b>Program Discrete Risks</b> - Functional Risks	458	-	153	129	95	81
	<b>Program Level Estimating Uncertainty</b> - Functional Resources	68	-	26	20	12	10
	<b>Total Contingency \$M</b>	<b>2,006</b>	<b>18</b>	<b>677</b>	<b>557</b>	<b>409</b>	<b>345</b>

The contingency of \$2,006 Million represents 23% of the Execution Phase Estimate-to-Complete cost of \$8,300 Million, or 32% of the external vendors' estimate of \$6,000 Million. With 98% of vendor cost estimates well defined at Class III or better, Management believes that the contingency amount is sufficient.

**6. OPG's oversight requirement has been assessed and is deemed to be appropriately sized.**

Since RQE, OPG's role as the General Contractor performing integration and oversight of safety, quality, schedule, cost and risk, with consideration of current field experience, has been evaluated.

Lessons learned from the pre-requisite projects have been evaluated and OPG has added resources in each of the following areas:

- Field construction support and oversight;
- Quality surveillance;
- Work control;
- Source surveillance and vendor procurement; and
- Contract and claims management.

Management is further evaluating its organization and looking for further opportunities to streamline processes and reduce oversight staff. Also, OPG's investment in vendor training, including supervisor training, is expected to improve performance and in time should have a positive impact on resources.

Due to the under spend in OPG labour of approximately \$40 Million to date, management believes that these increases can be managed and will not impact the Unit 2 estimate. However, Management is also carrying \$77 Million of contingency (per Unit) for risks and an uncertainty associated with higher owner's costs, which management believes is sufficient.

Management has put in place processes required to plan and forecast staff demands and will closely monitor all labour demands and variances during execution of the DRP to mitigate any further cost growth related to OPG's oversight.

The overall histograms of OPG and vendor resources are shown in Appendix 5A and 5B.

**7. The Unit 2 high confidence cost estimate is \$3.4 Billion including contingency, consistent with the estimate provided at RQE.**

The high confidence cost estimate to execute Unit 2, including contingency is \$3.4 Billion and is \$24 Million higher than presented at RQE due several vendor changes, increase in OPG staffing, but offset by lower anticipated contingency needs.

Furthermore, the in-service amount of \$4.8 Billion reported at RQE has been maintained.

Appendix 3 provides a project bundle level analysis of the current cost estimate and as compared to RQE.

**8. The overall budget remains within the \$12.8 Billion set at RQE.**

As shown in Appendix 2, the overall 4-Unit high confidence cost estimate remains at \$12.8 Billion.

**Table 4: Refurbishment Current Estimate Compared to Prior Estimates**

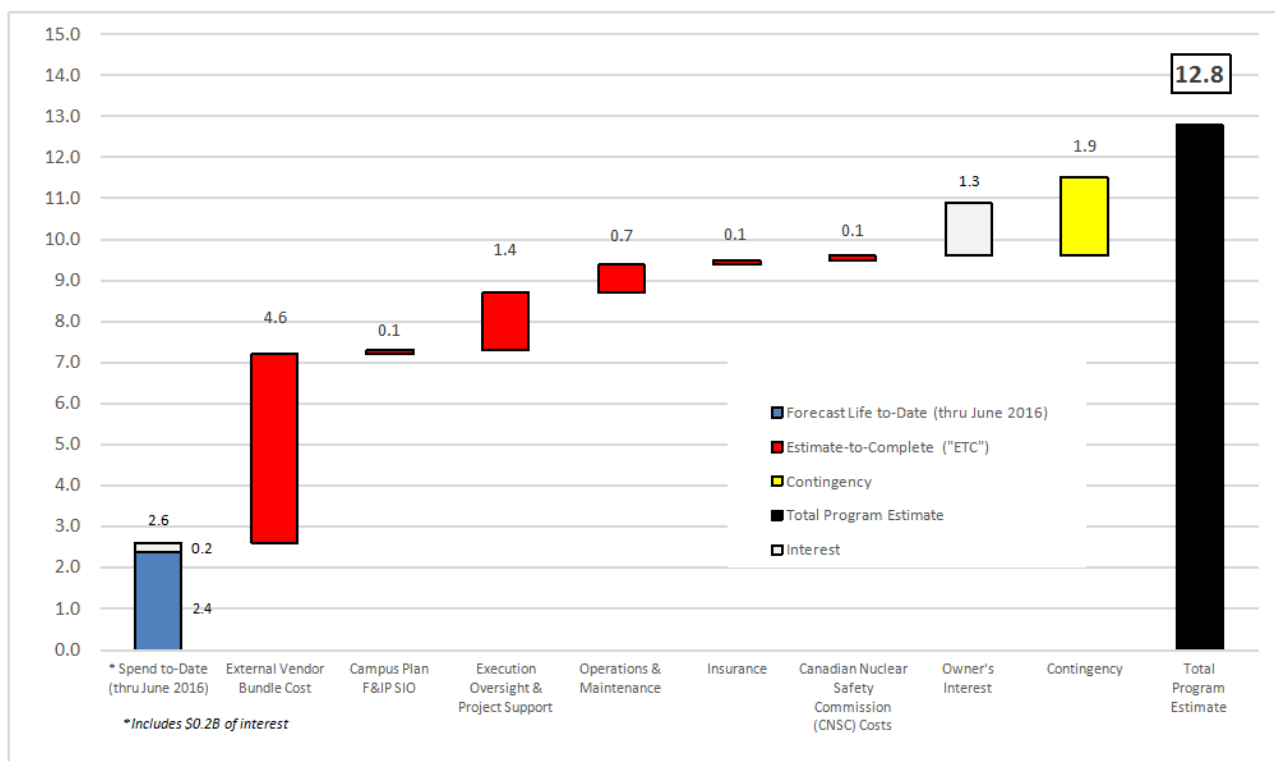
2009 Estimate	2015 RQE High Confidence Estimate	Current High Confidence Estimate
\$14.0 Billion <sup>(1,2)</sup>	\$12.8 Billion <sup>(2)</sup>	<b>\$12.8 Billion<sup>(2)</sup></b>

(1) The 2009 estimate was reported as \$10 Billion in \$2009, excluding interest and inflation. When interest and inflation is included, the estimate was \$14 Billion.

(2) Estimate includes interest and inflation. Inflation is estimated at 2% and interest is estimated using 5% to 2021 and 6% thereafter.

Figure C below provides a summary of the cost elements that build up to the high confidence 4-unit cost estimate. Each cost element now includes allocated inflation.

**Figure C: 4-Unit Cost Estimate Build-up**



Appendix 2A and 2B provides a more detailed breakdown of the overall cost.

**9. Funding is requested in the amount of \$2.9 Billion to complete Unit 2 refurbishment.**

The cumulative release at RQE was \$3,228 Million including \$723 Million for Unit 2 activities. The current high confidence cost estimate for the Unit 2 refurbishment, including \$677 Million of contingency, is \$3,417 Million. Management is requesting incremental funding of \$2,876 Million to complete the refurbishment of Unit 2 as well as the Facility & Infrastructure, Safety Improvement, and other in-plant pre-requisite projects, for a total cumulative release of \$6,104 Million. Details of the release amount are included in Appendix 6.

**Table 5: Program Funding Releases**

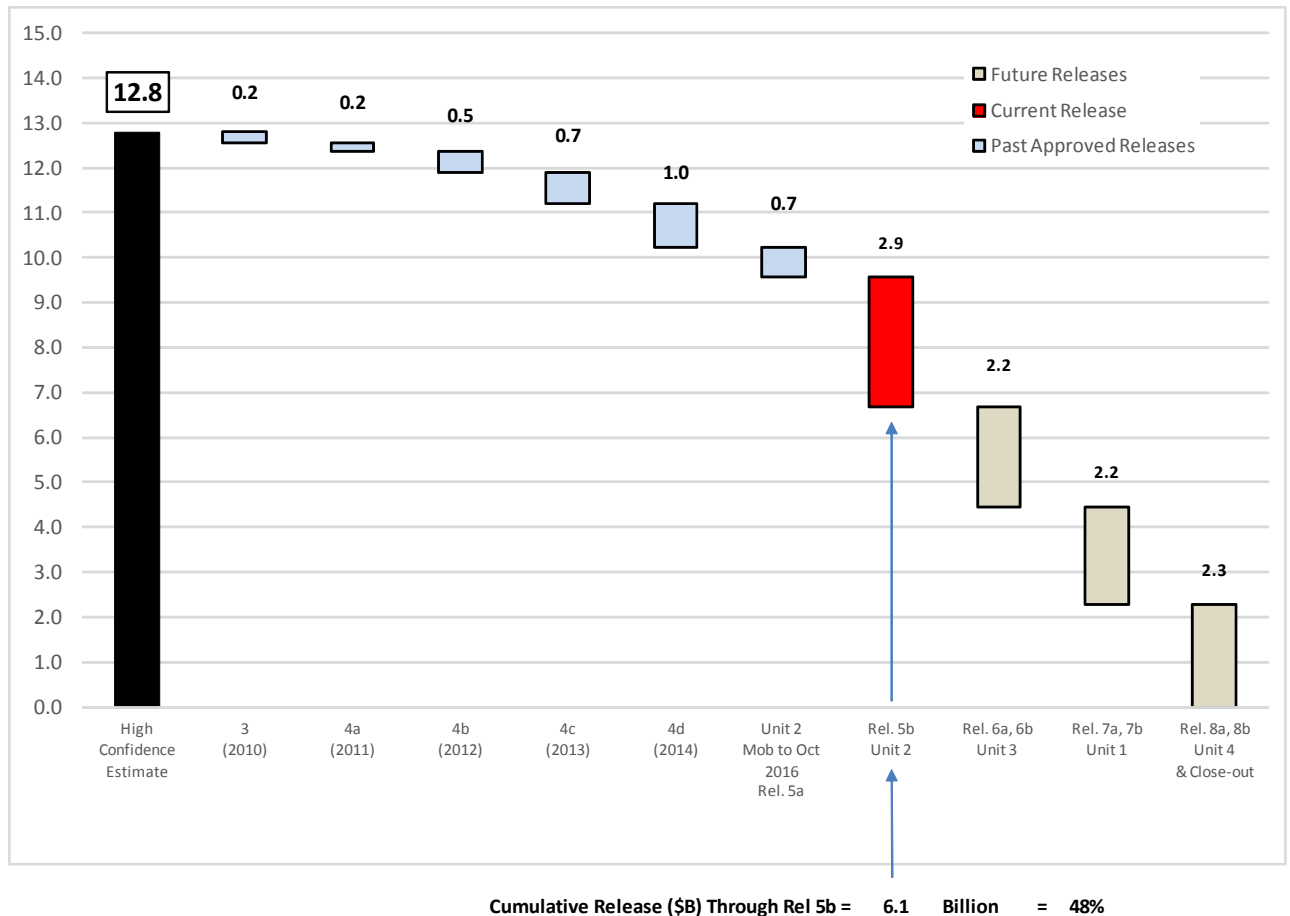
Previous Approved Funding Cumulative through Release 5a (at RQE)	Current Funding Request, Release 5b for U2 Execution	Cumulative Funding through end of Unit 2
3,228	2,876	6,104
Values in \$Million		

Release 5a funding, approved by the Board in November 2015, included approximately \$102 Million for a portion of subsequent unit planning, primarily for long lead materials for the Turbine Generator Control system, which will be installed initially on Unit 3, and the Re-tube and Feeder Replacement project.



Figure D below provides a summary of the cumulative releases to the DRP to date.

**Figure D: Program Funding Releases**



In 2017, Management will request additional funding to commence preliminary planning for subsequent unit refurbishments. This will include funding to complete engineering and to initiate long lead procurement for Unit 3. A dedicated team will be put in place to lead the Unit 3 planning effort.

**10. The LUEC of refurbishing and continuing to operate the Darlington units for a further 30 years remains at 8.1 ¢/kWh (2015\$).**

There is no anticipated change to the economic assessment, and the LUEC of refurbishing and continuing to operate the Darlington station for a further 30 years remains at 8.1 ¢/kWh (2015\$).

The DRP continues to contribute 3.3 ¢/kWh (\$2015) to the LUEC estimate, and the post-refurbishment operations and support costs necessary to run the plant, including fuel, continue to contribute 4.8 ¢/kWh (\$2015) to the total LUEC.

**11. Management will commence reporting to the DRC on the status of the Unit 2 Execution Phase in November 2016.**

The Unit 2 refurbishment baseline working schedule will be issued in mid September. At that time, Management will make any needed adjustments to the Unit 2 cost flows and control budget, which will then be used for performance monitoring and reporting.

## RECOMMENDATION / RESOLUTION

Management is requesting that the Board of Directors approve the following items related to the DRP:

- Approval to commence Unit 2 refurbishment in October 2016;
- Approval of the Unit 2 high confidence cost estimate (\$3.417 Billion) and high confidence schedule (40 months); and
- Approval of a release of funds in the amount of \$2,876 Million, which includes \$635 Million of contingency to execute the Unit 2 refurbishment.

**Recommended by:**

**Approved for submission to  
the Board of Directors by:**

\_\_\_\_\_  
Dietmar Reiner  
Senior Vice President, Nuclear Projects

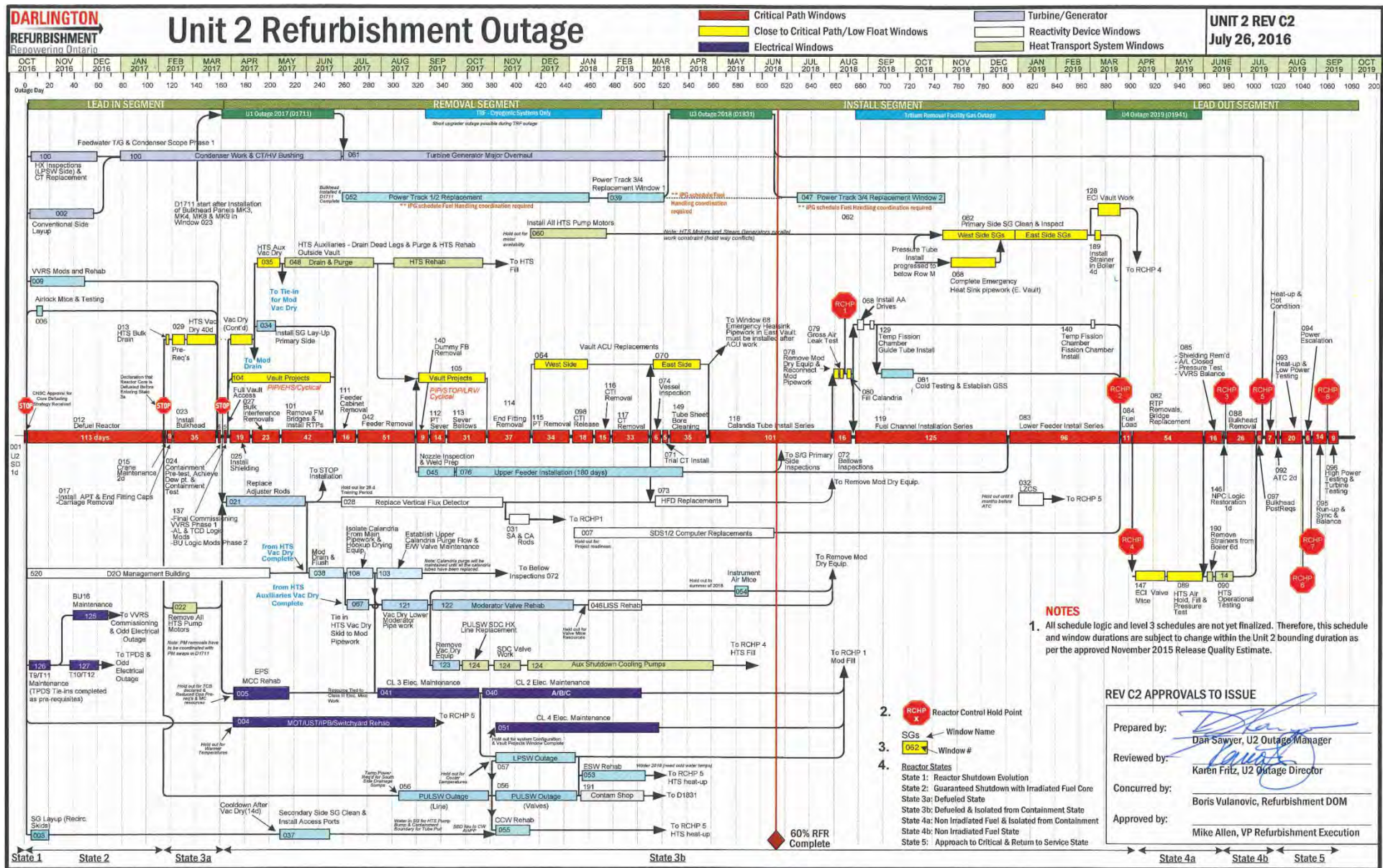
\_\_\_\_\_  
Jeff Lyash  
President and CEO

This Board memo was reviewed and approved for submission to the Board of Directors by the  
Darlington Refurbishment Committee at their meeting of August 11, 2016.

## APPENDICES

1. Unit 2 Level 1 Schedule
2. DRP 4-Unit Cost Estimate Summary including Variance Analysis to RQE
3. Unit 2 Cost Estimate Summary including Variance Analysis to RQE
4. Unit 2 Key Discrete Risk Summary
5. Resource Histograms
6. Funding Release Calculation

## APPENDIX 1: UNIT 2 LEVEL 1 SCHEDULE



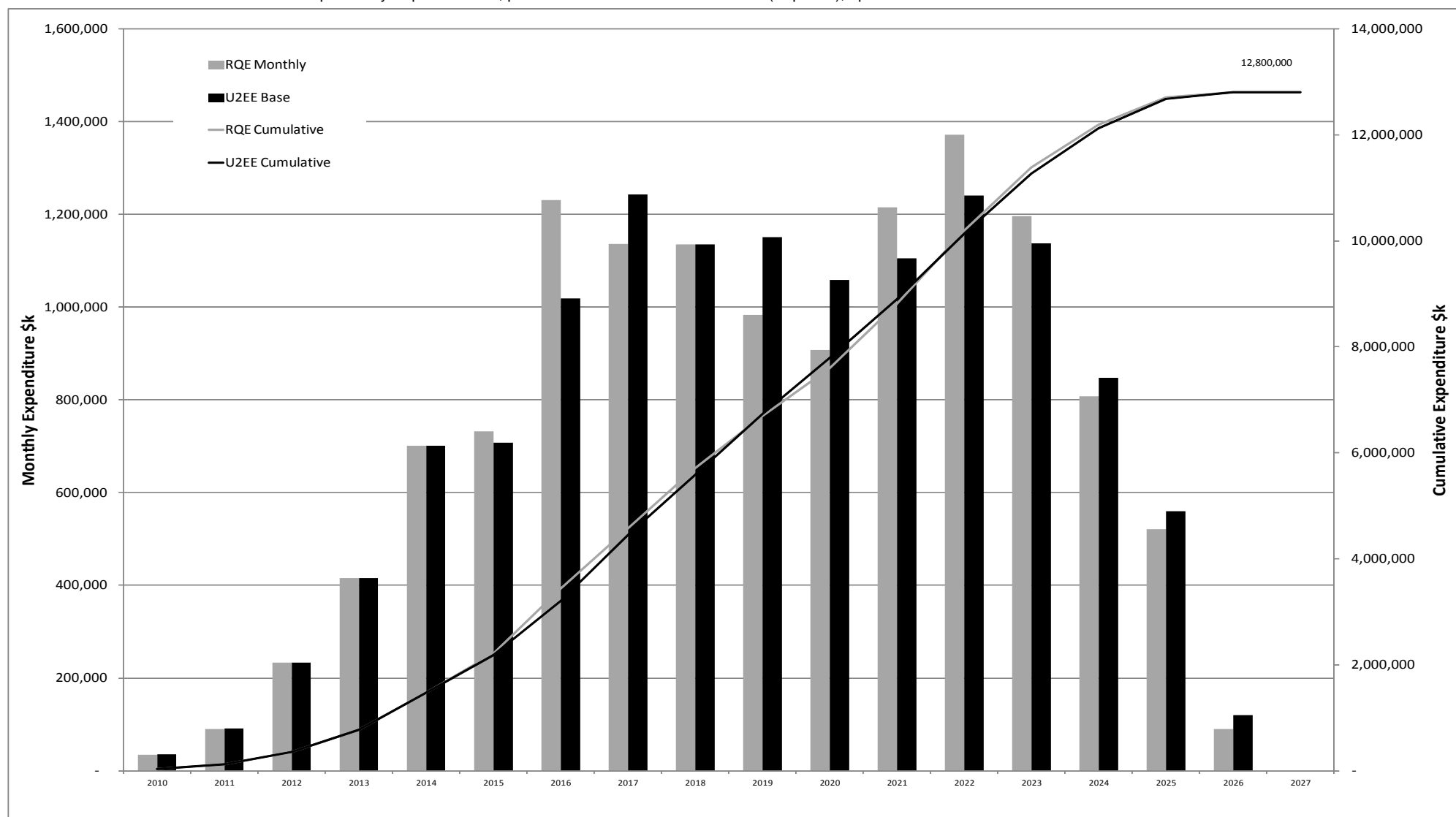
**APPENDIX 2A: 4-UNIT COST SUMMARY**

#	Division	RQE	Current U2EE	Variance from RQE	%
1	NR - Retubing & Feeder Replacement	4,489,335	4,494,607	5,273	0%
2	NR - Turbine Generator	862,083	865,336	3,253	0%
3	NR - Balance of Plant	570,780	587,350	16,569	3%
4	NR - Fuel Handling	186,563	166,363	(20,200)	-11%
5	NR - Defueling	50,798	54,917	4,119	8%
6	NR - Steam Generator	161,509	163,275	1,765	1%
7	NR - Specialized Projects	134,837	135,862	1,025	1%
8	NR - Shutdown, Layup and Services	232,311	197,877	(34,434)	-15%
9	NR - Unit Islanding	167,378	172,288	4,910	3%
10	NR - Waste Disposal	38,518	38,518	0	0%
11	NR - Refurbishment Support Facilities	98,114	82,901	(15,213)	-16%
<b>12</b>	<b>SubTotal Bundle Projects</b>	<b>6,992,227</b>	<b>6,959,296</b>	<b>(32,932)</b>	<b>0%</b>
13	NR - F&IP + SIO Projects	932,792	958,738	25,946	3%
<b>14</b>	<b>SubTotal Campus Plan Projects</b>	<b>932,792</b>	<b>958,738</b>	<b>25,946</b>	<b>3%</b>
15	OPG Functions + Ops & Maintenance	2,868,663	2,875,193	6,531	0%
<b>16</b>	<b>SubTotal Functions</b>	<b>2,868,663</b>	<b>2,875,193</b>	<b>6,531</b>	<b>0%</b>
17	Contingency	2,006,318	2,006,773	455	-
<b>18</b>	<b>SubTotal Contingency</b>	<b>2,006,318</b>	<b>2,006,773</b>	<b>455</b>	<b>0%</b>
<b>19</b>	<b>Nuclear Refurbishment Program</b>	<b>12,800,000</b>	<b>12,800,000</b>	<b>(0)</b>	<b>0%</b>

(1) All figures now include inflation & interest (RQE reported base costs in 2015, with inflation & interest "below-the-line")

# **APPENDIX 2B: 4-UNIT COST FLOW – U2EE vs. RQE**

To be updated by September 30<sup>th</sup>, post issue of REV0 Level 1 Schedule (Sept 15<sup>th</sup>), upon which time final interest will be re-calculated



		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	Total
RQE	RQE Monthly	35	90	233	416	701	732	1,231	1,136	1,135	983	907	1,215	1,372	1,196	807	521	90	-	12,800
	RQE Cumulative	35	125	358	774	1,475	2,207	3,438	4,574	5,709	6,692	7,599	8,814	10,186	11,382	12,189	12,710	12,800	12,800	12,800
U2EE	U2EE Total	36	91	233	416	701	707	1,018	1,243	1,135	1,151	1,059	1,105	1,240	1,137	848	560	120	-	12,800
	U2EE Cumulative	36	127	360	776	1,476	2,184	3,202	4,445	5,580	6,731	7,790	8,895	10,135	11,272	12,120	12,680	12,800	12,800	12,800

### APPENDIX 3: UNIT 2 COST SUMMARY

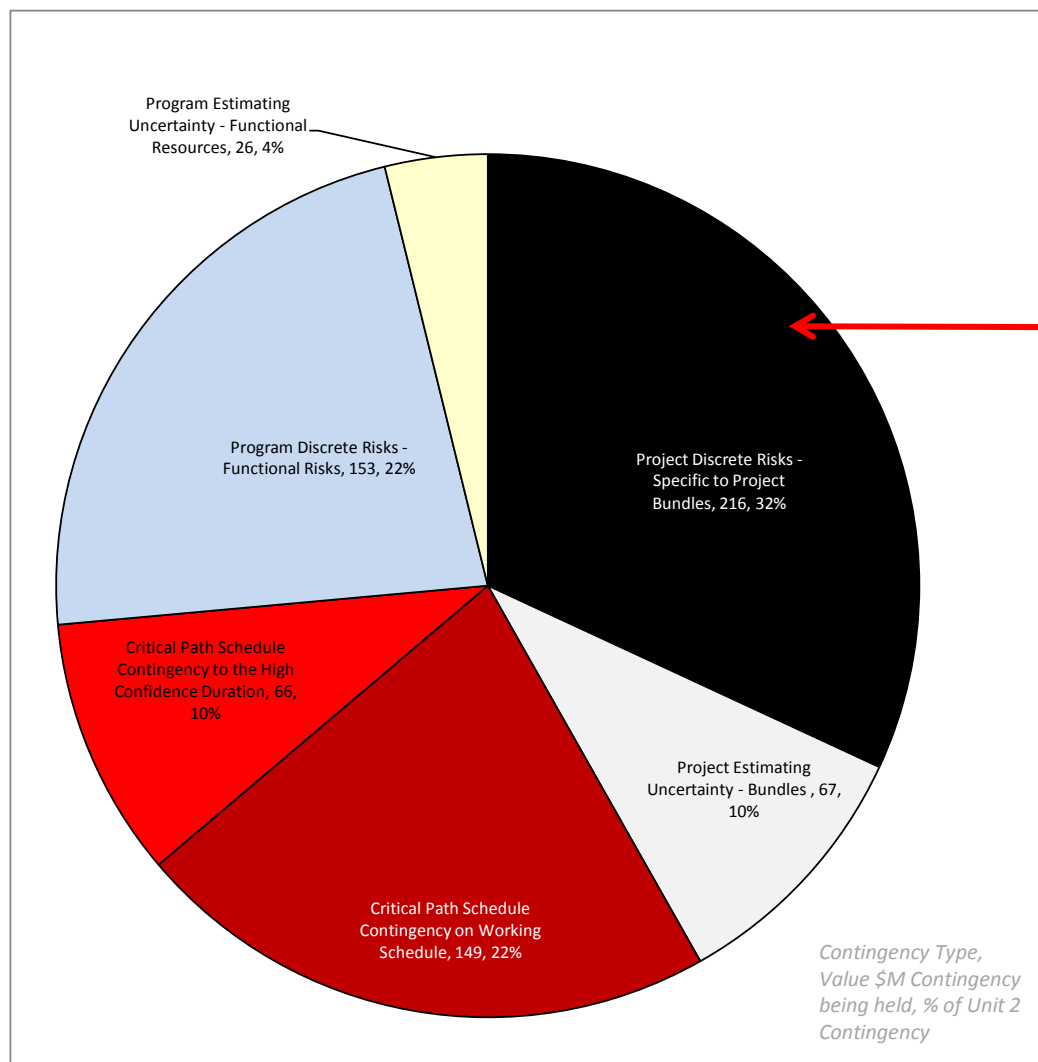
#	Division	RQE	Current U2EE	Variance from RQE	%
1	NR - Retubing & Feeder Replacement	1,143,965	1,148,041	4,077	0%
2	NR - Turbine Generator	226,164	228,012	1,849	1%
3	NR - Balance of Plant	165,731	186,299	20,568	12%
4	NR - Fuel Handling	21,498	16,448	(5,050)	-23%
5	NR - Defueling	31,544	35,978	4,434	14%
6	NR - Steam Generator	53,313	54,537	1,224	2%
7	NR - Specialized Projects	85,593	86,656	1,063	1%
8	NR - Shutdown, Layup and Services	83,371	76,354	(7,017)	-8%
9	NR - Unit Islanding	57,731	61,058	3,327	6%
10	NR - Waste Disposal	7,713	7,713	0	0%
11	NR - Refurbishment Support Facilities	35,478	36,382	904	3%
12	<b>SubTotal Bundle Projects</b>	<b>1,912,101</b>	<b>1,937,479</b>	<b>25,378</b>	<b>1%</b>
13	NR - F&IP + SIO Projects				
14	<b>SubTotal Campus Plan Projects</b>				
15	OPG Functions + Ops & Maintenance	791,583	802,114	10,532	1%
16	<b>SubTotal Functions</b>	<b>791,583</b>	<b>802,114</b>	<b>10,532</b>	<b>1%</b>
17	Contingency	689,530	677,452	(12,078)	-2%
18	<b>SubTotal Contingency</b>	<b>689,530</b>	<b>677,452</b>	<b>(12,078)</b>	<b>-2%</b>
19	<b>Nuclear Refurbishment Program</b>	<b>3,393,213</b>	<b>3,417,045</b>	<b>23,832</b>	<b>1%</b>

- (1) All figures now include inflation & interest (RQE reported base costs in 2015, with inflation & interest "below-the-line")
- (2) Campus Plan F&IP + SIO Projects (Unit F and Unit S) excluded from "Unit 2", but are included in the overall Release 5b funding request.
- (3) Estimate to Complete (ETC) costs for Unit 0 (Common Work) and Unit D (Definition Phase Work) are excluded from the above, but are included in the overall Release 5b funding request.



## APPENDIX 4: UNIT 2 KEY RISK & CONTINGENCY SUMMARY

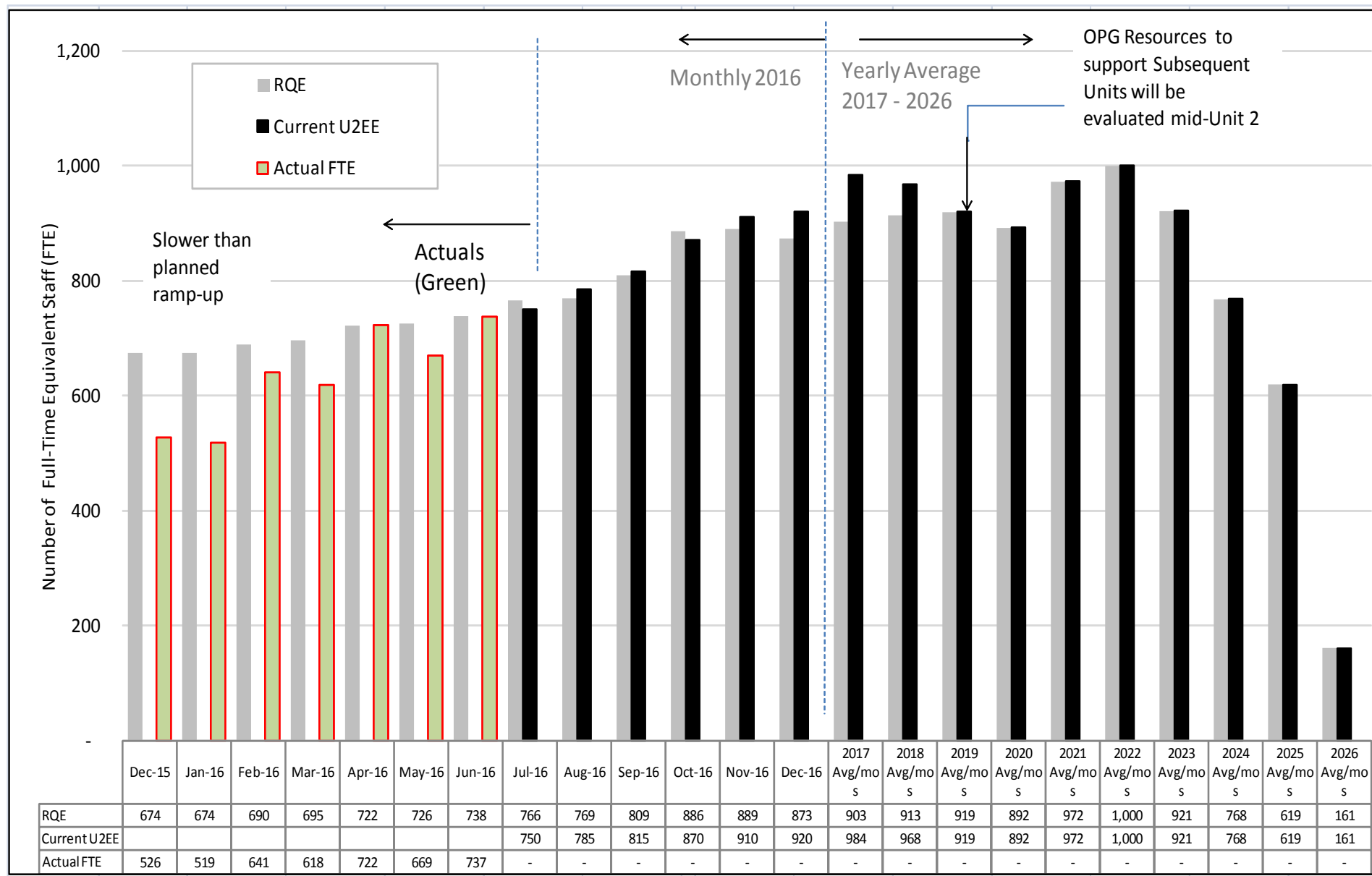
Unit 2 Discrete Top Risks by \$ Value



Bucket	Bundle / Functional	ID	Description	U2EE Unit 2 \$k
Discrete Risks	Retube and Feeder	13325	Concealed Conditions [ Window 167, 168]	20,565
Discrete Risks	Refurbishment Execution	683	Refurb Construction - Poor EPC Vendor performance may require additional oversight during all phases	18,381
Discrete Risks	Refurbishment Execution	783	Refurb Construction - Estimated Cost of General Services contract may be underestimated	17,190
Discrete Risks	Refurbishment Execution	TBD	Trough Management	16,487
Discrete Risks	Program Support	751	Foreign Exchange	16,006
Discrete Risks	Balance of Plant	13663	Additional BoP Resource Risk due to lack of Vendor EPC Experience	12,225
Discrete Risks	Turbine Generator	11250	TG Discovery work scope caused by inspections with impact on long lead items or major repairs	8,063
Discrete Risks	Retube and Feeder	13329	Claims from Retube and Feeder Replacement (RFR) Vendor Not already Covered in the Contract	6,594
Discrete Risks	Balance of Plant	14413	73750 Phase 2 cost escalation (Windows 122, 124, 029, 057)	6,579
Discrete Risks	Operations and Maintenance	708	Materials budget for emergent broke-fix maintenance during Shutdown, Layup and Runup	6,141
Discrete Risks	Operations and Maintenance	564	Large Potential Worker Doses due to Inadequate Internal (Alpha etc.) Hazard Characterization	6,045
Discrete Risks	Refurbishment Execution	717	Refurb Construction - Estimated Cost of RPPE Laundry may be underestimated	5,847
Discrete Risks	Retube and Feeder	13917	Insufficient Tool Quantities or Spares for RFR Execution - all causes [Potential Window 160-188]	5,619
Discrete Risks	Retube and Feeder	13860	Owner Specified Material (OSM) pricing from Unit-to-Unit Procurement [No Window Related]	4,956
Discrete Risks	Shutdown and Layup - Services	13619	SDLU Pre-requisite projects delays [No Window Related]	4,874
Discrete Risks	Shutdown and Layup - Services	14318	Quality Issues [No Window Related]	4,495
Discrete Risks	Retube and Feeder	14115	Feeder fabrication schedule delay as a result of flow element (I690) weldability challenges.	3,773
Discrete Risks	Operations and Maintenance	839	Valve Program Vendor Contract not Secured	3,690
Discrete Risks	Balance of Plant	13263	73639 - PHT & Auxiliaries - PHT & Aux - PHT Pumps Will Require Repairs	3,461

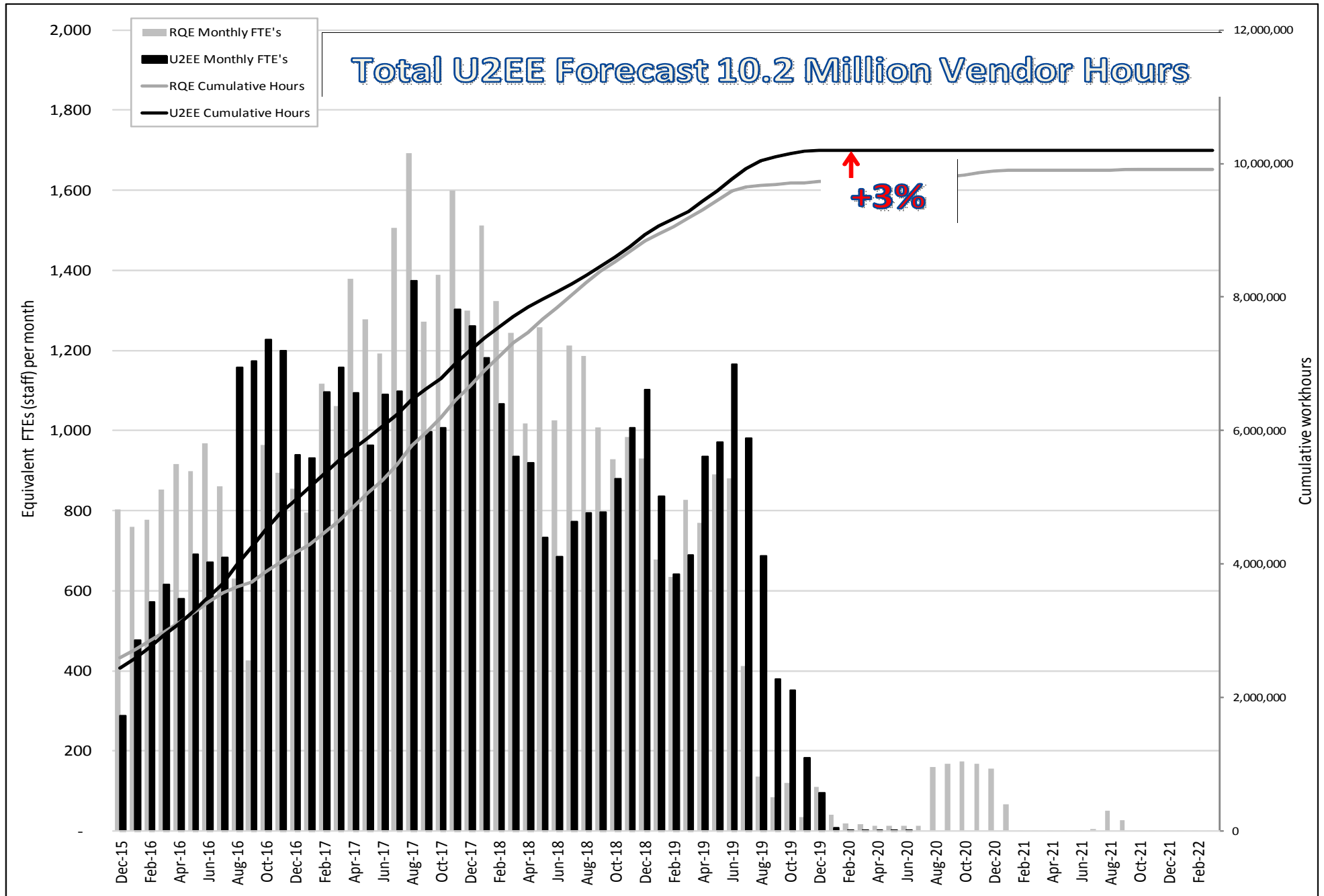
## APPENDIX 5A: RESOURCE ANALYSIS – OPG RESOURCES: U2EE vs. RQE

The following chart includes OPG Project Management, Oversight and Functional Support, plus Operations & Maintenance





APPENDIX 5B: RESOURCE ANALYSIS – VENDOR RESOURCES: U2EE vs. RQE (UNIT 2)



**APPENDIX 6: FUNDING RELEASE CALCULATION**

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e=c+d</i>	<i>f</i>	<i>g=e+f</i>
#		Cumulative Release 4	Approved Release 5a (at RQE)	Cumulative Release 5a	Current Request	Cumulative Release 5b (Unit 2)
1	Unit 0 (Common)	128,000	230,701	358,701	631	359,332
2	Unit D (Definition)	1,014,997	97,062	1,112,059	139,155	1,251,214
3	Unit 2	371,382	360,995	732,377	2,007,216	2,739,593
<b>4</b>	<b>Subtotal thru U2</b>	<b>1,514,379</b>	<b>688,758</b>	<b>2,203,137</b>	<b>2,147,002</b>	<b>4,350,139</b>
4	Unit F (F&IP projects)	693,547	186,983	880,530	94,293	974,823
5	Unit S (SIO Projects)					
<b>6</b>	<b>Subtotal Campus Plan</b>	<b>693,547</b>	<b>186,983</b>	<b>880,530</b>	<b>94,293</b>	<b>974,823</b>
7	Unit 3	0	45,805	45,805	0	45,805
8	Unit 1	0	50,730	50,730	0	50,730
9	Unit 4	0	5,465	5,465	0	5,465
<b>10</b>	<b>Subtotal Other Units</b>	<b>0</b>	<b>102,000</b>	<b>102,000</b>	<b>0</b>	<b>102,000</b>
10	Contingency U2	0	42,699	42,699	634,753	677,452
<b>12</b>	<b>Subtotal Other</b>	<b>0</b>	<b>42,699</b>	<b>42,699</b>	<b>634,753</b>	<b>677,452</b>
<b>12</b>	<b>Total DNP</b>	<b>2,207,926</b>	<b>1,020,440</b>	<b>3,228,366</b>	<b>2,876,047</b>	<b>6,104,413</b>

^

Requested 5b **2,876,047**

**Board Staff Interrogatory #56**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-8, Chart 2

The above reference states that the overall Release Quality Estimate (RQE) is a Class 3 and provides the individual class estimate levels for the major work bundles. The RQE is dated November 13, 2015.

Have any of the major work bundle estimates been revised to a higher class estimate since release of the RQE? If so, please provide details.

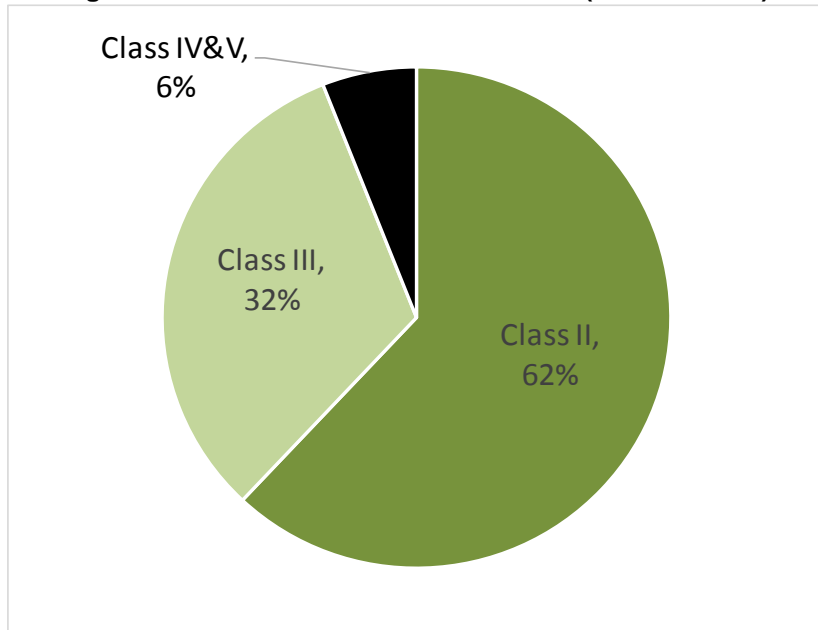
**Response**

Projects within the major work bundles have been revised to a higher class of estimates since the release of the RQE.

Refining of estimates for projects within the major work bundles has continued since the RQE with a particular focus on those estimates that were at Class 4 and 5. Figures 1 and 2 below compare the percentage of estimates for the major work bundles which were in the various estimate classes at RQE and in the August 2016 Unit 2 Execution Estimate (see Ex. L-4.3-1 Staff-55). As can be seen, as a percentage of overall value of the estimate, Class II estimates increased to 75% from 62%, Class III estimates shrunk from 32% to 23%, and Class IV and V estimates shrunk from 6% to 2%.

1

**Figure 1 - Estimate Classification at RQE (October 2015)**



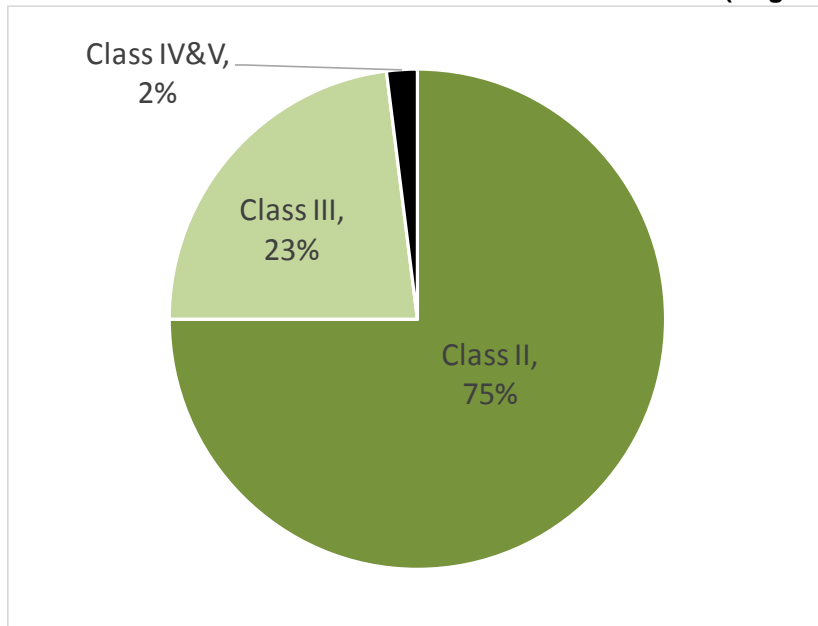
2

3

4

5

**Figure 2 - Estimate Classification at Unit 2 Execution Estimate (August 2016)**



6

**Board Staff Interrogatory #57**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-8, Attachment 1

OPG has provided a Release Quality Estimate (RQE) as part of the DRP Execution Phase Business Case Summary.

- a) How will OPG determine whether it is necessary to reforecast the RQE? Provide all written processes and procedures regarding cost reforecast process.
- b) How will OPG track cost trends and contingency? Provide all written processes and procedures.
- c) What reporting tools for earned value, budget status, safety and project status will OPG use? What is the format and content for these reports? Who is responsible for generating these reports? Who will receive these reports and with what frequency?
- d) For each Unit, identify what is the value and percentage of contingency applied to each major work bundle.
- e) What is management contingency above the project contingency – how is it distributed across the projects?

**Response**

- a) OPG will develop an estimate for each subsequent unit's refurbishment prior to seeking a release for execution of that unit. As part of that process, OPG will update its estimate for the completion of the Darlington Refurbishment Program (similar to the RQE). The process will include a review of the actual costs and schedule from previous units, applying lessons learned, updating risks and contingency and validation of contractors' estimates. The estimating process is documented in Nuclear Projects Cost Estimating Process NR N-MAN-00120-10001-EST-R002 (L-4.3-1 Staff-48a, Attachment 23).
- b) OPG tracks cost performance against budgets on a monthly basis and performs trend analysis using earned value management. On a monthly basis, cost performance reports are issued and project managers will identify and analyze variances to plan, trends, and items requiring corrective actions. When these trends indicate that contingency is

1 required to mitigate a risk, issue, trend, or other, then the change management process  
2 will be followed to drawdown/return contingency. Cost management reporting is  
3 documented in Nuclear Refurbishment Cost Management and Reporting N-MAN-00120-  
4 10001-PC-13-R000 (L-04.3-1 Staff-48a, Attachment 26), while Nuclear Refurbishment  
5 program change management is documented in Nuclear Refurbishment – Program  
6 Change Management N-MAN-00120-10001-PC-12-R001 (L-043-1 Staff-48a, Attachment  
7 27).  
8

9 c) OPG has established a robust cost management and project reporting solution.

- 10  
11 • The reporting tools used for earned value are the cost system [Ecosys], the  
12 scheduling software [Primavera 6], the information storage database [Integrated  
13 Database] and report building software [Microsoft Report Builder and Microsoft  
14 Business Intelligence (BI)].  
15
- 16 • For cost based Earned Value, work packages in Primavera P6 are progressed with  
17 their physical % complete (based on pre-established earning rules or unit counts).  
18 This % complete is loaded into Ecosys, and an earned value (in \$) is calculated  
19 based on an approved planned value to calculate CPI (Cost Performance Index). An  
20 automated routine runs to transfer the information within Ecosys into an Integrated  
21 Database such that automated reporting algorithms can read and utilize the data  
22 consistently to produce standardized progress and performance reports using  
23 Microsoft Business Intelligence (BI).  
24
- 25 • For schedule based Earned Value, the same initial process occurs as above (work  
26 packages in Primavera P6 are progressed with their physical % complete), however,  
27 this information, as well as other schedule resource information is utilized to calculate  
28 SPI (Schedule Performance Index). An automated routine runs each night to transfer  
29 the information within Primavera P6 into an Integrated Database such that automated  
30 reporting algorithms can read and utilize the data consistently to produce  
31 standardized progress and performance reports using Microsoft Business Intelligence  
32 (BI).  
33
- 34 • The reporting tools for budget status are the cost system [Ecosys], the information  
35 storage database [Integrated Database] and report building software [Microsoft  
36 Report Builder and Microsoft Business Intelligence (BI)].  
37
- 38 • The reporting tools for safety are the Station Condition Record (SCR) Database, and  
39 excel files maintained within secure SharePoint locations by the Safety department.  
40
- 41 • The primary reporting tools for Project Status are Primavera P6 (for project progress  
42 and schedule status) and Ecosys (for budget, cost, and change management status),  
43 as well as the Integrated Database and report building software using Microsoft  
44 Business Intelligence (BI). There are secondary systems that provide additional  
45 information, such as scope tracking, and work management. The information from

1 these secondary systems is utilized by the Integrated Database to ensure a complete  
2 set of reports and metrics are available.  
3

- 4 • Reporting within Nuclear Refurbishment follows a tiered structure where the  
5 information is gathered and reported on at the lowest level of granularity with rollups  
6 for tiered reporting to a variety of different reporting levels. For example, schedule  
7 progress is reported against activities in Primavera P6, rolled up to a work package  
8 where earned value is measured and costs are collected and reported. Work  
9 packages are rolled up to cost elements, vendors, projects, scope bundles, and the  
10 unit. The Nuclear Projects Executive Team will make decisions based on the overall  
11 progress of the refurbishment, which is a direct roll up of a progressed activity on the  
12 schedule and a work package in the costs system.  
13
- 14 • Reports are developed by the Project Planning & Controls Reporting department.  
15 These reports go through a stringent development and acceptance testing process to  
16 ensure that the reports accurately reflect the data that is entered. The project teams  
17 are responsible to ensure that the data entered within the key source systems (such  
18 as Primavera 6 and Ecosys) accurately reflect the status of their project. In addition to  
19 daily/weekly reviews within the project teams, there is a review and challenge process  
20 built into the month-end reporting cycle. The information within the automated reports  
21 is the basis for all executive reporting. Depending on the report, the analysis and text  
22 write-up on the status is performed by the appropriate individuals such as the Project  
23 Managers.  
24

25 The report audience and frequency of report generation is also tiered. The project teams  
26 receive schedule information on a daily and weekly frequency. Any safety events will also  
27 be reported on immediately. The Nuclear Projects Executive Team will receive schedule  
28 progress information on a weekly frequency. Cost performance is collected weekly and  
29 reported monthly.

1 d) The values are provided in the chart below:

2

<b>Contingency Summary Unit Detail (2015 \$M)</b> (Ref: Ex. D2-2-8, Attachment 1, Table C2 and Ex. D2-2-7, Chart 1)											
Major Work Bundles & Execution Support Functions	Total (\$2015 M)	F&IP and SIO		Unit 2		Unit 3		Unit 1		Unit 4	
		\$M	%	\$M	%	\$M	%	\$M	%	\$M	%
RFR (Retube & Feeder Replacement)	617		0%	247	38%	154	36%	123	38%	93	35%
TG (Turbine Generator)	218		0%	87	14%	55	13%	44	13%	33	12%
SG (Steam Generator)	20		0%	8	1%	5	1%	4	1%	3	1%
FH (Fuel Handling) and Defueling	63		0%	25	4%	16	4%	13	4%	9	4%
BOP (Balance of Plant)	230		0%	92	14%	58	13%	46	14%	35	13%
F&IP + SIO	76	42	100%	34	5%		0%		0%		0%
Project Execution, and Operations & Maintenance	280		0%	112	17%	70	16%	56	17%	42	16%
Unallocated Program Contingency	202		0%	40	6%	72	17%	37	12%	53	20%
<b>Total</b>	<b>1,706</b>	<b>42</b>	<b>100%</b>	<b>645</b>	<b>100%</b>	<b>429</b>	<b>100%</b>	<b>323</b>	<b>100%</b>	<b>267</b>	<b>100%</b>

3

4 e) OPG interprets the question to mean what is Program Contingency above the Project  
5 Contingency. OPG notes that Ex. D2-2-7 Chart 1 and Ex. D2-2-8, Attachment 1, Table  
6 C2 displays both Project Contingency and Program Contingency, distributed by Major  
7 Work Bundles and Execution Support Functions. Project contingency is related to  
8 discrete project risks, and is distributed to Projects and is available for Project Managers  
9 through the use of the Change Management process. Program Contingency is  
10 overarching contingency that is not directly attributable to a single project and, as such, it  
11 is held at the Program level. Program contingency can be released to a project through  
12 the Change Management process; however, its use must be authorized by senior project  
13 executives prior to drawdown.

14

15 If by "management contingency" what was meant was management reserve, OPG notes  
16 that there is no specific amount above the total \$1.7B (2015\$) contingency determined  
17 for management reserve. OPG does not expect the Darlington Refurbishment Program to  
18 exceed its high confidence estimate of \$12.8B. If low probability, high consequence risks  
19 outside of the control of the Darlington Refurbishment Program management occur,  
20 management would evaluate the impacts and make a recommendation to the OPG  
21 Board of Directors on the appropriate response.



**Board Staff Interrogatory #58**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-6 and D2-2-8

- a) What is the process that OPG will use to make DRP decisions impacting cost and schedule?
- b) Who within the project management organization has what type and level of decision-making authority?
- c) Describe OPG's strategy to work through disagreements with contractors that have cost and schedule impact, i.e. explain how these issues will be identified, escalated and resolved? What data will be provided to the person(s) with decision making authority? What is the timeline for this process?

**Response**

- a) Darlington Refurbishment Program (DRP) decisions impacting cost and schedule are made in accordance with the change management process discussed in Ex. D2-2-9, Attachment 1, and L-4.3-1 Staff-48, Attachments 25-27.
- b) OPG assumes the question is referring to decision-making authority over changes to cost and schedule.

**Schedule Changes:** Only the Senior Vice President, Execution and Senior Vice President, Nuclear Projects can authorize changes which impact the critical path schedule. They may release schedule contingency within the following limits:

- Project schedule contingency within the planned outage duration (target duration) is released via the Change Control Board, where the Senior Vice President, Execution can approve up to a 5 day impact on critical path and the Senior Vice President, Nuclear Projects must approve impacts greater than 5 days.
- Program schedule contingency within the high confidence schedule is released via the Program Change Control Board, where the Senior Vice President, Nuclear Projects may authorize up to 5 days of impact on critical path. All critical path impacts

1 above that threshold will require the approval of the Chief Nuclear Officer and Chief  
2 Executive Officer.

3  
4 **Cost Changes:** Provided the appropriate change management approval process is  
5 followed, cost contingency may be released as follows:

- 6  
7 • Project managers, project directors and senior project directors can release up to  
8 \$1M, \$2M and \$5M, respectively if they have budgeted contingency available to  
9 them.  
10 • Contingency releases over \$5M require Senior Vice President, Execution's approval  
11 at the Change Control Board.  
12 • Program Cost Contingency is discussed at the Program Change Control Board,  
13 where the Senior Vice President, Execution must authorize the release of cost  
14 estimating uncertainty contingency, and the Senior Vice President, Nuclear Projects  
15 may authorize release of contingency for discrete program risks.  
16

17 The Vice President, Project Planning and Controls, owns and administers the Change  
18 Management Process. The Project Planning and Controls organization will ensure that  
19 the Change Control Process at both the project level and program level are appropriately  
20 administered, ensure that all changes are documented, and will generate and issue  
21 contingency drawdown reports to Management and the Board of Directors.  
22

- 23 c) The Darlington Refurbishment Contract Management Plan has been provided as  
24 Attachment 7 to L-4.3-1 Staff-048.  
25

26 For each of OPG's major work bundle contracts, OPG has weekly meetings both  
27 internally and with its contractors to identify any issues. Such issues are tracked in issues  
28 logs and are shared between both organizations. Each contract has terms limiting the  
29 ability for the contractors to initiate project changes, which manages and reduces OPG's  
30 risk exposure to changes in target costs, target schedules or fixed fees. As set out in the  
31 Darlington Refurbishment Contract Management Plan, if any project change is proposed,  
32 Contract Management or Project Management is to confer with OPG Law and Supply  
33 Chain, as well as People and Culture and Finance as required, to determine whether a  
34 project change or contract amendment is appropriate.  
35

36 If there is a dispute between OPG and the contractor with respect to any changes that  
37 have cost or schedule impact, including allowable and disallowable costs, changes to the  
38 cost allocation table, and schedule relief for delays, each contract sets out the process for  
39 resolution of disputes. The dispute resolution process escalates the disputes from project  
40 managers, to the Steering Committee, to formal and binding arbitration. Timelines are  
41 set out in each contract for escalating a dispute to the next stage. Each contract also  
42 limits the recourse of the contractor and OPG to the ordinary courts.  
43

44 The information to be provided to the person(s) with the decision making authority differs  
45 depending on the circumstances. Key details pertinent to the dispute will be provided. For

- 1 example, contractor requirements and obligations as set out in the contract, purchase
- 2 orders or submittal schedules will be provided.

**Board Staff Interrogatory #59**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-8, Attachment 2, page 24

The above referenced Modus report states that "The various islanding projects are relatively small in cost but significant to the DR Project's success. The design of the Darlington plant, in particular the fueling bay that runs below the reactors, makes isolating a single unit for refurbishment a challenge."

- a) Please confirm that the isolating of a single unit from the operating units is unique to the DRP (i.e. that it has not been done on prior nuclear refurbishments).
- b) What special precautions have been taken to ensure that the operation of the remaining units does not interfere with the refurbishment of Unit 2 and vice-versa?
- c) How much has been spent to date on the islanding project compared to budget?
- d) What contingency has been provided for the various islanding projects?

**Response**

- a) OPG does not confirm that "isolating a single unit from the operating units is unique to the DRP." The reference cited in the question speaks to the particular challenges associated with islanding given that the duct in which the shared fueling machines travel runs below the reactors. OPG does confirm that the DRP is unique in that it is the first CANDU station where fueling machines are shared among the units, and where a unit under refurbishment will be immediately adjacent to an operating unit in that unit pair.

The Bruce A Station's design is similar to the Darlington design in that there are shared fuelling machines travelling in a fueling duct servicing all of the units. However, during the Bruce A Units 1 and 2 refurbishments between 2005 and 2012, both units were shutdown and refurbished, effectively in parallel. Units 3 and 4 (not immediately adjacent) were operating.

Units 1 to 4 at Pickering were retubed (pressure tubes replaced) in the mid-to-late 1980s and early 1990s. At various times during that refurbishment, the immediately adjacent unit was operating. However, the Pickering units all have dedicated fuelling machines and no

1 fuelling duct which accesses all of the units.

2  
3 Pt. Lepreau is a single unit station and, therefore, there was no or minimal islanding to be  
4 carried out.

5  
6 Wolsong is a multi-unit station and was refurbished while the immediately adjacent unit  
7 was operating; however, like the Pickering units (and Pt. Lepreau), the Wolsong units  
8 have dedicated fuelling machines.

- 9  
10 b) Many special precautions have been taken to ensure that the operation of the remaining  
11 units does not interfere with the refurbishment of Unit 2 and vice versa. As noted in Ex.  
12 D2-2-8, Attachment 2, p. 24: (i) a bulkhead will be installed to isolate the refurbishment  
13 unit reactor vault from the remainder of station containment once the de-fuelling of Unit 2  
14 is complete, (ii) barriers and access controls have been installed to ensure that staff  
15 working on refurbishment do not enter the operating areas and vice versa (unless  
16 required), and (iii) operating station systems have been isolated from the refurbishment  
17 units to the extent possible.

18  
19 In addition to physical barriers, as discussed in Ex. D2-2-9, pp. 5-6, the DRP includes a  
20 dedicated Operations and Maintenance Function which provides support to the major  
21 work bundles of the unit being refurbished and also serves as the custodian of the  
22 operating units in the plant by ensuring that the refurbishment work does not adversely  
23 impact those operating units. Daily interface meetings have been taking place which  
24 involve both refurbishment staff and operating staff to ensure that all work is well  
25 coordinated and there are no, or minimal, interferences.

26  
27 Special tiered training has also been developed for site staff as well as staff who are not  
28 normally at the station site but who access the station from time to time, to ensure that  
29 they are familiar with, and obey, the barriers and signage which have been put in place to  
30 avoid interference between the refurbishment unit staff and operating staff.

- 31  
32 c) As of August 2016, expenditures on the Islanding project were \$46.2M compared to a  
33 control budget of \$47.7M.
- 34  
35 d) The contingency amount of \$21M referenced in Ex. D2-2-8, Attachment 2, p. 24, is made  
36 up of two components:
- 37  
38 i. Cost uncertainty represents \$2M of the total and includes \$1.5M for the Bulkhead  
39 project, \$0.2M for the Barriers projects, \$0.2M for Project Management Support,  
40 with the remainder distributed to various other smaller projects.
- 41  
42 ii. The remaining \$19M represents contingency for discrete risks associated with the  
43 Islanding project. The largest of the discrete risks relates to the Bulkhead project,  
which is on critical path; \$14M contingency was provided for that risk.

**Board Staff Interrogatory #60**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-8, Attachment 1, Figure A1

The above referenced Release Strategy shows work on Unit 3 starting immediately after Unit 2 returns to service.

Please explain how this schedule will enable OPG to internalize and apply the lessons learned from Unit 2 going forward.

**Response**

The preparation and execution for each unit occurs in phases. For example, lessons learned during the completion of detailed design engineering for Unit 2 will be applied to Unit 3 as replication of engineering for Unit 3 will be completed in advance of breaker open on Unit 3.

Similarly, the execution of Unit 3 will occur in phases (see Figure 2 of Ex. D2-2-6 and Attachment 1 of Ex. D2-2-6). For example, the defueling of Unit 3 will start approximately 3 years after the completion of defueling on Unit 2, allowing significant time to incorporate lessons learned. Similarly the removal segment of the Unit 3 refurbishment will start over two years after the end of the removal segment on Unit 2, again allowing significant time to apply the lessons learned on Unit 2 to Unit 3. This same approach to lessons learned will be applied to all phases of the execution of Unit 3 and to the units following.

**Board Staff Interrogatory #61**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-3, Attachment 1, page 6

For the DRP Execution Phase, calculation and payment of all cost incentives and disincentives will be done on an aggregate basis for all completed units.

- a) Please explain how this will work in practical terms with the CRVA for DRP. For example, will the CRVA only be cleared at the completion of all four units?
- b) Were any incentive or disincentive payments made during the definition phase?

**Response**

- a) The costs of the DRP will reflect accrued incentives and disincentives at the completion of each unit as per OPG accounting process in accordance with US GAAP. The CRVA treatment of these amounts will be the same as for other sources of variance from OEB-approved capital and non-capital costs. Variances in non-capital costs are included in the CRVA as incurred, and the revenue requirement of variances in capital costs is included in the CRVA on the basis of variances in amounts placed in service. OPG anticipates that the CRVA balance would be cleared periodically in the normal course in conjunction with other deferral and variance account balances.
- b) While OPG's Definition Phase concluded at the end of 2015, some vendor Definition Phase activities are still ongoing as contemplated in their agreements, and in some cases, will continue to September, 2017. It is not currently anticipated that any incentive payments will be made by OPG. OPG will assess potential disincentives at the time of completion. Notwithstanding the above, with respect to the Retube and Feeder Replacement contract, a \$1,000,000 lump sum disincentive payment was paid to OPG as consideration for the movement of the target date for a limited number of Definition Phase work activities. Less than 2% (approximately \$18M) of work was outstanding to meet the milestone. In addition to the disincentive payment, OPG also established realistic but aggressive milestones and associated disincentives for the remaining Definition Phase work so as to incentivize the contractor to complete the work.

**Board Staff Interrogatory #62**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Reference: D2-2-8, page 8

The above reference states that OPG will complete the Unit 2 refurbishments within the total budget envelope of \$4.8B.

- a) How does that fit in with the Capital Refurbishment Variance Account (CRVA)? I.e. if Unit 2 in service additions are greater than \$4.8B, will those costs go into the CRVA?
- b) When OPG comes in for its next application for 2022 will there be a reforecast of the remaining DRP costs?

**Response**

- a) As stated at Ex. H1-1-1, pp. 12-13, lines 27-30, 1-5:

the Capacity Refurbishment Variance Account was originally approved in EB-2007-0905... to record variances between the actual capital and non-capital costs and firm financial commitments incurred to increase the output of, refurbish or add operating capacity to a prescribed generation facility ... **In 2015, O. Reg. 53/05 was amended to affirm that the scope of this account includes the capital and non-capital costs and firm financial commitments incurred in respect of the Darlington Refurbishment Program.** [Emphasis added].

If actual in service additions are different (greater or less) than amounts approved by the OEB in this proceeding, including the \$4.8B forecast for Unit 2 in-service addition, the cost impact of the difference will be booked to the Capacity Refurbishment Variance Account.

- b) Yes. In OPG's next payment amounts application, the evidence will include the best available forecast of the remaining DRP costs.



**Board Staff Interrogatory #63**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh A1-2-2

Ref: Exh D2-2-8, Attachment 1

In the current application OPG seeks the addition to rate base of \$4.8B related to Unit 2 in 2020 and \$743M related to supporting projects. OPG states that if actual additions to rate base are different from forecast amounts, the cost impact of the difference will be recorded in the CRVA. The evidence states that any amounts greater than the forecast amounts added to rate base will be subject to a prudence review in a future proceeding. While not stated in evidence, presumably any amounts less than forecast would be recorded in the CRVA and credited to ratepayers when the account is dispositioned.

What is the incentive for OPG to reduce costs for the Unit 2 refurbishment or for the entire \$12.8B DRP?

**Response**

OPG is an OBCA corporation whose mandate states that "OPG shall leverage its assets and expertise to generate new revenues on a commercially sound basis...."<sup>1</sup> Given the large percentage of OPG's assets that are regulated, a significant potential source of new revenues is the expansion of its regulated asset base. The Darlington Refurbishment Project (DRP) is a singular opportunity to renew and expand OPG's regulated asset base. This opportunity and the resulting revenues will only be realized if OPG is able to complete the entire DRP. The fact that the Government is expected to assess the on-going feasibility of DRP based on the performance of the Unit 2 refurbishment, creates a strong incentive for OPG to control costs and maintain the project schedule, consistent with safety.

The oversight provided by the OEB on this rate application and any subsequent prudence review of DRP costs in excess of forecast, will determine the amount that OPG recovers for DRP. Any cost disallowance ultimately would reduce the revenues that the company earns on its investment in DRP. Furthermore, if the project is over budget or late, management's performance will be scrutinized by OPG's Board of Directors (which has retained independent experts to provide oversight) and the Shareholder. This oversight (See Ex. D2-2-9, pp. 10 to 13), combined with OPG's management incentive program and contractor incentives included in the contracts, also drives OPG to safely complete the Unit 2 Refurbishment as quickly as possible and at the lowest possible cost.

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<sup>1</sup> Ex. A1-4-1 Attachment 2, page 4.

1  
2 The DRP is a destiny project for OPG, for the CANDU nuclear program, and for the Province  
3 of Ontario. OPG's management team and OPG's employees recognize that. If the DRP were  
4 not to succeed, there will be no, or a severely limited, future nuclear program for OPG and  
5 the Province of Ontario.

**Board Staff Interrogatory #64**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-8 Attachment 1, page 2

The above reference states that OPG's current Levelized Unit Energy Cost (LUEC) estimate of 8.1 ¢/kWh (2015\$) for the DRP is within the previously communicated estimate of 8 ¢/kWh in 2009\$.

- a) What total cost can the DRP rise to in 2026\$ that would still be equivalent to the LUEC 2009 at less than 8 ¢/kWh?
- b) Please calculate the LUEC when the full \$12.8B is used.
- c) Please calculate the LUEC when the costs related to previous DRP projects that have been moved to Nuclear Operations is added back.

**Response**

- a) OPG interprets this question to be: "to what amount can the DRP cost of \$12.8B (which includes interest and escalation) rise, all other factors being equal, and maintain the LUEC at less than 8¢/kWh (2009\$)?" The reference to 2026\$ is confusing, as the \$12.8B is expended over many years in dollars of those years, not in 2026\$.

The DRP cost could rise to \$16.3B (including interest and escalation), all other factors being equal, and the LUEC for the DRP would remain less than 8 ¢/kWh (2009\$).

- b) The LUEC of 8.1¢/kWh (2015\$) provided in Ex. D2-2-8 Attachment 1 is calculated using the full \$12.8B.
- c) If the costs for the projects reclassified to Nuclear Operations (see Ex. D2-2-10 p. 10-11) were to be added to the DRP costs, the LUEC would increase to approximately 8.25¢/kWh (2015\$).

Please refer to L-04.3-1 Staff-8, part c), and L-04.3-2 AMPCO-105 for the reclassification rationale.

**Board Staff Interrogatory #65**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-8 Attachment 1, page 28

OPG indicates that benchmarking has been done against other CANDU refurbishment projects at Point Lepreau and the Bruce 1& 2 Units. Please provide details.

**Response**

Please see Ex. L-4.3-1 Staff-053.

**Board Staff Interrogatory #66**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-8, Attachment 1 page 31

The above reference states that \$503M of the \$1.7B contingency is for schedule extension.

What is the worst case scenario (i.e. how many months past the current 112 months schedule) that this dollar amount of contingency will cover? For instance, would it cover a six month increase in duration of the overall schedule? If so, explain why the LUEC would increase by 0.1 cent/kWh with a 6 month increase in schedule.

**Response**

As stated in Ex. D2-2-8, Attachment 1, p. 31, the \$503M contingency for schedule extension is "to cover the risk of delay up to the high confidence schedule duration." The high confidence schedule is 112 months; therefore, if the final duration is as long as the high confidence schedule, the entire \$503M would be expended.

As noted on Ex. D2-2-6, p. 5, lines 6-10, OPG plans to manage day-to-day performance using the planned outage duration (target duration) (please see Ex. D2-2-6, Attachment 1), not the high confidence schedule. For Unit 2, the target duration is 35 months and the high confidence schedule is 40 months.

The calculated LUEC increase of 0.1¢/kWh for a six month schedule increase (1.5 months per unit) discussed in Ex. D2-2-8, Attachment 1, p. 38, is a sensitivity analysis on LUEC where the assumption is that the Darlington Refurbishment Program exceeds 112 months. The reason for the increases is that the longer duration is assumed to result in higher costs for Darlington Refurbishment Program execution, as well as a delay to energy production, resulting in impacts to the LUEC.

**Board Staff Interrogatory #67**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh: D2-2-8, Attachment 1, page 31

\$50M contingency is provided to retain critical trades and leadership resources between work on units. There are a number of other projects which are identified as possible other work.

- a) How did OPG determine the \$50M contingency amount? Please provide assumptions and references for any calculations.
- b) If work on other projects does not proceed, how does OPG intend to use the \$50M?
- c) Does OPG forecast spending any of the \$50M contingency in the 2017-2021 period?

**Response**

a) Two significant periods of reduced demand for planned contractor resources were identified (i) June 2019 through January 2020, i.e., as Unit 2 is completed and work transitions to Unit 3, and (ii) June 2022 through January 2023 between Unit 1 and Unit 4. This was estimated to be approximately 280 and 235 staff for each of these 8-month periods, respectively. The total potential bridging cost was calculated to be \$55 million, which would retain staffing levels at approximately 70% of core staff across these two periods. At 90% probability applied to this estimated cost, this equated to \$50M in contingency.

b) Contingency for these risks would be released using OPG's change management process as set out in Ex. L-4.3-001 Staff-58(b). Should the assignment of the retained resources to the Nuclear project portfolio work, fleet unit outage work, or Darlington 'Life Extension' work during this period be not possible, these resources would be utilized to enhance those resources performing planning, training and readiness-to-execute activities for the refurbishment of the subsequent units.

OPG would seek to minimize the cost impact to the extent possible. A loss of these resources would have a much greater impact on the refurbishment of Unit 3 as many of these resources may not return if relieved from Unit 2 duties, resulting in increased re-training and risks of a new workforce without the equivalent experience of those that worked on Unit 2.

- 1  
2 c) OPG does not forecast whether a specific risk will materialize and an associated  
3 contingency amount spent. As set out in Ex. D2-2-7, OPG expects to spend the  
4 contingency included in RQE. Any release of contingency would follow OPG's change  
5 management process as set out in Ex. L-4.3-001 Staff 58(b).

**Board Staff Interrogatory #68**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-8, Attachments 2, 3 and 4

In Attachment 2, BMCD/Modus made recommendations associated with certain components of the Release Quality Estimate (RQE). Similarly, in Attachment 3 KPMG identified a number of gaps and risks. In Attachment 4 the Expert Panel made eight recommendations.

- a) Please provide a status update on OPG's work in addressing BMCD/Modus' recommendations.
- b) Please describe how OPG is addressing the gaps and risks identified by KPMG.
- c) Please provide a status update on OPG's work in addressing the Expert Panel's recommendations. Specifically, what adjustments were made to the project schedule, productivity expectations and project management plans subsequent to the receipt of the Expert Panel's report.
- d) On page 14 of Attachment 4, it states "it will take vigilant project management and worker productivity not generally experienced on retube projects in Canada to achieve a schedule equivalent to or shorter than the P50 schedule". Please describe how OPG has determined that its worker productivity expectations are reasonable.

**Response**

- a) Between August, 2013 and December, 2015, 154 recommendations were initiated from the Burns McDonnell/Modus quarterly reports. These recommendations were addressed, dispositioned and closed out except for one which is at 'in-progress' status and due for closure this month. In the period from July, 2014 to December, 2015, Burns McDonnell/Modus conducted and reported on twelve (12) assessments. Seventy six (76) recommendations were addressed, dispositioned and closed out except for one which is also at 'in-progress' status and due for closure this month.
- b) OPG reviewed the recommendations provided by KPMG and, where required, built many of the recommendations into the Unit 2 Execution Estimate. Attachment 1 provides a listing of how each finding was dispositioned.



- 1 c) Please see Attachment 2. No changes to schedule, productivity or plans resulted from the  
2 Expert Panel's review, nor was the scope of the work of the Panel and the resulting  
3 actions related to the question. The objective of the Panel was to ascertain whether the  
4 product of the Class 2 estimate met their tests for do-ability. The Panel's conclusion was  
5 that it did; in addition, the Panel made suggestions related primarily to risk management,  
6 and other recommendations on areas to keep a close watch on, and areas for  
7 improvement. Those actions were input into OPG's Risk Management Oversight tool and  
8 have been acted on. Please see Ex. L-4.3-15 SEC-34 for further information regarding  
9 OPG's response to the Expert Panel's report.  
10
- 11 d) For the Retube and Feeder Replacement work, which is what the cited quote from Ex. D2-  
12 2-8, Attachment 4, p. 14 is referring to, the schedule is based on actual tests of the tools in  
13 the mock-up. Therefore, OPG believes worker productivity assumptions to be reasonable.  
14 Also, when compared to the durations of other refurbishments, and in consideration of the  
15 level of planning that OPG has completed compared to other CANDU refurbishments, OPG  
16 believes the schedule to be reasonable. However, OPG has assessed and recognized that  
17 risks may occur and is carrying schedule contingency for any amounts of schedule delay or  
18 productivity challenges that cannot be fully mitigated.

Darlington Nuclear Refurbishment Program

Unit 2 Execution Estimate (U2EE)  
**RQE Oversight Closeout File**  
**NK38-REF-09701-0614139**

During RQE various Oversight groups such as KPMG, Modus as well as OPG performed oversight activities. Findings were recorded in reports:  
NK38-REP-09701-0568865 OPG DNRP - Independent Estimating Review Services - Consolidated Main Report - November 6 2015 FINAL  
NK38-REP-09701-0564969 RQE Quality Assessment Report  
Modus RQE Assessment Report Final r1 Executed

As part of U2EE, a comprehensive review of the RQE oversight reports was performed by Planning & Controls. As part of the review process, a consolidated listing of observations & recommendations was developed in MS Excel in order to categorize and provide referencing of common and/or duplicative observations. Further reviews with multiple Functional owners and project subject matter experts ensured 1.) appropriate treatment of observations and recommendations, 2.) completeness of the scope of actions and traceability to duplicative and common items; and 3.) appropriateness of actions based on the plan for Unit 2 cost/schedule/risk finalization.

This MS Excel file contains the consolidated listing of action closeout.

Confidential

Oversight Closeout Spreadsheet

Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE	
<a href="#">5984</a>	<a href="#">MODUS 1</a>	Gary ROSE	Lindsay GREENLAND	Construction management metrics and systems for tracking progress of the work are currently only conceptual and should be tested and proven; this is particularly important for the RFR reactor face Series work which is presented in the schedule at only a row-by-row level of detail. A significant amount of development time is being spent on metrics for measuring the plan creation and planning effort and not enough on the work performance metrics. On projects across all phases of work, increased focus is needed to align construction metrics with schedule performance for more predictable outcomes. For RFR work, the gap year activities, or rehearsals, taking place on the mock-up should be utilized to test the metrics and systems – providing confidence in the ability to accurately track performance and update the schedule utilizing these systems; OPG should consider measuring performance on the rehearsal activities like a “mini” retube outage, utilizing all necessary systems, processes, procedures, and metrics necessary to accurately reflect progress and performance. An effort is already underway to address the need for Earned Value metrics from a previous report. These actions are in addition to and in support of this program.	See RMO Link	REPORTING	An Integrated Reporting Plan is in development. This plan will identify the various reporting elements for NR from tactical reports to Executive and Shareholder reports. IRP structure has been presented to NPET, and comments are being incorporated. Strawmodels for critical reports are being generated. This includes commodity, resource and cost tracking.	CLOSED
<a href="#">5979</a>	<a href="#">MODUS 2</a>	Gary ROSE	Derek MCAULEY to Karen Fritz Feb 15th	The DR Project Team is currently in the mode of planning and detailing DR Project pre-requisite work in both the Asset Suite (AS7) and P6 and is adhering to the MA-0022 procedure during this process. This process contains a significant number of steps to get through the entire planning process and is requiring significant time and dedicated resources to complete. The planning processes in MA-022 appears to be more for individual on-line maintenance activities, rather than project planning. MA-0013 is more in line with what we would expect for projects such as the Campus Plan and DR Projects. We have concerns that the DR schedule cannot be completely developed in a timely manner utilizing this process and having less than a year until breaker open. DR Program Outage Management is recommending that MA-0013 become the procedural guidance utilized to complete the prerequisite planning process. Making this change would require significantly less time and resources to complete and is better suited for the scope of work being planned. We are in agreement with this guidance change and believe the DR Program team should be supported in their desire to change the process.	See RMO Link	WORK CONTROL AND PLANNING	Modus is correct - the U2 Refurbishment Projects were not planned far enough in advance to an established, rigorous process to ensure readiness. Each Project Team has been using the MA0022 Process (Station Online readiness process) for their projects. Due to the magnitude and volume of preparation work in the Unit 2 'proper' that is following a project deliverable milestone set, the Prerequisite milestones are different for each prerequisite project. This is a significant lesson learned for Unit 3 and will be incorporated in the preparation milestones for that Unit by the Director, Unit 3 and the Project Office. The Unit 2 Director has put a dedicated Prerequisite Project Team in place, led by a Manager and supported by 3 WCTLs and the PCC. It is too late at this time for Unit 2 to introduce the MA0013-style milestone set to the Prereq projects, however, the team is tracking all deliverables for all 53 windows in a report card and weekly & daily readiness meetings with the project teams. The team is tracking progress and keeping action logs for outstanding deliverables, together with the Construction department, to ensure all deliverables are met. The Prereq Team is tracking a 'readiness' milestone for each project. This team will be in place until Unit 2 Breaker Open. The team has introduced a protocol with the station, provided a T-X weekly meeting schedule and Terms of Reference for each meeting. The project teams are attending meetings and following the expected process. MA-0013 is not a Refurbishment document, therefore it will never be the document of reference on Refurbishment for any work. N-MAN-10005 is being rewritten to reflect the current reality and processes and will continue to evolve until the Unit 3 milestones are established at a detailed project deliverable level. -10005 includes more that MA-0013 due to the EPC	CLOSED
<a href="#">5978</a>	<a href="#">MODUS 3</a>	Gary ROSE	Derek McAuley	Currently, there are too many milestone constraints causing artificial critical paths that only impact downstream activities inside that specific project and have no visible external impact to the DR Project as a whole. These artificial critical paths could be diverting attention away from other areas of the project that require greater focus. This is of immediate concern in the Campus Plan projects where we have observed constrained finish dates and other critical milestones. For Revision C to be considered a success, a critical path must be generated that is repeatable, has no hard constraints and is traceable through the project from beginning to end. This includes for the critical Campus Plan project schedules (EPG3, D2O and RWPB). Secondary and tertiary paths must possess the same qualities. A concerted effort is required to determine whether these paths should be showing as critical or whether a management decision or schedule adjustment can be made to take attention from those paths. The outage planning team is currently focused on this exercise for the outage schedule, but management needs to understand the paths through the prerequisite phase as well. The exercise of removing the hard constraints and identifying the paths through the pre-requisite phase must be the priority because of the number of paths that could affect breaker open and other near-term milestones.	See RMO Link	SCHEDULE	All Campus Plan milestones constraints are turned to soft constraint (allows the milestone to move with the logic), two remaining hard constrained milestones are linkages to Refurbishment Execution Windows for the D2O Storage to identify Ready to Accept PHT Water.  A weekly Milestone Constraint Report has been generated to monitor all hard constraints added to Campus Plan and Refurbishment projects.	CLOSED

Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPONSE
<a href="#">5977</a>	<a href="#">MODUS 4</a>	Gary ROSE	Carlos BARRIOS	The DR Team has chosen to utilize a new cost management platform supplied by EcoSys. The DR Team needs to have a detailed written plan for implementation of the new system that is mindful of: The reasonable amount of time implementing the new system will require; The need to maintain parallel systems until the new system is functioning; Changes in metrics and reporting that are likely to occur.	See RMO Link	COST	The plan to implement Ecosys has been approved and the vendor, discussed by OPG and approved internally by the CIO and the VP of Planning and Control. The implementation will be done by phases (phase 1, 2 and 3) and the first phase will be completed by April 29, 2016 according to the plan. Ecosys is successfully placed in service with improvements and optimizations being identified by users and implemented.
<a href="#">5975</a>	<a href="#">MODUS 5</a>	Gary ROSE	Lisa REN	The RQE process has been a rigorous effort. Often in such situations, the bases and justifications for decisions are not well documented. Impact estimate values and ranges can play a role in future budget management matters and in dealing with challenges from external (and internal) sources. Individually, the bases for such numbers may not be important. However, the overall quality of the program may be challenged if justifications for input values are weak or non-existent. Establish simple criteria for documenting the bases for input values such as qualitative risk impact values and ranges. Review the Contingency input sheets to assess the quality of reasonableness and defensibility of justifications; and address inadequate basis documentation where appropriate. This must be accomplished while the personal source of the input is available. Ensure that justification is well documented for applying correlation, calculating burn rates, and other similar matters. With respect to contingency, quantitative cost impacts of discrete risks have been generated by project and functional teams and managers. Many were developed in the accelerated process of creating contingency input for RQE. Because of time constraints, inputs may not have received a rigorous independent review. The effect of this on the	See RMO Link	RISK	Steps are now in place based on the recommendations from Modus.  1. Established a simple criteria for documenting the basis for input values such as qualitative risk impact values and ranges. Risk personnel have provided a shelf check list to Risk Initiators to use when doing a monthly review of existing risks. 2. The Risk team continues to review the QUALITY of reasonability and defensibility of justifications; and addressing missing rationale by having the initiator provide further details where they were required. 3. Independent review was completed by the RISK review team off all submitted for contingency risks both prior to RQE deadline and ongoing by the Risk team staff. 4. More formal project team reviews took place in preparation for the U2 EEE Milestone to review material changes to contingency flagged risks. · Work closely with CCB process, to reconcile contingency withdraws to risks · Work closely with Risk SPOC to update Post RQE risk impacts, and monitor new risks impacts via defined template · Post –RQE contingency inputs files are set up and were reviewed in preparation of U2EE. · Scheduled challenge meetings executed. · Palisade consultant was onsite for May-Jun on–site visit and provided ongoing
<a href="#">5970</a>	<a href="#">MODUS 6</a>	Gary ROSE	Robert OBERTREIS	The ramp-up of qualified estimators for RQE resulted in acquiring estimators from multiple companies who were unfamiliar with OPG procedures and standards. By relying on outside resources with varying skill sets, the learning curve for outsiders was much steeper than it should have been. Moreover, OPG will need to maintain the estimating function through the Unit 2 Execution Phase and prepare for subsequent units. Continuity will be more critical for future estimating efforts. For the Unit 2 estimate and subsequent unit estimates, OPG should consider cost estimating a function worthy of permanent staffing and consider long-term retention of resources. The work of the estimating team could reasonably expand to evaluating the results and lessons from Unit 2 for subsequent unit estimates.	See RMO Link	ESTIMATING	A planning effort for establishing Nuclear Projects Estimate Centre of Excellence is underway. Insofar as NR, evaluation of staffing is in progress with submission of resource requirements to resource management group. Key positions including estimating leads and an analyst for the iTWO estimate software are part the requirements. Ongoing requirements are being planned based upon Nuclear Projects organizational development. U2EE was successfully completed with continuity of the same resources that supported RQE development. This was a benefit in understanding and familiarity with scope and vendors.
<a href="#">5969</a>	<a href="#">MODUS 7</a>	Gary ROSE	Robert OBERTREIS	The RQE cost data resides in the Master Consolidated File (MCF), which is a series of excel spreadsheets with few controls around the data and its traceability from point A to point B during development of the RQE. It also appears the spreadsheets were not password protected during data assembly. Our understanding is US Cost is being modified for the purpose of centralizing inputs to the Unit 2 estimate. For the Unit 2 estimate, OPG should consider a standardized cost system platform that deters use of manual intervention and has data security controls and version controls in place.	See RMO Link	INTEGRATION	iTWO estimating software has been selected as standardized system with implementation in progress. <b>All U2EE estimates are stored in iTwo.</b>
<a href="#">5968</a>	<a href="#">MODUS 8</a>	Gary ROSE	Robert OBERTREIS	The DR Team did not complete all of the deliverables or reach the maturity level for all aspects of the control budget that were planned. With the completion of the RQE, the team should consider using lessons learned from the RQE effort to develop a comprehensive Plan for estimating Unit 2. The DR Team's Unit 2 Estimating plan should clearly identify assignments and accountabilities across the full organization. The schedule for reviews and NPET involvement should be worked out well in advance with the goal for all deliverables to be provided (minimum) 3 days ahead of time). Time, location and extent of reviews should consider the engagement needed from senior management. NPET should also provide feedback to the Project Controls team regarding the materials used for the NPET presentations and any future changes that could improve the future review cycle. Include the requirements for Quality Assessment and reporting requirements including: reference to an assurance plan and systemic monitoring of QA during preparation of the estimate. Provide an assessment of the underlying data in coordination with the BOE. Recommend that the	See RMO Link	INTEGRATION	Unit 2 Execution Estimate Development Plan developed to incorporate these comments.

Oversight Closeout Spreadsheet

Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE	
<a href="#">5966</a>	<a href="#">MODUS 9</a>	Gary ROSE	Judith WILLETTE	The DR Team should ensure that the RQE documentation needed to substantiate its decisions during development of the RQE is properly archived and available for future needs, including the unit-specific estimates and future regulatory proceedings. OPG's archiving of the documents should consider: All documents that support the RQE should be identified with a document number that is consistent with applicable OPG NR governance (i.e. NK38-NR....). The documents should be well organized in a controlled environment. The complete RQE package should include the source documentation for necessary for the traceability of all cost numbers. Once prepared, the sufficiency of OPG's system for document maintenance needs to be tested through audit/assessment.	See RMO Link	INTEGRATION	RQE documentation to substantiate decisions during RQE development is considered complete and properly archived. The attached snapshot of NK38-REF-09701-0584627 RQE Board Submission Package - Approval & Supporting Items summarizes the documents used to produce the RQE and their location. Document locations include sharepoint, and, where appropriate, Asset Suite, with the appropriate document number consistent with OPG NR governance. Source documentation for cost numbers is found in the Estimating database. The attached "RQE Board Submission Package-Approval and Supporting Items Document Structure" is a visual representation of these documents to aid in understanding the interrelationships between the documents throughout the RQE process. A summary of status notes that were made over the course of completing this Action are attached. Document maintenance within OPG is audited and assessed periodically following current OPG governance. U2EE was compiled and will be documented in the same structure in alignment with OPG records management program.	CLOSED
<a href="#">6063</a>	OPG-PR1	Gary ROSE	Robert OBERTREIS	PR1: Program Release and Estimate Planning Based on RQE lessons learned, produce a plan for the Unit 2 Project Execution Estimate that is focused on the use and integration of existing OPG business processes and tools. The plan should also explicitly address database sources, data integrity assurance, and data consolidation methodologies.	See RMO Link	INTEGRATION	The finalization of Unit 2 costs, schedule and risks is based upon utilizing the current process and tools as follows:  1. progression of the schedule from Rev B through to Rev C and Rev 0 utilized standard outage processes and primavera P6 implemented by the Refurbishment Work Management team,  2. costs are finalized: a.) using RQE as a control baseline with changes managed through the change management process and procedure; b.) integrated as part of project cost status and forecasting within the cost management tool with traceability to changes, and c.) implemented by NR Cost Management.  3. risks are updated with a contingency analysis in accordance with the standard risk processes and tools by NR Risk Management.  The plan and deliverables for Unit 2 Execution Estimate and Board Submission is recorded within action 00007276 Unit 2 Execution Estimate Process/Dates.	CLOSED
<a href="#">6064</a>	OPG-PR2	Gary ROSE	Robert OBERTREIS	PR2: Monitoring and Control To better anticipate, identify, and mitigate the types of estimate execution issues experienced in RQE, it is recommended that more structured monitoring and control mechanisms be established early in the estimating cycle. Consideration should be given to metrics development, clarity of accountabilities, standardized meeting agendas that include schedule and deliverable reviews, as well as the use of structured recovery plans for missed/threatened milestones and deliverables.	See RMO Link	ESTIMATING	The observations have been implemented as follows:  1. Plan documented within Execution Expectation and RMO Actions and rolled out to each bundle and action owner,  2. Weekly meetings with agendas and minutes,  3. RMO utilized to record deliverables and actions required to support the plan,  4. Changes to direction and plan recorded and decision documented,  5. Control mechanism in place for changes via change management process. 6. Gated process is applied to finalize and baseline the plan for ongoing monitoring and performance measurement.	CLOSED
<a href="#">6065</a>	OPG-PR3	Carlos Barrios	Gary Rose	PR3: Process Integration In addition to planning for integration, the project management processes, including scheduling, cost management, change control, gating and estimating need to be integrated to support a consolidated program estimate. <b>It is recommended that a process review be performed</b> and that the requirements and mechanisms for process integration to achieve a program release estimate be documented and communicated to relevant participants and stakeholders.	See RMO Link	INTEGRATION	<b>For Process Integration, Work Package coding is the unique identifier for Refurb project control system, cost is estimated in iTwo and the dates will planned in P6 and Ecosys will marry the two together, through common works packages. Also, collaborative approach has been considered to improve the communication between participants and stakeholders.</b> Now that the Gated Process has been roll out to all Nuclear projects, a follow up audit will be done in all PP&C processes and governance to ensure:  1) Alignment and Integration to the Gated Process  2) Alignment and Integration to PM Standard 0028  3) Alignment and Integration among all processes	CLOSED



Oversight Closeout Spreadsheet

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<a href="#">6066</a>	OPG-PR4	Gary ROSE	Robert OBERTREIS	PR4: Estimate Source With the evolution of Cost Management and Estimating software, the future source of the program estimate, and any required transition plan, are not currently defined. There needs to be clear direction regarding the estimate source prior to the start of the Unit 2 Project Execution Estimate cycle, supported by a change management plan.	See RMO Link	ESTIMATING	Refer to response to item 5969 for details on estimate source and management for U2EE.	CLOSED
<a href="#">6067</a>	OPG-PR5	Lisa REN	Estimating Group/Risk Group (Donna Flewell)	PR5: Integrated Action Plan It is recommended that DNRP management develop a comprehensive action plan, including target completion dates, that addresses the findings of this assessment, those of the Independent Estimating Review as well as any other internal and external oversight reviews. This action plan should be incorporated into the Unit 2 Project Execution Estimate Plan.	See RMO Link	INTEGRATION	This Matrix outlines the response to this action. All identified actions were added to RMO tool for tracking as listed in Memo NK38-REP-09701-0575373, dated December 17, 2015. RQE Observations and Lessons Learned Matrix was finalized and select items updated to reflected status after development and approval of U2EE.	CLOSED
<a href="#">6069</a>	OPG-SR1	Gary ROSE	Robert OBERTREIS	SR1: This assessment report has not evaluated Class 4 & 5 Project estimates. Recommendation that these become Class 3 estimates and schedule before 2016 Unit 2 execution.	See RMO Link	ESTIMATING	The Unit 2 EE included progression of estimates from \$265M in Class 4/5 estimates at RQE to \$80M for the U2EE. This represents a very small percentage of the \$12.8B program. The Gated Process will ensure all project > AACE class 3 in line with regular project progression independent of the Unit 2 Execution Estimate Approval.	CLOSED
<a href="#">6070</a>	OPG-SR2	Gary ROSE	Robert OBERTREIS	SR2: Recommendation that OPG Estimating Team evaluate Campus Plan's existing projects "most likely" estimates and schedules to avoid project delay and vendor potential claims in the future.	See RMO Link	ESTIMATING	Significant management effort and involvement with estimating support underway on an ongoing basis to support the performance evaluation of Campus Plan projects. The final approved estimates to complete (i.e. forecasts) were included in the Unit 2 Execution Estimate, these forecasts were informed by updated project schedules.	CLOSED
<a href="#">6072</a>	OPG-SR3	Gary ROSE	Robert OBERTREIS	SR3: Recommendation that an overall cost reduction analysis strategy be incorporated within the estimate planning.	See RMO Link	ESTIMATING	RQE Utilized N-MAN-00120-10001-EST-03 NR Project Estimate Oversight, Review and Validation that leverages a detailed line by line cost review for the purpose of cost reduction opportunities (as well as under-estimates) with a comment & disposition process to ensure traceability to items identified and their dispositions to ensure the cost estimates are appropriate and accurate within the range defined by their estimate class.  Insofar as supporting cost reductions, OPEX, metrics and ratio's are utilized where applicable and where enough basis exists to support comparative analyses.  EST-06 provides commodity code standards from which to perform benchmarking and comparative analyses.	CLOSED
<a href="#">6073</a>	OPG-SR4	Gary ROSE	Ryan Smith	SR4: Develop an enhanced utilization of benchmarking by senior management. It is recommended that DNRP senior management effectively incorporate benchmarking checks as part of their vetting and review process.	See RMO Link	INTEGRATION	The recommendation to incorporate benchmarking checks as part of DNRP senior management's vetting and review process will be added as an action for addressing within the Project Excellence Initiative as one of the improvement initiatives specific to NR that will be applied to the Unit 3 Release Quality Estimate. OPEX from previous refurbishments was a fundamental component of both the RQE and Unit 2 Execution Estimate. Expansive OPEX review was incorporated into the RFR Class 2 Estimate that was used for the RQE and U2EE. The related proposed initiative deliverable is: Common knowledge base comprising industry best practices, processes and tools. Include the use of benchmarking. Target end Q2 2017. Ref RMO action #7790.	CLOSED
<a href="#">6074</a>	OPG-SR5	Gary ROSE	Robert OBERTREIS	SR5: Cost and Resources Reconciliation - Cost Estimate Breakdown and Schedule resources man-hours require reconciliation in a manner that is easy and efficient. The Recommendation is that estimating and scheduling demonstrate further detail to support BOE described, e.g. labour hours, labour rates, labour productivity in each WBS item, nuclear labour factors, shift, etc.	See RMO Link	ESTIMATING	Standard for Basis of Estimate, N-MAN-00120-10001-EST-04, specifies required basis details including labour hours, rates, and productivity factors etc., and the data structures are implemented as part of ECOSYS and iTWO systems and will now be at the Work Package Level.	CLOSED
KPMG	7.2-1	Robert Obertreis	Robert OBERTREIS	Project Cost Classifications (i.e., refurbishment vs. maintenance work): Build an OPG owned bottom up estimate without "non-refurbishment" scope items – a detailed review will likely lead to identifying cost reduction opportunities.	Finance review of classification of work will be included as part of RQE	INTEGRATION	Thorough review of O&M scope was performed between RQE and U2EE, resulting in revisions to Ops and Maint budgets and classification of NR scope to Cyclic/Maint scope, and adjustments were made accordingly. Ops increased (vis CCF) and program is still awaiting reduction of Maint scope for items deemed DO (Darlington Outage/cyclic funded). FMP's, and bases updates are in Action tracking and being coordinated by Art Maki and our PP&C teams.	CLOSED
KPMG	7.2-2	Robert Obertreis	Robert OBERTREIS	Opportunity for Owner Oversight Optimization: Improve collabouration between Project Managers and Functional Team leaders to identify optimization and streamlining opportunities within the functions to optimize program wide functional costs.	Phase 1 functional review complete. Phase 2 functional review by December 2015.	INTEGRATION	Continued integration and collaboration has occurred since RQE, to revise Functional group estimates and resources deemed necessary to execute Unit 2. CCF's have been processed as part of the U2EE estimate updates. Many functions increased in cost (+65mil for U2), however current and projected under-spends (\$40mil as of June 2016) were identified. Unit 314 resources for OPG functions will be evaluated mid-Unit2 execution. FMP's are currently being updated, with a plan completion (in Action Tracking) mid-September	CLOSED

Oversight Closeout Spreadsheet							
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KPMG	7.2-3	Robert Obertreis	Estimating Group	Increase Project Manager Accountability by ‘Projectizing Functional Costs’: Create short-term goals, clarify accountabilities and define intermediate steps to help drive the RQE schedule.□	Within each bundle/function, list the responsible persons for the overall project execution plan, cost estimate, and schedule	INTEGRATION	Management has determined that this is not the approach that will be taken on the NR Program. Again, FMP’s with responsibilities and deliverables mapped staff positions are underway, FMP’s are to be a new item a in action tracking.
KPMG	7.2-4	Robert Obertreis	Estimating Group	Consistency of Indirects’ Classification: Clarify the definitions for project indirect costs and functional indirect costs. In addition, functional team leaders need to know what level of support is required by the bundles.	Provide a more consistent definition of indirect costs classification.	ESTIMATING	For estimates submitted by contractors for RQE and previous releases, the structure of costs, including the composition of indirect costs has been governed by existing contracts and contractor standard operating procedures and, for specific estimates, documented within the BOE’s. To establish consistency, the categorization of cost items is set out within the estimating standard N-MAN-00120-10001-EST-06 Nuclear Refurbishment Estimate Commodity Code Standards .
KPMG	7.2-5	Robert Obertreis	Estimating Group	Improve visibility on the maturity of the estimates: Implement IDB to increase transparency with respect to the status of estimates.	Create a tracking document to show the status and version of each estimate/ schedule to be included in RQE.	ESTIMATING	Tracking of estimate classification is performed within iTWO and documented using estimate checklists per estimating and gating governance. Schedule Level is assigned per schedule management governance and checklists. Reporting of estimating and scheduling status is performed as part of management reporting processes, meetings and action tracking.
KPMG	7.2-6	Ryan Smith		Cost Risk Sharing- ESMSA: Ensure that the RQE fully evaluates, quantifies and includes the risk of overruns for current ESMSA contractors.	Demonstrate how historical campus plan cost overruns with ESMSA have been taken into account when calculating contingency in risk analysis for BOP and SDLU projects, ensure contingency analysis includes experience of ESMSA contractors.	RISK	The risk analysis for the RQE includes substantial cost estimating uncertainty and discrete risk contingency, both at the project and program level associated with ESMSA work. This was true for RQE and is further reinforced with increased ESMSA performance cost contingency for U2EE.
KPMG	7.2-7	Ryan Smith		Contract Risk Sharing- Joint Venture EPC: Incorporate scenario analysis of the risk of OPG borne cost overruns based on the terms of the contract into the contingency.	Incorporate scenario analysis of the risk of OPG cost overruns based on termof the contract into the contingency RFR	RISK	This was included in the schedule analysis for RQE. Risks related to OPG imposed delays on the contractor were assessed by OPG leadership and included where appropriate with a schedule impact and associated contingency assigned to this type of event.
KPMG	7.3- PCC#1-1	Robert Obertreis	Robert OBERTREIS	Owner estimate requirement including accuracy and review/approval timing.	RQE Management plan does not reference timing of reviews/approvals.Provide a cross-reference in RQE MP to the latest version of the RQE Roadmap. This cross-reference has been provided in the RQE MP (rev 2), which needs to be approved and issued.	ESTIMATING	Part of lessons learned for next unit RQE. NK38-PLAN-09701-10235 RQE Cost Estimate Development Plan, provided the scope, roles and responsibilities across the organization for the estimate development efforts. Included within the plan were roadmaps that outlined the timing of each bundle's progression and integration into overall RQE. The nature of finalizing Unit 2 cost, schedule and risk deliverables differs from RQE in that RQE was a bottoms up cost estimate development effort to establish the program's control budget and Unit 2 is a confirmation of RQE using standard project controls and change management processes. As such, the Unit 2 effort and deliverables is captured and monitored using RMO Action Log starting with Action ID 7276 which provides the framework for completing U2EE and subsequent actions for each P&C functional area. The U2EE was assembled and approved by the board of directors in August 2016. Prior to execution of Unit 2, all projects will go through Gate 3A to be baselined for performance and ongoing monitoring.
KPMG	7.3-PCC#1-2				Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PCC#1-3				Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PCC#1-4	Robert Obertreis	Robert OBERTREIS	Review meeting with key stakeholders	Key stakeholders are not identifiedRevision to Terms of Reference (“TOR”) needs to be issued. Reference s.2.0. NK38-REF-09701-10005-R0. Also update RQE MP s1.2. (only references "senior management"), and review process and expected meeting date deadlines are not currently being followed.	ESTIMATING	Refer to NK38-PLAN-09701-10235 RQE Cost Estimate Development Plan which provided the scope, roles and responsibilities across the organization for the estimate development efforts. Included within the plan were roadmaps that outlined the timing of each bundle's progression and integration into overall RQE, including management and stakeholder reviews. Within Unit 2 cost/schedule/risk finalization efforts, the stakeholder reviews have been scheduled in advance and materials "template" using the process that was taken in RQE as a starting point. This effort was successfully completed for both RQE and Unit 2 EE.
KPMG	7.3- PCC#2-1	Robert Obertreis	Robert OBERTREIS		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PCC#2-2				Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PCC#2-3				Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PPC#2-4	Derek McAuley	Derek McAuley		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PPC#2-5	Robert Obertreis	Robert OBERTREIS		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PPC#2-6	Robert Obertreis	Robert OBERTREIS		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PPC#2-7	Robert Obertreis	Robert OBERTREIS		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.

Oversight Closeout Spreadsheet							
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KPMG	7.3-PPC#2-8	Tracy Leung	Tracy Leung	Estimate material is filed and maintained according to the WBS	WBS in which the program estimate has been presented to date requires further definition of the controls accounts in order to be effectively used as a control budget for execution purposes (i.e. tracking construction performance and measuring cost variances). Ongoing activities to further develop the control accounts and design a full CBS (Cost Breakdown Structure) prior to execution. An intermediate level WBS is also being developed (control accounts). These control accounts should be refined through 2016 and prior to commencement of the US outage as the estimate continues to evolve and gain maturity/increased definition.	ESTIMATING	The estimating detail is being recorded in alignment with the WBS, and is aligned at the project number level. Ongoing efforts to align to the PEPCCC and work package level is underway but is not 100% complete for Unit 2 EE board approval. This is a requirement for projects to progress through Gate 3A which all projects must pass through by September 30th.
KPMG	7.3-PPC#2-9	Robert Obertreis	Robert OBERTREIS	Bulk Commodity Material Quantities	Produce a program level PEP, or equivalent document, and update the program document to include aEstimating plan will be updated for the RQE Check Estimate to specify more clearly the requirements around material quantity estimates and ensure progression of current estimates that have not achieved class 3. The PM's can update the PEP's if they do not include the detailed contracting strategy, or the PgMP for the contracting strategy could be updated to reflect quantity estimates and the status of the RQE. summary of the contracting strategy.	ESTIMATING	A check estimate is not being performed and this suggestion forms part of lessons learned for next unit RQE. Projects that did not pass through a gate 3 nor completed class 3 estimates at the time of RQE are progressing towards Class 3 estimates and gate 3's utilizing estimating and gating process/governance. Bundle Project plans are a pre-requisite to progressing through gate 3 and functional management plans are refreshed as part of Unit 2 finalization.
KPMG	7.3-PPC#2-10	Robert Obertreis	Robert OBERTREIS	Bulk Material Quantity Take-Off Allowances (Design Development Allowance)	OPG, in conjunction with scope reviews by project teams, are vetting the EPC Contractors' material quantity estimates and the design development allowance to improve the quality of the final estimate produced, it is important for the EPC Contractor to follow AACE recommended practices (i.e., describe the rationale for estimate allowances in relation to the level of engineering definition) to promote transparency in how the quantity estimates were developedEstimating plan will be updated for the RQE Check Estimate to specify more clearly the requirements around material quantity estimates and ensure progression of current estimates that have not achieved class.	ESTIMATING	Basis of estimates address design basis, allowances and utilization of assembly level and quantities. Almost all of submitted class 3 estimates have Bulk Material Quantity Take-Off Allowances
KPMG	7.3-PPC#2-11	Robert Obertreis	Robert OBERTREIS	Bulk Material Construction Waste Allowances	OPG, in conjunction with scope reviews by project teams, are vetting the EPC Contractors' material quantity estimates and the construction waste allowance to improve the quality of the final estimate produced, it is important for the EPC Contractor to follow AACE recommended practices (i.e., describe the rationale for estimate allowances) to promote transparency in how the quantity estimates were developed.Estimating plan will be updated for the RQE Check Estimate to specify more clearly the requirements around design allowances and ensure vendors provide clear rationale on the use of design (and other) allowances.	ESTIMATING	For most of the U2EE projects, wastage allowance is included in the material quantities, this has minor affect on the total cost.



Oversight Closeout Spreadsheet								
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE	
KPMG	7.3-PPC#2-12	Robert Obertreis	Robert OBERTREIS	Bulk Commodity Material Pricing	OPG, in conjunction with scope reviews by project teams, are vetting the EPC Contractors' material pricingto improve the quality of the final estimate produced, as well as keep audit ready records of this relevant information it is important for the EPC Contractor to follow AACE recommended practices and provide a table that summarizes the source of the pricing information (i.e, budget quotes, firm quotes, in-house estimates, etc.) to promote transparency.Estimating plan will be updated for the RQE Check Estimate to specify more clearly the requirements around material pricing estimates and ensure vendors provide clear support for pricing.	ESTIMATING	All the BOE have a section for material pricing and all the pricing sources have been attached as appendices. This suggestion(adding a table) forms part of lessons learned for next unit RQE	ALL FOR UNIT 3 RQE
KPMG	7.3-PPC#2-13	Robert Obertreis	Robert OBERTREIS		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.	CLOSED
KPMG	7.3-PPC#2-14	Robert Obertreis	Robert OBERTREIS	Freight	OPG, in conjunction with scope reviews by project teams, are vetting the EPC Contractors' freight costs to improve the quality of the final estimate produced, as well as keep audit ready records of this relevant information.BOE will reflect the basis of costs re: field engineering costs identified. EPC Contractor should also follow AACE recommended practices and identify the cost and pricing sources for foreign and domestic freight.	ESTIMATING	Basis of Estimate template has been revised to specifically address Freight within the contents, <b>most of the revised estimate has item for Freight</b> . A table also has been added to include all line items that are subject to Currency Exchange rates.	CLOSED
KPMG	7.3-PPC#2-15	Robert Obertreis	Robert OBERTREIS	Adjustments to productivity for labour density	The Work Management Function is analyzing logistical issues and scope interfaces around RFR. Any labour density issues would be considered by Work Management. In addition the RFR function should review how this has been considered in the estimate. Estimating plan will be updated for the RQE Check Estimate and will specify the productivity plan as required by OPG governance	ESTIMATING	The effort to identify conflicts and optimize resourcing is undergone through Schedule Integration Development and the progression of the integrated schedule from Rev bravo, Charlie and through to Rev zero (final unit execution schedule). Through the work package assessing and schedule progressions, any changes to the vendor's execution plan is initiated through the change management process. There are no "factors" applied to adjust productivity plan for labour density.	CLOSED
KPMG	7.3-PPC#2-16	Robert Obertreis	Robert OBERTREIS	Adjustments to productivity for excessive shifts	The final shift schedules need to include in the Project Execution Plan, or equivalent document. It is assumed that this change is being incorporated into the schedulesReview PEP (or equivalent document) to ensure the relevant information is included. Align, summarize and make visible the relevant information.	ESTIMATING	The shift patterns utilized as basis for the work execution are recorded in the basis of estimate for each project submission and verified through the estimate review process. Shifts are reflected within the execution schedules. Any change in shifts during the finalization of planning and Unit 2 execution cost/schedule, will initiated through change management process.	CLOSED
KPMG	7.3-PPC#2-17	Robert Obertreis	Robert OBERTREIS	Description of the base productivity calculation	Productivity Plan has not been identified. But it is a document required by OPG governance. This should be specified in the RFR Rev B schedule because it is the integrated, resource loaded schedule all the way through to breaker close to be validated when issued. BOE will reflect the basis of costs re: productivity calculations.	ESTIMATING	RFR BOE reflects cost basis and productivity factors utilized and agreed upon. Refer to; 509407-0000-00000-33RA-0168	CLOSED

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Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE	
KPMG	7.3-PPC#2-18	Robert Obertreis	Robert OBERTREIS	Indicate the construction work week basis and applicable shift schedules (i.e.: 8 hours per day x 5 days per week.)	The final shift schedules need to include in the Project Execution Plan, or equivalent document. It is assumed that this change is being incorporated into the schedules.Work week basis will depend on the contract. However, all the work week and shift schedule should be incorporated into the Rev B schedule and will be validated when issued. The shift schedules need to be included in the PEP.	ESTIMATING	The construction work week basis is i1ncorporated into Rev B schedule. Recent move to 5x8s from 4x10s was considered and assessed for Unit 2 execution estimate, impacts are expected to be marginal both on cost and productivity. Negligible impact on Unit 2 EE costs.	CLOSED
KPMG	7.3-PPC#2-19	Robert Obertreis	Robert OBERTREIS	Identify how commissioning and start-up costs are determined	The AACE guidelines specify that an explanation of how commissioning and start-up costs will be determined should be provided, and a brief description of the related scope is required. KPMG has not seen adocument that states how the commissioning and start-up costs are to be determined.Estimating plan will be updated for the RQE Check Estimate to specify more clearly the requirements around commissioning and start up detailed estimates as a progression from current functional estimates. OPG hascommissioning specs for all systems and return to service procedures and this would govern activities and the associated estimate.	ESTIMATING	Estimate submissions covered by Execution Functional Management Plan and the O&M Return-to-Service organization. Commissioning conducted by OPG Operations and supported by contractors whom have submitted commissioning support costs as part of estimate submissions based on agreed to support requirements. OPG direct commissioning efforts developed as part of work package assessing deliverables.	CLOSED
KPMG	7.3-PPC#2-20	Robert Obertreis	Robert OBERTREIS	Show how the engineering labour plans are built-up	As part of the Planning documents there is no staffing plan. There are higher level figures that cover the overall staffing. As noted about each of the FMP and PMP have their own staffing requirements included in their respective documents but there is no global document. Project managers are not responsible for the staff that is being applied to the job as the cost resides elsewhere.Verify engineering labour plans within functional estimates.	ESTIMATING	Staffing plans, organizations and FMP's, providing the basis of which have been submitted, reviewed and approved through Senior Management. All changes from RQE have been collated and documented using the change management process.	CLOSED
KPMG	7.3-PPC#2-21	Robert Obertreis	Robert OBERTREIS	Identify how other office costs and fees will be covered.	The individual projects are not being charged for G&A costs. This is not a construction industry best practice.Identify home office cost treatment	ESTIMATING	Treatment of G&A and fees are negotiated as part of each vendor's contract and the ESMSA.	CLOSED
KPMG	7.3-PPC#2-22	Robert Obertreis	Robert OBERTREIS	Identify the intended sources of benchmark data	RFR and other bundles have incorporated some benchmark data and OPG has several benchmarking documents, but missing direct sources of how benchmark data will be found and compiled into a report to support the program.Continue to benchmark direct costs against similar projects where meaningful comparatives are available.	ESTIMATING	Completed for RQE. Main source of benchmarking data is OPG's OPEX and historical work orders within Passport. Refer to item response for 6073 for more detail.	CLOSED
KPMG	7.3-PPC#2-23	Robert Obertreis	Robert OBERTREIS		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.	CLOSED
KPMG	7.3-PPC#2-24	Robert Obertreis	Robert OBERTREIS		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.	CLOSED
KPMG	7.3-PPC#2-25	Robert Obertreis	Robert OBERTREIS		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.	CLOSED
KPMG	7.3-PPC#2-26	Robert Obertreis	Robert OBERTREIS		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.	CLOSED

Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE
KPMG	7.3-PPC#2-27	Robert Obertreis	Robert OBERTREIS		Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PCC#3-1	Robert Obertreis	Robert OBERTREIS	BOE Purpose	Cost Estimating professionals need the BOE in order to understand and assess the estimate itself. In addition, the BOE is a record of communications and record of documentation utilized to prepare the estimate. More importantly the BOE should contain a greater level of detail for brownfield projects than for greenfield projects, and the larger the project, the more detail it requires. The BOE is also a legally supporting document. AACE specifies that this section should contain a brief and concise description of the total project (i.e. type of project, Scope, overall timing etc.). The purpose section does not clearly summarize the total project, which makes it difficult for the reader / reviewer to understand the context of the BOE. OPG is producing a Program level Basis of Estimate which will consolidate assumptions and project level basis of estimates from all projects into a comprehensive Program level Basis of Estimate. This will continue to be updated as project level estimates and basis of estimates are updated. A first	ESTIMATING	Program, Project Bundle and Functional BOE's aligned to AACE. The size, complexity and organization of the DRP has led to a portfolio of projects aggregated to twelve project bundles and twelve functional bundles. Within the twelve project bundles, there are approx 86 projects that relate to physical work in the field, each of which if not already completed as part of infrastructure projects, have a basis of estimate that was submitted for RQE along side the cost estimate itself. The objectives stated within this finding has been fulfilled by each project estimate and basis of estimate submission - as example, RFR Estimate and BOE submission comprised in excess of 55, 000 pages and 28 Chapter Reports that articulate the basis of the estimate. Additionally, the BOE's and estimates were reviewed in accordance with the estimating governance before acceptance. The nature of the number of projects has made it challenging to aggregate information in a manner that is consumable in "one sitting"; as such, the program BOE has relied upon referencing other documentation while providing enough context to provide the overview of the program. As an improvement, each bundle will have a Unit 2 BOE that will summarize that bundle and contribute to the overall Unit 2 BOE.
KPMG	7.3-PCC#3-2	Robert Obertreis	Robert OBERTREIS	BOE Methodology	Nuclear Projects Estimating Manual, N-MAN-00120-10001-EST-R002 provides the requirement for Basis of Estimate and a template within App C. This was rolled out through supply chain to the ESMSA contractors coordinated through the bundles and project management.Program Basis of Estimate is prepared and finalized upon completion of the estimate development process.	ESTIMATING	No Action taken. Program, Project Bundle and Functional BOE's aligned to AACE requirements and best practices.
KPMG	7.3-PCC#3-3	Robert Obertreis	Robert OBERTREIS	Estimate Classification	Identified as Closed in KPMG Final Report. No Recommendations Identified.	ESTIMATING	Identified as Closed in KPMG Final Report. No Recommendations Identified.

Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE
KPMG	7.3-PCC#3-4	Robert Obertreis	Robert OBERTREIS	Design Basis	This section should identify the types and status of engineering and design deliverables that were used to prepare the estimate. In addition, the AACE guideline recommends that two attachments be provided 1.) An estimate deliverables checklist and 2.) The list of all engineering drawings. The AACE guidelines also recommends documenting specific quantity metrics such as overall piping quantities etc. Current methodology for estimate classification is Nuclear Refurbishment Estimate Classification Requirement and Assignment N-MAN-00120-10001-EST-02-R001 2015-04-01 R000 was developed in DEC 2014 and this revision per date. Will specify Purpose, Methodology, Estimate Classification, Design Basis, Cost Basis, Allowances, Assumptions, Exclusions, Exceptions, Risk and Opportunities, Containments, and Estimate Quality Assurance	ESTIMATING	No Action taken. Program, Project Bundle and Functional BOE's aligned to AACE requirements and best practices.
KPMG	7.3-PCC#3-5	Robert Obertreis	Robert OBERTREIS	Cost Basis	It is not clear as to how the functional project indirects are allocated to each bundle. Thus, it would be difficult for stakeholders to assess the actual indirect costs for each bundle. Under the current methodology, it might to unclear to stakeholders as to what are actual direct costs vs indirect costs. This section does not describe the methods and sources used for determining all material, labour, and subcontract pricing Will specify Purpose, Methodology, Estimate Classification, Design Basis, Cost Basis, Allowances, Assumptions, Exclusions, Exceptions, Risk and Opportunities, Containments, and Estimate Quality Assurance Estimating plan will be updated for the RQE Check Estimate and will establish assumptions, risks and opportunities as well as allowances and reserves.	ESTIMATING	Functional costs are allocated through individual project numbers and tracked accordingly. Program, Project Bundle and Functional BOE's aligned to AACE best practices. As this is a mega program, certain costs for centralized support are not directly attributable to one bundle or the other and fractional cost allocations to bundles cannot be practically applied.
KPMG	7.3-PCC#3-6	Robert Obertreis	Robert OBERTREIS	Allowances	This section should identify the level and types of allowances used in the estimate (i.e. Material Take-off Allowances). This section should also describe any other costs that have not been detailed in the estimate (i.e. Lump sum allowances for specific areas of scope) The program RQE BOE will specify Purpose, Methodology, Estimate Classification, Design Basis, Cost Basis, Allowances, Assumptions, Exclusions, Exceptions, Risk and Opportunities Containments, and Estimate Quality Assurance	ESTIMATING	Project BOE's and estimates have identified allowances and factors that have been reviewed in accordance with the estimating governance. Certain allowances such as small tools, consumables, rework etc are prescribed by the contracts in place (ES MSA, JV EPC Agreement etc).

Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE
KPMG	7.3-PCC#3-7	Robert Obertreis	Robert OBERTREIS	Assumptions	The AACE guidelines specify that the assumptions should be included in this section. A person who is reviewing the 4D BOE cannot make an assessment of the assumptions since they are documented in external sources outside of the 4D BOE documentThe program RQE BOE will specify Purpose, Methodology, Estimate Classification, Design Basis, Cost Basis, Allowances, Assumptions, Exclusions, Exceptions, Risk and Opportunities Containments, and Estimate Quality Assurance	ESTIMATING	Release 4D was not developed as per a fully integrated estimating effort and no formal BOE was developed. For the purpose of RQE, the templates were reviewed for Program, Project Bundle and Functional Plans that form BOE's to ensure alignment to AACE including assumptions. Additionally, an RQE assumptions log was created to ensure the capture of assumptions that formed the basis of RQE. The U2EE was a change control process that was implemented from the cost and schedule outlined in the RQE.
KPMG	7.3-PCC#3-8	Robert Obertreis	Robert OBERTREIS	Exclusions	While it appears OPG intends to meet the AACE guidelines, this section has been noted as an Area For Improvement.The program RQE BOE will specify Purpose, Methodology, Estimate Classification, Design Basis, Cost Basis, Allowances, Assumptions, Exclusions, Exceptions, Risk and Opportunities, Containments, and Estimate Quality Assurance	ESTIMATING	Although vendor BOE's have a specific topic for Exclusions, the section often refers back to assumptions where statements of exclusion have been made together with assumptions. This is an area under continual improvement and will form lessons learned for the next Unit RQE.
KPMG	7.3-PCC#3-9	Robert Obertreis	Robert OBERTREIS	Exceptions	The AACE guidelines specify that the exceptions should be included in this section or as a checklist and attachment to the BOEThe program RQE BOE will specify Purpose, Methodology, Estimate Classification, Design Basis, Cost Basis, Allowances, Assumptions, Exclusions, Exceptions, Risk and Opportunities, Containments, and Estimate Quality Assurance.	ESTIMATING	RQE Program BOE includes a list of exceptions.
KPMG	7.3-PCC#3-10	Robert Obertreis	Robert OBERTREIS	Risks and Opportunities	The AACE guidelines specify that the risks and opportunities should be included in this section and a risk analysis report should be provided as an attachment to the BOE.The program RQE BOE will specify Purpose, Methodology, Estimate Classification, Design Basis, Cost Basis, Allowances, Assumptions, Exclusions, Exceptions, Risk and Opportunities, Containments, and Estimate Quality Assurance.	ESTIMATING	A detailed RQE Contingency Development Plan and Report was prepared outlining the basis of risk and quantification of contingencies for the project bundles and the program as a whole. This has been updated for U2EE as well and is referenced in the Program BOE. Refer to Unit 2 Execution Estimate Contingency Development Plan NK38-PLAN-09701-10275.
KPMG	7.3-PCC#3-12	Robert Obertreis	Robert OBERTREIS	Reconciliation	A Program level Basis of Estimate will be prepared prior to the finalization of RQE. This document will incorporate a reconciliation of RQE against previous estimates and a summary breakdown by projects, functions, phases and major cost element.The program RQE BOE will specify Purpose, Methodology, Estimate Classification, Design Basis, Cost Basis, Allowances, Assumptions, Exclusions, Exceptions, Risk and Opportunities, Containments, and Estimate Quality Assurance.	ESTIMATING	As part of the RQE effort, reconciliations to past estimates & releases were provided and reported upon in board submissions (documented in records). The reconciliation of Unit 2 execution estimate to RQE will be part of the reporting and presentations in accordance with board and other external reporting, outlining major changes and evolutions to the project estimate. This will include base work as well as risk and contingency progressions and comparisons to RQE.



Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPONSE
KPMG	7.3-PCC#3-13	Robert Obertreis	Robert OBERTREIS	Benchmarking	While this section is incomplete and has been noted as an Area For Improvement (AFI), this section doesidentify several activities or work that will be performed in the DRP.Estimating plan will be updated for the RQE Check Estimate and will specify theproductivity plan as required by OPG governance.	ESTIMATING	A check estimate is not being performed for Unit 2 EE and this suggestion forms part of planned improvements for the next units RQE. Refer to items 6073 and 7.3PPC#2-22 for more details regarding benchmarking and future unit plans for benchmarking enhancements.
KPMG	7.3-PCC#3-14	Robert Obertreis	Robert OBERTREIS	Estimate Quality Assurance	This section appears to be incomplete and has been noted as an AFI. It references several external sources including the FMPs, Bundle Gated Documents and EPC ContractsThe program RQE BOE will specify Purpose, Methodology, Estimate Classification, Design Basis, Cost Basis, Allowances, Assumptions, Exclusions, Exceptions, Risk and Opportunities, Containments, and Estimate Quality Assurance. Estimating plan will be updated for the RQE Check Estimate and will specify the productivity plan as required by OPG governance.	ESTIMATING	A check estimate is not being performed and this suggestion forms part of lessons learned for next unit RQE.
KPMG	7.3-PCC#3-15	Robert Obertreis	Robert OBERTREIS	OPG has documentation that does identify the parties responsible for the project and function Bundles and have established an estimate review team.	The estimating team was articulated in the RQE Cost Estimate Development Plan (NK38-PLAN-09701-10235) and will be incorporated into the BOE.	ESTIMATING	No Action taken, comment is addressed.
KPMG	7.3-PCC#4	Robert Obertreis	Robert OBERTREIS	No issues noted in this section	No issues noted.	N/A	No issues noted.
KPMG	7.3-PCC#5-1	Robert Obertreis	Robert OBERTREIS	Identified team lead responsible for review process	Identified as Closed in KPMG Final Report. No Recommendations Identified.		Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PCC#5-2	Robert Obertreis	Robert OBERTREIS	Plan for Management estimate review	Estimate review is to include the accountable Project Manager, estimating manager, applicable team members and stakeholders per the PM's discretion. No mention in documentation of executive management involvement. This review process has subsequently been completed and the NPET level was included in various rounds of review.Overall program estimate reviews were scheduled to occur in late August to early Sept. This plan was included in the RQE roadmap, but should also have been incorporated or referred to in the RQE Management Plan to establish the review process and timelines at the onset of the process.	ESTIMATING	Completed per RQE roadmap and RQE Cost Estimate Development Plan (NK38-PLAN-09701-10235). The U2EE was completed in similar fashion with Estimating Plan and Risk and Contingency Development Plan NK38-PLAN-09701-10275 and Associated U2EE Roadmap.
KPMG	7.3-PCC#6-1	Ryan Smith	Ryan Smith	Scope is described with respect to the overall project plan		INTEGRATION	RQE was not an independent project bundle but rather the assembly of scope, cost, schedule, and risk information from the project bundles and functions there is no need for a specific RMP for the RQE effort. There was a specific RQE contingency development plan and contingency development report approved and issued for RQE that outlines how the risk and uncertainty products from the project bundles and functions were obtained through their application of the NR risk process, and integrated into a product for RQE.

Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE
KPMG	7.3-PCC#6-2	Ryan Smith	Ryan Smith	Provide a statement of the purpose and objectives of the project in respect to risk management, how project strategies translate into risk management, and the projects risk appetite and priorities	High-level risk strategies and reasoning have been referenced, but no update to RMO tool or updated/ consolidated N-MAN. A sample structure for linking confidence level with contingency approval is given, but no approved process is noted. Although informally the relative priorities are understood between 1. cost, 2. schedule, 3. scope, without explicit reference or direction, N-MAN users on the project may not understand the corporate risk tolerances and their reporting hierarchy, meaning senior management may not get the information they require.Incorporate new contingency development guide in the revised RQE management plan. Also include slides that describe application of N-MAN to QE. Will be verified when issued.	RISK	A process has been agreed upon to ensure the top technical risks and high impact/low probability risks are included in senior executive and corporate level reporting. This list is hand selected by the central risk management group in consultation with NPET and the CNO. This process considers risk tolerances and risk appetite of the corporation , NR Key Risk Areas, and other such considerations and will be sustained. These enterprise level considerations are above the level of detail needed in the Risk Management User Manual and in fact may distract the PMs from project risk management. The manual is currently under revision and a sentence or two referencing this may be included.
KPMG	7.3-PCC#6-3	Ryan Smith	Ryan Smith	The RM schedule shows key tasks such as planned integrations with contractors, software implementation milestones, planned qualitative and quantitative risk assessment sessions, planned quality audits, planned closeout activities.	Identified as Closed in KPMG Final Report. No Recommendations Identified.	RISK	Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PCC#6-4	Ryan Smith	Ryan Smith	The following are some potential KPIs that may be defined in this section: · treatment plans developed and approved within required time period · timing from identification to assessment and treatment · percentage of risks with action or treatment due dates being met · for risks that occurred, the severity of the actual consequence versus identified consequence	Identified as Closed in KPMG Final Report. No Recommendations Identified.	RISK	Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PCC#6-5	Ryan Smith	Ryan Smith	Address specifically when and who participates in risk meetings as well as the minimum frequency of these meetings. There could also be an extension to the overall communications matrix or have a specific risk communication risk matrix. This should indicate who should be receiving copies of reports and other risk deliverables or who just needs to be informed of them being issued.	Identified as Closed in KPMG Final Report. No Recommendations Identified.	RISK	Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	7.3-PCC#6-6	Ryan Smith	Ryan Smith	Reporting may be considered a subset of communications but it will need to address the how and when of such items as: What is to be reported; Who is to write the report(s); When is it to be issued; How is it reported; Is it meant to be a standalone report or part of an overall project report; If it is part of an overall project report, who is coordinating the overall report and when does the risk report need to be issued for inclusion.	Identified as Closed in KPMG Final Report. No Recommendations Identified.	RISK	Identified as Closed in KPMG Final Report. No Recommendations Identified.
KPMG	8.4- RFR-01	Robert Obertreis	Robert OBERTREIS	Values for DFL, Training, and Contingency in the Chapter Summary Reports do not match the overall RFR Class 2 Total Target Cost Summary Table (Table 24 of the Milestone Report).For example, for Training – Onboarding the Milestone Report states \$69,783,366 while the Chapter Report states \$74,821,394	Rev 0 ■ JV to update for these inconsistencies in the Rev.1 documentation. Rev 1 ■ Two high-level reconciliation issues still exist: The contingency cost is the same in the Milestone report and Contingency Target Cost & Target Schedule Development document in Rev 1. The contingency cost in Table 1 of the document 509407-0000-00000-33RA-0172 are the same as indicated on Table 6 of 509407-0000-00000-33RA-0144 (milestone report). However, the contingency values in Table 1 and Table 3 of the document 509407-0000-00000-33RA-0172 are not same. There seems to be an error in documentation. ■ The cost build up from Training Series excel file does not align with Chapter report. Total cost difference is \$143,778.	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. Inconsistencies identified in the documentation were addressed through the estimate review process and updated in the REV 01 Submission.

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Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE
KPMG	8.4-RFR-03	Robert Obertreis	Robert OBERTREIS	Labour rates for CWP match to 7 x 10 (2 shift) instead of 4 x 10 (2 shift). The rates for boiler maker JM in the document DFL Summary Report - Series (509407-0000-00000-33RA-0147.pdf), Appendix E are different than the rates used in the estimate excel (\$81.76/hr has been used for estimation rather than \$84.63/hour as quoted in the rate schedule).	Rev 0 ■ Labour rates that should be used within the CWP excels have been confirmed via OPG interview, which also confirms our findings. Rev 1 Labour rates should be made consistent between the labour rates mentioned in the Appendix C of the DFL chapter summary report and the estimate excel for all the CWPs	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. Labor rates, build-ups, factors and shifts have been confirmed for the REV 01 Submission.
KPMG	8.4-RFR-04	Robert Obertreis	Robert OBERTREIS	OPG has stated that there should be different rates (7 x 10 and 4 x 10) used for critical and non-critical path items, there is no documentation that confirms this verbal statement Regardless of which rate is used, JV should have written documentation about which spefici rates will be used under which specific cicumstance (Ie. critical and non critical activities).	Rev 0 ■ JV to update their documentation to clarify under what scenarios the different shift structures (7 x 10 vs. 4 x 10) are used, and provide documentation for this assumption. Rev 1 ■ As of Rev 1, excel documents rates are now all 7 x 10 shift rates, but the Chapter Reports still state they are 4 x 10 shift rates. The CWP variance report also indicates usage of 7X10X2 shifts ■ JV to confirm which rates are correct. Documentation sources should match	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. Labor rates, build-ups, factors and shifts have been confirmed for the REV 01 Submission. Based on the CWP work activities and work schedule, different shift patterns have been used in the estimate. This is defined in each CWP description.
KPMG	8.4- RFR-05	Robert Obertreis	Robert OBERTREIS	Training Cost Review: No source for dollar cost estimate. The Excel documents only break down the estimated hours. A list of all hourly rates and how and where they are applied is required	Rev 0 ■ KPMG to review evidence that hours for Training Cost Review match hours in Milestone Report and relevant Chapter Summary reports. Rev 1 ■ For Training Series, timberline data has not been supplied and the supporting Appendix B excel file's total cost numbers do not align with Chapter Summary. Appendix B shows that the “project total cost for training is \$80,793,723”, and when cross referenced to the Appendix F Training Series Chapter Summary Labour cost amount of \$80,649,945 (page 6), it differs by \$143,778. Additionally, it appears that the Appendix B total was the amount official approved. In the file entitled “Final Cost Build Uptraining Seris Signed R02.pdf”, there is a signoff on the amount of \$80,793,724, which matches the Appendix B File total and not the chapter summary. ■ JV to reconcile the supporting excel file to the Chapter Summary Report	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. Training cost build up reviewed and errors identified were corrected, reviewed and accepted in Rev01 through estimating review process.
KPMG	8.4-RFR-09	Robert Obertreis	Robert OBERTREIS	■ The JV is charging a 10% margin on top of the OSM Costs. OPG is paying for PMT hours to purchase the OSM. OPG is paying for the PMT labour, OSM costs, and profit, which makes it appear to double count the profit costs	Rev 0 ■ OPG to confirm if these are acceptable profit margins. If not, JV to revise pricing structure. Rev 1 ■ OPG to still confirm if these are acceptable profit margins.	ESTIMATING	This cost outline is as per the established contract.
KPMG	8.4-RFR-10	Robert Obertreis	Robert OBERTREIS	■ The average overall overhead is 12.8%, which is higher than industry average. Additionally, this overhead percentage should be a relatively consistent percentage between each cost component, but is not as it is with PMT at 48%.	Rev 0 ■ OPG to confirm if these are acceptable overhead margins. If not, JV to revise pricing structure Rev 1 ■ OPG to still confirm if these are acceptable overhead margins.	ESTIMATING	This cost outline is as per the established contract.
KPMG	8.4-RFR-19	Robert Obertreis	Robert OBERTREIS	■ Training Onboarding estimate seems highly conservative (high) as it assumes that at the start of each unit, and at each increase in resource loading, all individuals will require onboarding training. There is no discussion surrounding resource-leveling and minimizing training by keeping those already trained in-service through scheduling. There could be a potential cost overestimation assumption.	Rev 0 ■ OPG to provide evidence regarding the decrease in training onboarding costs, and provide in Rev.1 submission. Rev 1 ■ From Appendix E of the Chapter Report, initial onboarding training is still being conducted at the beginning of each unit execution but the percentage of total labour that will onboard the project that have transferrable qualifications will scale down from 60% on Unit 2 to 50% on Unit 4 (previously it was a flat 60%). This would represent a minimizing of training hours through use of previously trained personnel. ■ This issue is now downgraded to C.	ESTIMATING	Training & on boarding cost build up was thoroughly reviewed and accepted through estimating war team review process leading up to RQE.



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Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE	Status
KPMG	8.4-RFR-26	Robert Obertreis	Robert OBERTREIS	Training Series: Attrition hours seem to be included twice in the Chapter Summary, if these inflated hours used for the cost estimate (no source to check) then additional costs may be included in estimate.	Rev 0 ■ JV to confirm that Attrition hours are not double counted. If they have been counted twice, JV to correct for Rev.1 submission.  Rev 1 ■ Although it has been explicitly stated that no attrition costs will be included from section 3.1 of the Training Series Chapter Report, it still exists within the excel sheet calculation within Appendix B. ■ JV to fix calculation for next draft.	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. Training & on boarding cost build up was thoroughly reviewed and accepted through estimating war team review process leading up to RQE and finalized in the R01 Estimate.	CLOSED
KPMG	8.4-RFR-30	Robert Obertreis	Robert OBERTREIS	OSM: ■ There are no explicit \$/part values available in the excel document provided, that should go into each line's \$/part x quantity calculation. Additionally, when the \$/part values are reverse calculated, they are not consistently applied amongst all the units.	Rev 0 ■ JV to update documentation for Rev.1 submission. Rev 1 ■ With the updated Rev 1 documentation, there has been no changes to the status of this gap issue. \$/part values are still not fully inputted. JV to update documentation.	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. Majority of PO's for OSM had been issued before the final comprehensive review process. This was finalized in the R01 estimate and reconfirmed through RQE and U2EE.	CLOSED
KPMG	8.4-RFR-37	Robert Obertreis	Robert OBERTREIS	Contingency: ■ Figure A-5 on page A.1 of Appendix A of document 509407-0000~00000-33RA~0172.pdf indicates that the contingency cost delay to schedule is \$155.31 million. Table 2 on page 9 indicates that the schedule contingency delays would be 394 days and the last paragraph on page 8 indicates that \$350,000 per day has been used to quantify the schedule delays. The multiplication of these two numbers result in total cost of \$137.9 million. The difference of \$17.41 million is unaccounted for the one unit, which can be extrapolated to a total \$68 million difference across the four units.	Rev 0 ■ JV to confirm which value is correct and update document for Rev.1 submission. REV 1 The total cost of Unit 2 excluding contingency and Commissioning - Not part of the Target Cost when divided by 8234 days results in a deaily rate of \$ 398,582. This when muliplied by the 305 contingency days result in total cost of \$ 121.5 million which is significantly higher than the estimated contingency of \$103.8 million. It appears that the contingency cost has been underestimated. ■ The burn rate indicated in Burn rate tab of excel "Cost Risk Analysis Submittal Unit 1 Rev.1" is \$319,599.15. This when multiplied by 305 contingency days gives an estimated value of \$97.5 million. Adding the SS&E contingency of \$4 million gives a total contingency of \$ 101 million which is \$3 million less than the total contingency of \$103.8 million.	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. Risk and contingency build up thoroughly reviewed and accepted through estimating war team review process and issued in Revision 1. A final contingency was submitted, reviewed and accepted by OPG Project Management, Estimating, and Risk Management team and is available for review. OPG reviewed jointly, first in a daylong detailed review by the risk department and then upon final approval of the contingency estimate and target cost and schedule.	CLOSED
KPMG	8.4-RFR-38	Robert Obertreis	Robert OBERTREIS	OSM: ■ The Parts List contained in the SOW was found to be lacking and had to be amended/reconcile d (appendix C of OSM Chapter Summary). The estimate is based on scope of work and it does not account for extra items required based on the Appendix C list.	Rev 0 ■ JV to update OSM estimate file and make an allowance for parts and materials. Rev 1 ■ With the updated Rev 1 documentation, there has not been a change to the status of this gap issue. It continues to state under Section 2 Scope that "It was further found that some items (refer to Appendix C) that meet the definition of OSM and are to be used in the Work, are not actually subject to purchase by the JV under the terms of the Agreement. These items are not included in the estimate. The reconciliation of OSM is further detailed in Appendix C of this Chapter." ■ Additionally, the \$/Part prices are still not inputted into the supporting excel file, and therefore the \$/Parts, Unit Prices, and Total Costs are not built up via formula. ■ JV to update OSM estimate file and make an allowance for parts and materials.	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. Majority of PO's for OSM had been issued before the final comprehensive review process.	CLOSED

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Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE	STATUS
KPMG	8.4-RFR-41	Robert Obertreis	Robert OBERTREIS	OSM: ■ Unit costs missing for many major parts, unit price fluctuates for caladria/tubes between units due to removal of sum for PPQ and Spares not equal to the average per unit cost. Unit costs should not be missing, and unit prices should not be fluctuating without proper explanation through documentation.	Rev 0 ■ JV to update documentation for Rev.1 submission. Rev 1 ■ With the updated Rev 1 documentation, there has been no changes to the status of this gap issue. A comparison of the line item's Total Cost divided by # of Parts to another comparable line item still shows differences. Therefore there are differences in the unit pricing per unit. ■ JV to update documentation for Rev 1 submission	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. OSM summary reviewed and a cost build up included in Rev 01 submission. The estimate is substantiated with required level of detail and PO's.	CLOSED
KPMG	8.4-RFR-44	Robert Obertreis	Robert OBERTREIS	CWPs: There are hardcoded numbers within the CWP excel files and that cannot be validated by documentation.	Rev 0 ■ JV to update documentation for explanations within the Rev.1 submission. Rev 1 ■ The number of workers required (located from “CWP_2145_S3 1_R3 (GHR9)(MBR2).xlsx”, “Main” tab, Column H), and hours required (Column I) are hardcoded. Interviews with OPG indicated that the timelines are based on the experience of working on similar projects. However, assumptions regarding the number of crew required and the number of days have not been discussed in the chapter summary for the respective CWPs. ■ PMT costs were consistent and traceable from the overall costs reported in the RFR Execution Phase (Class 2 Estimate)(R12) Aug 31 (i.e., the Milestone Report), through the source documents. However, trace ultimately leads to the CWP Summary Spreadsheet - Class 2 - Rev 01 document where the values for both PMT hours and costs are hardcoded and cannot be tied to any source data. ■ The number of workers required (CWP_2172_S3.A_R1(GHR8)(MB).xlsx “, Main” tab, Column H), hours required (Column I) is hardcoded. Interviews with OPG indicated that the timelines are based on the experience of working on similar projects. However, assumptions regarding the number of crew required and the number of days have not been	ESTIMATING	CWP's and cost estimates were thoroughly reviewed and accepted through estimating war team review process and issued in Revision 01. CWP's represent the lowest level of data input and, as such, have data values inputted directly.	CLOSED
KPMG	8.4-RFR-48	Robert Obertreis	Robert OBERTREIS	OSM: ■ OSM Chapter Summary does not include reference to: • engineering specifications • Specifications provided to the Supplier • Suppliers response to specifications. Although it is stated that engineering is complete, it is difficult to determine which individual project engineering specifications or requirements have obtained a quote, and therefore puts in question level of certainty that can be placed on the estimates	Rev 0 ■ Specify which specifications were followed when purchasing materials. Rev 1 ■ The updated Rev 1 document for the OSM Chapter Summary has remained the same in regards to this gap issue. Without reference to the level of detail listed for the engineering specifications provided to suppliers and their response to those specifications, the level of risk in terms of material pricing cannot be adequately gauged. ■ JV to specify which specifications were followed when purchasing materials.	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. Scope and engineering specifications for OSM completed and documented as part of the definition phase of the project. These items are referenced in the final approved R01 of the estimate.	CLOSED
KPMG	8.4-RFR-49	Robert Obertreis	Robert OBERTREIS	■ Class 2 estimate for Unit 2 has increased by \$58M from Class 3 due to new scope and higher accuracy (percentage change of 26%). However, there is a significant portion that is a budgetary number and is still subject to higher fluctuation. There should be a consideration for the remaining budgetary numbers to be validated.	Rev 1 ■ Within the OSM Material Spreadsheet (Class 2) Rev 02 (GH-AL) - Sept 10(SAMAD).xlsx file, column D identifies if the line item's source is from a budget, a PO, or RFQ. There currently are 106 line items that are currently labelled as budgetary pricing for OSM, and 166 line items for Goods, which indicates that the budgetary pricing may still be too high for the Class 2 estimate. ■ JV to update documentation for actual quotes when obtained.	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. Results of this estimate refinement has been incorporated as part of Unit 2 Execution Estimate finalization, forecasting, and change process. Update documentation for actual quotes will be part of reporting and cost control. 83% of OSM cost was based on existing POs reference JV doc# 509407-0000-00000-33RA-0144	CLOSED

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Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPONSE
KPMG	8.4-RFR-30	Robert Obertreis	Robert OBERTREIS	■ The backup or rationale for using an unnamed factor within the CWP excel file that cannot be traced as this has been linked to a different file. This factor takes form as an undescribed column with hardcoded numbers that directly impact the	Rev 0 ■ Update documentation and clearly specify when factors are to be used. Rev 1 ■ The Labour hours for work activities sourced from “CWP_2145_S3 1_R3 (GHR9)(MBR2).xlsx”s “Main” tab, Row 30 to Row 605, Column I (Hours) are calculated by using factors from Column AG and multiplying it with Cell AI607. While the numbers in Column AG have been sourced from a different worksheet	ESTIMATING	This observation was identified prior to finalization of the Rev01 Class 2 Estimate, approved by both JV and OPG. The CWP estimate was calculated based on a duration derived from TPG results and a crew basis, then allocated for the quantity of operations. These TPG results and other relevant basis sheets for activity durations are documented.
KPMG	8.4-RFR-57	Robert Obertreis	Robert OBERTREIS	■ Base rates in the Timberline reports does not match the PMT rates table in Appendix E of the Chapter Summary. No assumptions or explanations are apparent for this discrepancy.	Rev 1 ■ JV has updated the estimate spreadsheet for Rev.1 to ensure traceability based on the Timberline data. ■ Under the Direct Site Labour, the base rates per hour contained in the Timberline data do not always match up with the PMT Rates from Appendix E. ■ Based on comments received from OPG, it is understood that the difference in labour rates has been addressed post-Rev 1, as per the Milestone Report (Section 8, item #4). JV to provide evidence that this change has been applied, and that rates used match those in Appendix E.	ESTIMATING	Rates were reviewed for consistency and accepted in Revision 1.
KPMG	9.4-BOP-01	Dereck McCauley	Dereck McCauley	Missing Logic in the schedule could potentially degrade the ability to analyze critical path with a reasonable level of confidence.	Require the Vendor to verify and validate the critical path to ensure mostly Finish to Start logic with very few lags, no gaps, etc.; and ■ OPG should confirm that the Vendor has provided greater detail in the next revision of the estimate package.	SCHEDULING	Detailed planning is an iterative process. Rev A gave us the major time lines and sequence of the windows and critical path. Rev B was based on the JV RFR Level 5 schedule and the Level 2 schedules from the other bundles. Rev C is based on the detailed assessing of the Comprehensive Work Packages. Rev C also included Horizontal views of the Windows through a number of Off Site session with OPG and the Vendors. With each issuance of the of the Revised Level 1, the amount of detail, the logic ties and the resource requirements improved and gaps are identified with actions to close. Currently the Vertical Slice sessions are taking place to identify conflicts in logic and resource allocation. Rev 0 will be our baseline based on detailed planning and resource leveling.
KPMG	9.4-BOP-02	Dereck McCauley	Dereck McCauley	Critical Path that has too many activities relative to the total number indicates a schedule with increased risk due to less ability to implement mitigation planning required from actual changes in durations or dates.	Require the Vendor to verify and validate the critical path to ensure mostly Finish to Start logic with very few lags, no gaps, etc.; and ■ OPG should confirm that the Vendor has provided greater detail in the next revision of the estimate package.	SCHEDULING	Most of the critical path goes through the Retube and Feeder Replacement project therefore many of their tasks are critical path .The contractual requirements were to produce a detailed schedule in support of their Class 2 estimate which made up the largest part of the RQE for execution. The details are also based on detailed Logic Flow Diagrams which identify step by step the tasks and logic required to remove and install the fuel channels. Since the RQE, the other Bundles have developed their detailed schedules which has increased the number of non-critical tasks. The Program made a strategic decision to ensure that the bulk of the non-RFR work is completed prior to the point at which RFR is 60% complete. This strategy allows for mitigation and contingency strategies on the non critical path work (such as BOP) to be implemented without impacting the overall program critical path.
KPMG	9.4-BOP-03	Dereck McCauley	Dereck McCauley	■ Using ‘Hard Constraints’ in the schedule will interfere with Critical Path analysis and cloud visibility in forecasting, and level of confidence.	■ Require the Vendor to provide an explanation in the estimate package as to why they are necessary, remove the ‘Hard Constraints’ or replace them with ‘Soft Constraints’ such as Start of Finish on or before/after; and ■ OPG should confirm that the Vendor has provided greater detail in the next revision of the estimate package.	SCHEDULING	For long term, large projects and complex programs, there needs to be way points. There needs to be a small number of midway milestones that are deadlines. Any activities that cannot meet the mid-way milestones should also be identified and focused. A project over 3 years long will have too many Level 3 activities to properly identify and manage critical path. We have to segment the long duration into intervals, and constrain a small number of milestones. In each interval, critical activities can be identified. Our contracting strategies require us to provide the vendors a structure aligned to the project they have been awarded . They require control over their schedule. The vendors are connected logically through interface milestones. Assuming you can get it, any small error happens on one of the critical path activities, will collapse all L3 Schedules. Each window is represent buy control Accounts and Work packages. Base on this structure, a Level 2 plan is also created. By constraining the dates associated with milestones, the critical path can be determined for major schedule intervals (windows) in addition to the entire project. Float can also be calculated on each schedule interval. This segmentation of the project schedule into intervals allows earlier indication of schedule problems and a better view into the activities whose completion is critical.

Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE
KPMG	9.4-BOP-04	Dereck McCauley	Dereck McCauley	Leads (negative lags) in the schedule indicates logic sequences that are not precedence relative and will cloud/interfere with Critical Path analysis.	■ Require the Vendor to provide an explanation in the estimate package as to why they are necessary or delete them and if needed replace them with appropriate activities and/or logic ties; and ■ OPG should confirm that the Vendor has provided greater detail in the next revision of the estimate package.	SCHEDULING	As part of the Baslineing process associate with Rev 0, all schedules will go through the Acumen Fuse tool. This tool identifies all leads and negative lags. Any unnecessary leads or lags will be replaced with logic
KPMG	9.4-BOP-06	Dereck McCauley	Dereck McCauley	Negative Float identifies specific logic chains with significant potential to impact the planned completion of the project.	■ Require the Vendor to provide an explanation in the estimate package as to why they are necessary or delete them and if needed replace them with appropriate activities and/or logic ties; and ■ OPG should confirm that the Vendor has provided greater detail in the next revision of the estimate package.	SCHEDULING	The schedule will not be baselines with negative float in the schedule. Any identified negative float in execution will be managed and monitored by the Window Manager and the Project Manger with support from Work Control and Planning and Controls. A Report has been developed to identify negative float by project.
KPMG	9.4-BOP-07	Robert Obertreis	Robert OBERTREIS	■ A high level comparison illustrated several discrepancies between the labour hours in the cost estimate and schedule with regards to Construction, Engineering and Project Management Team for the three projects which is an indicator that cost could be understated in the RQE. For example, on average the Engineering estimate hours were 80% less than the P6 schedule labour hours.	Actions Taken ■ OPG provided cost profile documents and updated estimates which address some of the discrepancies. For example, the Engineering discrepancies in particular, were due to the fact that Engineering hours (for Phase 1) were rolled up in a “Project Defined’ (Summary worksheet, Row 13) cost account. Now, the discrepancy in engineering hours is approximately 12%; ■ However, for Adjuster Rods, the labour hours in the estimate file is still significant (+67%) higher than the labour hours in the P6 because the Vendor has not submitted an updated schedule; and ■ OPG should confirm that the Vendor submits the revised P6 schedule with updated labour hours (this is why it is still open as a Category C). Further Actions ■ To increase the level of confidence in the BOP cost estimates OPG could consider notifying the Vendor of these quality issues and request that the Vendor revise and resubmit estimates / schedules of an acceptable quality.	SCHEDULING	This effort is integrated with the Schedule Integration development and is reviewed as part of Unit 2 finalization with progression of schedule from Rev B, C, 0 and final Unit 2 Baseline. All projects including the BOP projects will go through Gate 3A prior to breaker open to ensure alignment of cost estimate, P6 hours, and ecosys load.
KPMG	9.4-BOP-08	Robert Obertreis	Robert OBERTREIS	■ The Vendor’s estimate does not appear to define any potential critical activities in the schedule or explain how the Vendor plans to deal with any potential interferences.	■ If there are critical activities as OPG’s SOW seems to suggest then OPG should require the Vendor to include a section in the estimate package that describes such activities and explains how the Vendor plans to deal with them; and ■ OPG should confirm that the Vendor has provided greater detail with respect to the critical activities in the next revision of the estimate package.	SCHEDULING	The critical path activities, and JV integration with other entities doing work in and near their execution windows are being resolved through a series of vertical slice reviews that are ongoing. These review will continue until the issuance of the Rev 0 schedule in August 2016. In alignment with scheduling standards the vendors are providing detailed level activities specifically showing the critical activities in the windows.
KPMG	9.4-BOP-09	scott guthrie	tbd	■ Although the vendor’s estimate (i.e. Unit 2 tab, under Indirect Labour header) includes indirect cost, these values appear to be hardcoded (e.g., for Containment, HSSE row 281, Construction Indirect row 291) and there does not appear to be an explanation for the hours, weeks etc.	The vendor should provide greater detail regarding the basis and source of indirect costs in the next revision of the estimate; and ■ OPG should confirm that the Vendor has provided greater detail with respect to the source / basis of indirect costs in the next revision of the estimate package.	ESTIMATING	Agreed; In general indirect cost is high and deliverable level is unclear. A separate team has been assigned to review the total indirect hours across the boundless and opportunities to share the resources. This process continues with the goal of continuous estimate improvement.



Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPONSE
KPMG	9.4-BOP-10	scott guthrie	tbd	■ Indirect costs for small tools, consumables and equipment rental are calculated by using hardcoded factors (i.e. % with no source / basis) that are applied to the total direct labour cost.	OPG could consider validating the hardcoded factors to ensure that they are in-line with the commercial terms of the Vendor's agreement (i.e., ESMSA agreement) or OPEX; and ■ Also, due to the uncertain nature of the Vendor's parametric estimating approach in the current estimate package, OPG should also consider reviewing in detail the Vendor's indirect costs, overhead costs and other assumptions when the vendor submits the next revision of the estimate (i.e., bottoms up activity based estimates).	ESTIMATING	Each estimate submitted is reviewed in detail and includes indirects, allowances, etc in addition to direct costs. With respect to small tools and consumables, the allowance has been aligned to consistent percentages with any exceptions addressed within the BOE.
KPMG	9.4-BOP-11	scott guthrie	tbd	■ It is unclear how the cost for general project facilities are accounted for in the estimate.	OPG should confirm that the Vendor has provided greater detail with respect to how the Vendor is handling 'general project facilities' costs in the next revision of the estimate package.	ESTIMATING	This is outlined in the terms of the ESMSA contract.
KPMG	9.4-BOP-12	Robert Obertreis	Robert OBERTREIS	■ No mention of insurance policies that will be used. 'Project Insurance' is included as a line item in the estimate (i.e. J412 Unit #2) but has no cost. There does not appear to be any explanation for project securities in the BOE or the vendor's 'Step 5' presentation.	The Vendor should clarify the approach to project insurance. If the intent is for the contractor to purchase insurance then that should be explained in the BOE and reflected in the cost estimate. However, if the intent is for OPG to secure project insurance at the program level (i.e., DNRP) then that should be explained in the project BOE and a reference provided to the program BOE for further details and insurance costs.	ESTIMATING	Project Insurance cost has a separate BOE (prepared by Refurb Estimating group) and all costs are collect in the BOE estimate tables .
KPMG	9.4-BOP-13	Robert Obertreis	Robert OBERTREIS	■ There does not appear to be any information in OPG's SOW or the vendor's estimate with respect to what year the pricing is in (i.e. 2015 dollars) or how the escalation item will be handled	■ The Vendor should provide greater detail for its sources of cost data (i.e. year) and how escalation will be handled in the next revision of the estimate.	ESTIMATING	The year of the estimate is documented within the final Basis of Estimate documentation.
KPMG	9.4-BOP-14	Robert Obertreis	Robert OBERTREIS	■ There does not appear to be any productivity factors (e.g., labour, tool performance) used in the three BOP estimates that were reviewed for the BOP vertical slice.	The vendor should reference the source for all labour hours and clarify if there are any productivity adjustments in the next revision of the estimate. For example, productivity rates associated with training on the adjuster rod mock-up	ESTIMATING	Productivity factor has been removed from the estimate based on the project team request (and agreed by OPG Estimating team), and included with hours norms, this has no affect on the total cost
KPMG	9.4-BOP-15	Robert Obertreis	Robert OBERTREIS	■ Although the Vendor's 'Step 5' presentation references the SOW, there appears to be a discrepancy in the numbers (i.e. quantity of flux detectors). It appears the Vendor's estimate uses more actual FD's than is necessary, not including the spare parts; and ■ The SOW specifies 82 VFDs and 51 HFDs. However the Vendor's Excel estimate workbook in one location (i.e., electrical tab) specifies 84 VFD removals and 85 VFD installations, and in another location (i.e., the mechanical tab). The mechanical tab specifies 84 VFD installations.	■ OPG's internal estimates for the flux detectors are as follows: -98 vertical FDs and -3 horizontal FDs; ■ Even though there appears to be a discrepancy in the quantities between the vendor's estimate and OPG's internal worksheet there does not appear to be a significant discrepancy in the estimated build-up of hours. The total difference in calculated man hours between OPG (18,223 hours) and the Vendor (18,362 hours) is approximately 1%; and ■ OPG should consider checking to make sure that the Vendor has ascertained the correct quantities of flux detectors in the next revised estimate submission.	ESTIMATING	Agreed. The quantity issue still exist for U2EE and it has a minor impact on the cost. To be monitored in the next revision
KPMG	9.4-BOP-16	Robert Obertreis	Robert OBERTREIS	■ In the 'Mechanical' tab the cutting of the 84 VFDs and 51 HFDs is clearly outlined, however due to inconsistent terminology and descriptions in the Excel cost estimate workbook it is not clear how the removal of the additional 17 detectors is accounted for in the estimate.	OPG should consider checking to make sure that the Vendor has used consistent terminology and that the Vendor has ascertained the correct quantities in the next revised estimate submission.	ESTIMATING	Agreed. The quantity issue still exist for U2EE and it has a minor impact on the cost. To be monitored in the next revision
KPMG	9.4-BOP-17	Robert Obertreis	Robert OBERTREIS	■ There appears to be approximately 4,900 hours for estimated for VFD waste handling activities. However, there does not appear to be any direct labour hours allocated to HFD waste handling in the Excel cost estimate workbook.	■ All the hours for waste handling on the 'Mechanical' tab of the estimate worksheet appears to have been allocated to VFD waste handling. OPG should confirm in the vendor's revised estimate that cost (i.e., hours) has been accounted for HFD waste handling.	ESTIMATING	Agreed. The quantity issue still exist for U2EE and it has a minor impact on the cost. To be monitored in the next revision

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Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE
KPMG	9.4-BOP-18	scott guthrie	tbd	■ The vendor has provided costs (~\$531K) for Phase 3 commissioning / closeout in the estimate (Summary Sheet, K51). The majority of the cost is allocated to Mod Team Leader ("MTL") (i.e. 3520 hours / \$422,400). It is unclear how this level of	■ The vendor should provide an activity based detailed estimate in the next revision of the estimate for commissioning and close out activities; and ■ Also, the Vendor should clarify if Phase 3 costs have been resource levelled across the BOP bundle.	ESTIMATING	BOE Revision incorporates changes. Will be monitored in subsequent revisions. In general OPG estimating team noticed PMT hours are high subsequently a separate team has been assigned to review the total PMT hours across the bundles. OPG is reviewing strategy to centralize the PMT costs for ESMSA vendor support.
KPMG	9.4-BOP-19	Robert Obertreis	Robert OBERTREIS	■ It is not clear how freight has been accounted for in the estimate. For example it is unclear whether the \$12,000 cost for each Flux Detector includes freight cost.	■ The Vendor should clarify in the cost estimate how the cost of freight has been accounted for in the estimate.	ESTIMATING	BOE new template includes freight cost changes. Will be monitored in subsequent revisions. <b>(This item has no cost impact since the cost was included in the estimate)</b>
KPMG	9.4-BOP-20	scott guthrie	tbd	The vendor has provided costs (~\$1.4M) for Phase 3 commissioning / closeout in the estimate (Summary Sheet, K51). It is unclear how this level of effort was determined.	■ The vendor should provide an activity based detailed estimate in the next revision of the estimate for commissioning and close out activities; and ■ Also, the Vendor should clarify if Phase 3 costs have been resource levelled across the BOP bundle.	ESTIMATING	The cost breakdown is provided, 96% of the cost is PMT cost. Refer to item 9.4-BOP-18 for detail on PMT strategies in development to reduce costs.
KPMG	9.4-BOP-21	Robert Obertreis	Robert OBERTREIS	■ It is not clear how freight or taxes have been accounted for in the estimate. There is a line item for freight in the unit tabs but it has a zero dollar impact on the estimate.	The vendor should provide greater detail with respect to how the costs of freight or taxes have been accounted for in the next revision of the estimate.	ESTIMATING	Freight cost need to be added to the BOE. Tax is not included. Will be monitored in subsequent revisions. <b>(This item has no cost impact since the cost was included in the estimate)</b>
KPMG	9.4-BOP-23	scott guthrie	tbd	■ In the Vendor's BOE, it was indicated that the procurement for all major components was done in Phase 1, and Phase 1 costs is a hard coded value in the estimate file (PEPC 'Project Defined' cost account ~\$2.7M).	Actions Taken ■ In a meeting with the BOP team on August 18th, 2015 the BOP team provided an internal OPG working document that provided the breakdown for the ~\$2.7M 'Project Defined' costs as follows: WBS 10000 – Proj Mgmt: \$358K WBS 30400 – Detailed Eng: \$1,184K WBS 30700 – Work Plans: \$529K WBS 40000 – Procurement: \$651K; and Further Actions ■ OPG could consider requiring that the Vendor breakdown the 'Project Defined' costs into their appropriate WBS structure so that an accurate breakdown of costs and 'cost ratios' (PMT / Direct cost) can be evaluated by the OPG project team in the next revision of the estimate.	ESTIMATING	Phase-1 is definition phase and reflect the actual cost. The procurement cost is documented in the BOE, refer to section 2.3 for details.
KPMG	9.4-BOP-24	scott guthrie	tbd	The vendor has provided costs (~\$123K) for Phase 3 commissioning / closeout in the estimate (Summary Sheet, K51). The majority of the cost is attributed to Project Manager Phase 3 (i.e. 365 hours / \$40,128) and Project Coordinator Phase 3 (i.e. 365 hours / \$43,776). It is unclear how this level of effort was determined as the only reference in the BOE is a 'multi-disciplinary trade support and engineering support as required will be provided' (ref BOE, Section 2.8)	The vendor should provide an activity based detailed estimate in the next revision of the estimate for commissioning and close out activities; and ■ Also, the Vendor should clarify if Phase 3 costs have been resource levelled across the BOP bundle.	ESTIMATING	Refer to response to item 9.4-BOP-18.
KPMG	9.4-BOP-25	Robert Obertreis	Robert OBERTREIS	It is not clear how freight has been accounted for in the estimate.	■ The vendor should provide greater detail on how freight has been accounted for in the next revision of the estimate.	ESTIMATING	BOE Revision incorporates changes. Will be monitored in subsequent revisions. <b>(This item has no cost impact since the cost was included in the estimate)</b>
KPMG	9.4-BOP-26	scott guthrie	tbd	There does not appear to be any assumptions / clarifications documented for subcontractors (i.e. Crossby Dewar) as it was done in the other BOP projects reviewed.	OPG could consider requiring that the Vendor clarify and fully document its assumptions / clarifications in the next revision of the estimate.	ESTIMATING	BOE Revision incorporates changes, the level of detail for subcontractor (i.e. Crossby Dewar) is acceptable and assumptions are documented in the estimate sheet.
KPMG	9.4-BOP-27	Robert Obertreis	Robert OBERTREIS	There does not appear to be a comprehensive document listing all engineering deliverables received by OPG.	The Vendor should provide a comprehensive document listing all engineering deliverables and their status (i.e., % complete) should be provided in the next revision of the estimate.	ESTIMATING	No Project EC is required.
KPMG	9.4-BOP-28	Robert Obertreis	Robert OBERTREIS	■ The BOE does not appear to be self-contained or provide sufficient detail to support the estimate in accordance with best practice.	As per the AACE guidelines for developing a Basis of Estimate document, several sections such as 'Methodology', 'Estimate Classification', 'Planning Basis', 'Design Basis' etc. should be included in the BOE. Also information from the Vendor's 'Step 5' collabouration presentation should be transferred and incorporated into the BOE and flushed out in greater detail in the next revsion of the estimate.	ESTIMATING	BOE Revision incorporates changes. Will be monitored in subsequent revisions. The new BOE included all recommended section by AACE as well as extra info required by OPG.

Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPONSE
KPMG	9.4-BOP-29	Robert Obertreis	Robert OBERTREIS	■ No section for "Design Basis" or anything similar in the BOE.	■ As per the AACE guidelines a completed estimate deliverables checklist indicating the project deliverables should be provided as an attachment to the BOE to support the preparation of the estimate and the associated estimate classification.	ESTIMATING	BOE Revision incorporates changes. The design basis provided in Section 2 of BOE.
KPMG	9.4-BOP-30	Robert Obertreis	Robert OBERTREIS	■ In the BOE, there is an "Assumptions" section where some assumptions made by the Vendor are listed. However, this does not appear to be a current or comprehensive list. For example, there are assumptions and clarifications listed in the Vendor's 'Step 5' document which are different from what is listed in the BOE	■ The BOE should be updated and reconciled with the 'Step 5' presentation. Also it should be made clear how these assumptions have impacted the estimate. Furthermore clarifications from the subcontractor should be incorporated into the BOE assumptions Section so as to ensure there is universal documentation of assumptions in the next revision of the estimate.	ESTIMATING	Assumption is documented. Project BOE met the minimum AACE requirement. The Assumptions are sufficient to classify the estimate. Will be monitored for improvement in subsequent revisions.
KPMG	9.4-BOP-31	scott guthrie	tbd	■ In terms of PMT and indirect costs levelling it is unclear at this point what the contracting strategy is - .i.e. whether one ESMSA vendor will be substantially responsible for all of the BOP work or whether the work will be it will be split up among more than one ESMSA vendor.	■ The vendor should clarify its approach to resource levelling the PMT / Indirects (i.e. treating the BOP projects individually or as one 'big' project) in the next revision of the estimate.	ESTIMATING	This has been addressed. The ESMSA vendors have been asked, and have provided at the time of U2EE, a consolidated PMT picture outlining by name the individuals supporting the projects to ensure cost and management efficiency of the work. A separate team has been assigned to review the total PMT hours across the bundles.
KPMG	9.4-BOP-32	Robert Obertreis	Robert OBERTREIS	There appears to be some high level assumptions for work week/scheduling for direct labour in the Vendor's 'Step 5' presentation.	The vendor should provide greater detail about work week / scheduling after the CWP's are assessed and revised schedules are submitted in the next revision of the estimate.	ESTIMATING	Effort integrated as part of the outage schedule integration development and horizontal and vertical slice meeting. Revision 0 of the U2 integrated schedule was issued August 25th. The schedule provided as attachment to BOE was preliminary and is now integrated.
KPMG	9.4-BOP-33	Robert Obertreis	Robert OBERTREIS	While the BOE does have a separate section called 'Exclusions' it refers the reader to the Assumptions section.	■ As per the AACE guidelines for developing a BOE, OPG should consider requiring that the Vendor to develop the "Exclusions" section of the BOE so as to make it clearer what the exclusions are in the next revision of the estimate.	ESTIMATING	The BOE issued for U2EE have list of exclusions in the right section.
KPMG	9.4-BOP-34	Robert Obertreis	Robert OBERTREIS	■ The vendor's 'Step 5' presentation identifies the major items involved in this project. For example, for the Containment project the major items identified are the fan / electrical package (Scope 7011), installation of two containment valves (Scope 7012), and wiring / instrumentation and control installation (Scope 7010).	The information from the vendor's 'Step 5' presentation should be consolidated with the estimate package (i.e., transferred into the BOE) in the next revision of the estimate.	ESTIMATING	The list as provided in the BOE was for major items only, details are listed in the attached detail estimate sheet that accompanies the BOE.
KPMG	9.4-BOP-35	Robert Obertreis	Robert OBERTREIS	■ The Vendor's Step 5 presentation appears to provide more detailed information than the Vendor's BOE with respect to the project's planning basis; and ■ Even with this additional detail, there are several inconsistencies in the Vendor's naming convention for certain activities throughout the estimate documentation. For example in the Adjuster Rods project the Vendor's Step 5 presentation specifies 'Remove Mechanism: 1	■ The Vendor should consolidate the estimate documentation and provide a comprehensive BOE; and ■ Also, OPG should require the Vendor to reconcile activity naming / labelling inconsistencies in the next revision of the estimate.	ESTIMATING	Will be monitored in subsequent revisions to consolidate the estimate documentation and receive a comprehensive BOE
KPMG	9.4-BOP-36	Robert Obertreis	Robert OBERTREIS	■ There are no exclusions listed in the BOE. While there is an exclusions section heading in the BOE, there is no information related to exclusions listed.	■ As per the AACE guidelines for developing a BOE, OPG should consider requiring the Vendor to develop the "Exclusions" section so as to make it clearer which exclusions exist in the next revision of the estimate.	ESTIMATING	The BOE's issued in support of U2EE have list of exclusions in the right section.
KPMG	9.4-BOP-37 (no 38-41)	Robert Obertreis	Robert OBERTREIS	■ There does not appear to be a planning basis in the BOE document for resources (i.e. resource plan).	■ OPG could consider requiring that the Vendor clarify its basis and assumptions for resources and labour productivity rates in the next revision of the estimate.	ESTIMATING	As per AACE- 34; the resource plan is not required to be as a separate section. The resource basis requirements are included and managed by scheduling and other OPG groups. PMT hours have been aligned with estimated hours and is integrated with the scheduling efforts to ensure they are suitable based on the work and timelines.
KPMG	9.4-BOP-42	Robert Obertreis	Robert OBERTREIS	■ Risk Register has been received and it appears to be in-line with best practice and OPG governance. However, many of the risks contain probabilities of 50% or higher.	■ This is an indication that the 'Base Plans' need improvement or further development; and ■ OPG should revise the risk register after the next revision of the estimate.	Risk	Unit 2 Execution Estimate risk challenge process has addressed this item. The demonstrated performance of the ESMSA contractors during the RTE period has indicated high risk of quality and rework issues and this is accurately reflected in the risk register and contingency estimate.
KPMG	9.4-BOP-43	Robert Obertreis	Robert OBERTREIS	■ Links to external files contained outside of the estimate file workbooks. For example, all links in the Crossby Dewar tab are traced back to an external file – UM('C:\Users\rob\AppData \Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\LVH 866E9\{D-0704-14 (P2014-0070) Flux Detector Rehabilitation Rev 2.xlsx}\Scaffolding Scope\M20:M23)	■ The vendor should provide all the information necessary for the cost estimate in the Excel cost estimate file (i.e. it is not best practice to have links to external files contained outside of the estimate file workbooks) in the next revision of the estimate.	ESTIMATING	Corrected in the current submission.

Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE
KPMG	9.4-BOP-44	scott guthrie	tbd	■ Factors are applied to costs for key activities without explanation. (e.g. In the Flux Detectors project, for example, the PEPC procurement cost account for Vendor: Non-Long Purchasing and Materials for Unit 2 in the Summary sheet (Cell J30) has been calculated by multiplying the material cost (K409 in Unit 2 sheet) by 4.5% and adding Non Long Lead Equipment Phase 2 (K119, Unit 2 sheet under 2nd Tier Subcontractors).	■ The vendor should provide greater detail with respect to how factors are applied to costs for key activities in-line with the Vendor's agreement (i.e., the ESMSA agreement) in the next revision of the estimate.	ESTIMATING	These factors are the contractually agreed ESMSA OH, Profit and markup. BOE mentioned the estimate is based on ESMSA Agreement.
KPMG	9.4-BOP-45	scott guthrie	tbd	■ Factors are applied to costs for key activities without explanation. (e.g., in the Flux Detectors project, for example, the project management cost area for Unit 2 in the Summary sheet (Cell J16) has been increased by 12% to arrive at the cost in respective cells in Column J and it is unclear on what basis this adjustment was made.	■ The vendor should provide greater detail with respect to how factors are applied to costs for key activities in-line with the Vendor's agreement (i.e., the ESMSA agreement) in the next revision of the estimate.	ESTIMATING	These factors are the contractually agreed ESMSA OH, Profit and markup. BOE mentioned the estimate is based on ESMSA Agreement.
KPMG	9.4-BOP-46	Robert Obertreis	Robert OBERTREIS	■ It is unclear how some total costs have been apportioned to separate PEPC accounts. For example, all Job Expenses have been apportioned between Construction Support Work and Construction Indirects using a 90/10 allocation, respectively. This calculation cannot be traced back to any assumptions in the Vendor's estimate package. ■ In another example, it is unclear how the Vendor has apportioned 'additional costs' (such as material handling, cleaning, training, etc.) to OPG's control accounts (i.e., Scope IDs). It appears that the Vendor has apportioned the 'Additional Costs' to specific Scope IDs based on the Scope ID's direct-to-total man hour ratio.	■ The vendor should provide greater detail with respect to how certain costs have been apportioned between various PEPC accounts in the next revision of the estimate.	ESTIMATING	Job Expenses is divided between construction and commissioning support work using a 90/10 allocation. This level of detail is meeting the AACE requirements and it has been accepted as reasonable by the estimating department.
KPMG	9.4-BOP-47	Robert Obertreis	Robert OBERTREIS	■ The estimate is broken down to the 'Full Time Equivalent ("FTE") Level' for direct labour and a blended rate is used to calculate the direct labour cost. The direct labour has not been broken down to the trade level.	■ While OPG's SOW does not appear to provide the Vendor with requirements (i.e., bottoms up estimating) for estimating direct labour, prior to execution the vendor should provide a bottoms up estimate for determining the number and types of craft labour required in the next revision of the estimate.	ESTIMATING	Labour blended rate calculated considering the DFL percentage for each trade level. The calculation provided in the BOE. This method is acceptable per AACE and does not effect the cost.
KPMG	9.4-BOP-48	Robert Obertreis	Robert OBERTREIS	■ The pricing source for wage rates does not appear to be defined in the vendor's estimate package. It is not clear if the labour rates used can be sourced back to EPSCA (I.e., collective agreement) and there does not seem to be a reference year (I.e. 2015) for the rates.	■ The vendor should reference the source for the labour rates and the reference year. OPG should verify that the vendor is using the correct rates (and year) for calculating labour costs in the next revision of the estimate.	ESTIMATING	The labour rates for BOP ESMSA executed work have been checked and they are based on ESMSA contract terms, and Oncore actual that OPG incur for this support.
KPMG	9.4-BOP-49	Robert Obertreis	Robert OBERTREIS	The unit labour hours can be traced back to the 'Functional' tabs of the Vendor's Excel estimate file. However, these hours are hard coded and there does not appear to be a basis for their build-up	■ The vendor should reference the source for all labour hours and clarify if there are any productivity adjustments in the next revision of the estimate.	ESTIMATING	These have been raised to vendor through comment and disposition sheet and OPG received detail behind hard coded numbers. The BOE template has been updated to eliminate this feature.
KPMG	9.4-BOP-50	Robert Obertreis	Robert OBERTREIS	The craft mix has not been defined in the estimate. The vendor's estimate for labour is based on parametric estimating i.e. Level of effort based on hours and full time equivalents ("FTE").	The vendor's labour estimate is based on parametric estimating. OPG should review the vendor's crew mix when the vendor submits its detailed activity based (bottom up) estimates in the next revision of the estimate.	ESTIMATING	The crew mixes have been provided in the rate calculation table and CWP detail estimate.
KPMG	9.4-BOP-51	Robert Obertreis	Robert OBERTREIS	■ Pricing source and methodology for construction indirect costs (and hours) is unclear; and ■ For example, in the Flux Detector project cost estimate, a significant amount of the hour and rates used for Indirect Labour appear to be hardcoded. For construction indirect costs specifically, the construction / site manager and superintendent rates (Ref Unit 2 tab Cell H290 – 295) have been hardcoded whereas the rates for the other areas such as the general foremen (Ref Unit 2 tab Cell H296) can be traced back to the labour calculation worksheet where the hours for the various trades and the blended rates have been calculated.	The vendor should provide greater details for the pricing source and methodology for construction indirect costs in the next revision of the estimate.	ESTIMATING	These have been raised to vendor through comment and disposition sheet for each project ( whenever is applicable) and the comment is not disposition in most of the projects. OPG project team took the action to monitor the work at field.



Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE
KPMG	9.4-BOP-52	Robert Obertreis	Robert OBERTREIS	Material costs exist in the Vendor's Excel cost estimate workbook, but with no cost basis (i.e., market, budget, historical) or reference year for the price. ■ For example, there does not appear to be any pricing sources for major equipment in the flux detector project. The estimate contains hardcoded, round number costs for the detectors (i.e. \$12,000 ea.). it is unclear whether this is based on historical, budgetary quotes or market prices etc.	The Vendor should provide pricing sources for all major equipment e.g. flux detectors (vendor quotes, historical data – year of historical data and so on) in the next revision of the estimate.	ESTIMATING	The contractor did not provide pricing source however , they provided basis for most and major items and the material cost has been checked against OPG Asset Suit. Will be monitored in subsequent revisions.
KPMG	9.4-BOP-53	Robert Obertreis	Robert OBERTREIS	There does not appear to be any pricing sources for commodities and bulk materials.	■ The Vendor should provide bulk material and commodity pricing sources in the next revision of the estimate.	ESTIMATING	The contractor did not provide pricing source however , they provided basis for most and major items and the material cost has been checked against OPG Asset Suit. Will be monitored in subsequent revisions.
KPMG	9.4-BOP-54	scott guthrie	tbd	The Pricing source for home office costs (project management, engineering, etc.) is unclear. Project management – overhead and profit is calculated as a percentage of direct and indirect labour (7% and 5% respectively) – ref. 'Unit 2' worksheet, rows 414 and 415; ■ Indirect labour includes PMT costs. Engineering design – part of the cost for the first tier subcontractor (engineering) is a hard coded number on the 'Summary' worksheet, row 13 (called 'Project Defined'). However, this amount includes more than just engineering cost, it also includes PMT and procurement costs. For example, the 'Project Defined' cost is \$2.3M, however, per the Bundle Integration Review this amount includes \$238K of PMT and \$1.6M of procurement cost; and ■ It is unclear why the engineering costs are not included in Unit 2 worksheet for the first tier subcontractor costs (phase 1 engineering) as all these costs are zero (\$0) – ref. Unit 2 worksheet, rows 76 and 77.	■ The Vendor should clarify where the percentages (i.e. 5% ad 7%) are coming from for Overhead and Profit (i.e. reference the applicable section of the ESMSA agreement) in the next revision of the estimate; and ■ The Vendor should also allocate Phase 1 costs to the appropriate WBS category, i.e. – break down the 'Project Defined' costs per the correct WBS category (e.g., allocate \$238K to PMT, allocate \$2.3M to procurement) so that an accurate picture of the key ratios can be presented (e.g., Vendor PMT cost ratio vs. direct work, Engineering cost ration vs. direct work) in the next revision of the estimate.	ESTIMATING	The percentages are based on the ESMSA contract, and referenced in the BOE. Other comments are addressed through Comment and disposition sheet. Sufficient information has been provided on the project basis and issued in the approved estimate.
KPMG	9.4-BOP-55	Robert Obertreis	Robert OBERTREIS	While there appears to be budgetary quotes for some of the costs (18", 8" and 6" 3-Way Valve Assembly and the 24" BF Valve assembly), others costs that are hardcoded appear to have no basis. For example, the fan/damper control panel cost of \$50,000 (ref O15, Electrical tab); and ■ Furthermore in the estimate Excel file, the cost for the Blower Fans 1 and 2 and Roll Up doors have been indicated to be from budgetary quotes, however their source is not clear.	The vendor should provide the back-up / sources for major materials / equipment in the next revision of the estimate.	ESTIMATING	The quotes are not provided, will be monitored in subsequent revisions.
KPMG	9.4-BOP-56	Robert Obertreis	Robert OBERTREIS	There does not appear to be any pricing sources for commodities and bulk materials. For example, the cost for the globe valve (\$45K) andspool pieces (\$20K) have been hardcoded with no basis / source. (ref Cell Z30, Z59 Piping Tab)	The Vendor should provide bulk material and commodity pricing sources in the next revision of the estimate.	ESTIMATING	The issues identified were resolved through the comment and disposition process. Pricing sources were identified where available and any absences were reflected in the assignment of estimate class.
KPMG	9.4-BOP-57	Robert Obertreis	Robert OBERTREIS	The pricing sources for major equipment is not clear. In the BOE, it was indicated that the procurement for all major components was done in Phase 1, and Phase 1 costs is a hard coded value in the estimate file (~\$2.7M); and ■ On a minor note for the second tier contractor, there does not appear to be any pricing sources for the Procurement of Long & Non-Long Lead materials and it is a hardcoded value (Tier 2 ENG tab)	The vendor should provide the back-ups / sources for major materials / equipment in the next revision of the estimate.	ESTIMATING	The issues identified were resolved through the comment and disposition process. Pricing sources were identified where available and any absences were reflected in the assignment of estimate class.
KPMG	9.4-BOP-58	Robert Obertreis	Robert OBERTREIS	There does not appear to be any pricing sources for commodities and bulk materials.	■ The Vendor should provide bulk material and commodity pricing sources in the next revision of the estimate.	ESTIMATING	The contractor did not provide pricing source however , they provided basis for most and major items and the material cost has been checked against OPG Asset Suit. Will be monitored in subsequent revisions.
KPMG	9.4-BOP-59	Robert Obertreis	Robert OBERTREIS	This project involves tooling and it does not appear that the vendor has had an opportunity to perform training on the mock-up yet so the durations/productivity rates could be uncertain until the testing and training has been carried out.	The vendor should provide greater details with respect to the durations and productivity rates of the work activities after the testing and training has been completed in the next revision of the estimate.	ESTIMATING	Training cost was included in the estimate to degree known/understood and was approved estimate class reflected that level of definition.

Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPONSE
KPMG	9.4-BOP-60	Robert Obertreis	Robert OBERTREIS	In general the vendor's estimate reflects the project objectives and scope of work. However, there are many quality issues (i.e. BOE is incomplete and not comprehensive and there are approximately 60 Category B and C issues outstanding)	■ OPG should work with the Vendor to continue to improve the quality of estimates. This will likely require the Vendor to employ a more detailed, accurate and bottom-up approach estimation methodology	ESTIMATING	OPG has worked with the vendor to improve the quality revisions and requirements were outlined in the revised BOE template. Revised, approved estimates of good quality for BOP were included in the U2EE estimate
KPMG	9.4-BOP-61	Robert Obertreis	Robert OBERTREIS	There does not appear to be any cost for equipment in the vendor's estimate. In addition, there does not seem to be any assumptions in the Vendor's estimate as to where all the equipment required to lift and move equipment and transport materials are presumed to be available from.	OPG could consider requiring that the Vendor clarify its basis and assumptions for the equipment required to lift and move equipment and transport materials in the next revision of the estimate.	ESTIMATING	Costs for all Equipment that Contractor intends to use to move/lift material has been included as factor applied to DFL and it is not based on deliverables. Will be monitored in subsequent revisions.
KPMG	9.4-BOP-62	Robert Obertreis	Robert OBERTREIS	There does not appear to be any cost for equipment in the vendor's Excel cost estimate (see Unit 2 worksheet, Rows 384 - 403). However, according to the BOE (ref. BOE, Section 4 (assumptions), #23) the Vendor appears to be planning to purchase equipment (e.g., tow motors and cranes) to execute the work.	OPG could consider requiring the Vendor to clarify its equipment purchasing plan and confirm that it is reflected in the next revision of the estimate.	ESTIMATING	Costs for all Equipment that Contractor intends to use to move/lift material has been included as factor applied to DFL and it is not based on deliverables. This was aligned with the approved estimate class at the time of review.
KPMG	10.4 OM-1	Robert Obertreis	P&C Lead	Labour rates used in the estimate are in 2013, 2015, and 2016 dollars.	At the time of writing, the OPG Finance team indicated that a new consolidated 'master' Excel functional cost estimate file was created using the inputs from the individual subfunctions' Excel cost estimate files. It was also discussed that OPG has reviewed and consolidated the labour rates in the new master file; and ■ Although it had previously been requested, at the time of writing, the KPMG team had yet received a copy of the consolidated master cost estimate file for review and to confirm this information from the interviews.	ESTIMATING	<b>This rates are correct, within the Master Consolidated File (MCF) rev 4 there are two different rate table worksheets; one for \$2015 and one escalated to \$DOY (dollar of the year). Each of these worksheets contains three tables:</b> <b>1. Labour rates for OPG w/o OT (not used for any calculations)</b> <b>2. Labour rates for OPG with OT (Factor of 2% in 2016 and 2026, 4% from 2017 to 2025) Excluding management positions.</b> <b>3. Labour rates for Augmented staff (Aug Staff Mark up of 15% on Labour rates for OPG w/o OT)</b>  <b>All FTE costs in the MCF "Flat Data" worksheet are calculated using these rate tables. There is a consistent formula in the worksheet that calculates the FTE cost. Every FTE line item is costed out in both \$2015 and \$DOY.</b>
KPMG	10.4 OM-2	Robert Obertreis	P&C Lead	■ There are fluctuations in the level of effort "LOE" allocated to each unit that are random, and not traceable back to the O&M Functional Management Plans or supporting documentation; and ■ Any learning curve effects, efficiencies, risks should be stated in assumptions and applied methodically. Discrepancies that cannot be justified with such assumptions should be reconciled through an estimate review process.	At the time or writing, the Operation, Maintenance, and Radiation Protection ("RP") team leads indicated that they were going to review LOE allocated to all units, check for inconsistencies and document the reasons for fluctuations in their respective estimate documentation; and ■ The Operation and Maintenance leads provided work-in-progress documentation and verbal explanation for the fluctuations in their respective estimate documentation. It is anticipated that the documentation of the assumptions will be finalized prior to the 'check estimate' in 2016.	ESTIMATING	1. Labour rates for OPG w/o OT (not used for any calculations)

Oversight Closeout Spreadsheet							
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE
KPMG	10.4 OM-3	Robert Obertreis	P&C Lead	There are a number of discrepancies between the positions and levels of effort presented in the operations organizational chart versus the ones presented in the RQE Template spreadsheet.	Follow-up meetings with the Operation, Maintenance, and Radiation Protection (“RP”) leads the discrepancies were discussed. The Operations and RP teams indicated that they are going to examine FTEs allocated to different functions to identify if the organizational requirements have been accurately reflected in the estimate; ■ The O&M / Finance team explained that (a) the organizational chart is more of a conceptual representation that is used to communicate requirements to the station and (b) the number of positions fluctuates throughout the course of the program so a point in time snapshot of the staffing levels could be misleading. Therefore, the organization charts were not intended to be relied on to identify the number of positions required (and they were not used for RQE purposes – the excel cost templates were used for RQE purposes). The number of positions and levels of effort should be accurately reflected in the costestimate spreadsheets which were used as the basis for the RQE; and	ESTIMATING	2. Labour rates for OPG with OT (Factor of 2% in 2016 and 2026, 4% from 2017 to 2025) Excluding management positions.
KPMG	10.4 OM-4	Robert Obertreis	P&C Lead	There is a potential 15%- 30% factor applied to all O&M RQE Resource Estimates that does not get stated in the planning instruction tab. This potential factor is applied to each role in every month or year.	The OPG Finance team indicated that a new consolidated ‘master’ Excel functional cost estimate file was created using the inputs from the individual sub-functions’ Excel cost estimate files. It was also discussed in the meeting that OPG has reviewed and consistently applied the factors/ multipliers (i.e., multipliers for augmented staff costs) in the new master file. Although KPMG had requested the document multiple times, at the time of writing KPMG had yet to receive a copy of the consolidated master cost estimate file for review.	ESTIMATING	3. Labour rates for Augmented staff (Aug Staff Mark up of 15% on Labour rates for OPG w/o OT
KPMG	10.4 OM-5	Robert Obertreis	P&C Lead	The scope of work for the operations function, as defined in the Functional Management Plan and Ownership Transfer Plan, do not seem to be reflected in the estimate.	Lack of a comprehensive SOW for O&M was discussed with O&M functional leads. Operations and RP teams indicated that they are going to work towards generating supporting documentation that link LOE to specific O&M tasks. The maintenance team stated that their estimate is not SOW driven and doesn't need to be modified or linked to SOW.	ESTIMATING	
KPMG	10.4 OM-6	Robert Obertreis	P&C Lead	The lack of an integrated schedule poses an issue for interfacing with RFR, BOP, and other projects during their critical path activity or peak planning for capacity.	Those activities that interface with critical path activities, and occur during peak capacity periods should be scheduled if possible to provide the opportunity to conduct further schedule analysis.	ESTIMATING	All FTE costs in the MCF “Flat Data” worksheet are calculated using these rate tables. There is a consistent formula in the worksheet that calculates the FTE cost using the Job Family (Resource Type L4) and the Resource Type L3 (which specifies Aug, Regular, etc) to determine which rate table to pull the rate from. Every FTE line item is costed out in both \$2015 and \$DOY.

Oversight Closeout Spreadsheet								
Org	Auditor Findings	Owner	Delegate	Finding Description/ISSUE	Action Required	FUNCTIONAL AREA	TOPIC REPSONSE	
KPMG	10.4 OM-7	Robert Obertreis	P&C Lead	Job titles are not standardized among O&M documentation.	Consistent terminology should be used throughout the estimate files and supporting documentation, such as Ownership Transfer Plan.	ESTIMATING		CLOSED
KPMG	10.4 OM-9 (there is no 8)	Robert Obertreis	P&C Lead	Assumptions / Basis recorded in the RMO tool are not easily identified within the RQE Template spreadsheet or clearly linked to scope in the FMP or OTP.	Any assumptions should be stated explicitly in the Planning Instructions tab, and it should be clear where they are applied.	ESTIMATING	Planning Assumptions are identified in the FMP and detailed in the RMO tool	CLOSED
KPMG	10.4 OM-10	Robert Obertreis	P&C Lead	The calculations in the Output-Life cycle cash flow tab appear to possess some issues with data integrity: hard coded factors are applied, and disaggregation of costs into monthly amounts is hard-coded into cells. While all sheets are linked, the model appears to be lacking in best practices. Some values in the formulas are hard coded, and some of the assumptions cannot be traced back to supporting documentation.	Review and properly document RQE estimate inputs, definitions, factors, and structure.	ESTIMATING	All tables are pivot tables based on Unit 2 EE raw data from a consistently applied template used by all departments.	CLOSED
KPMG	10.4 OM-11	Robert Obertreis	P&C Lead	It is not clear how the Resource Breakdown Structure used in the RQE Template spreadsheet corresponds with the Organizational Structure for O&M functions.	It would be difficult at this time to resequence the WBS structure of functions, meaning emphasis should be made on standardizing the subcategorization of the 6-digit WBS number so that it is easy to trace similar sub-categories from one functional estimate to another.	ESTIMATING	Action complete; U2EE estimate contains an aligned O&M-WBS, and the resources have been standardized per JF2.	CLOSED
KPMG	10.4 OM-12	Robert Obertreis	P&C Lead	The RQE workbook does not contain strong definitions that align with Organizational Structure, Scope of Work, WorkBreakdown Structure, or supporting documentation such as the Ownership Transfer Plan.	Consistent terminology should be used throughout the estimate files and supporting documentation, such as Ownership Transfer Plan.	ESTIMATING	FMP's, PMP's, BOE's and all input templates follow a standardised format for U2EE.	CLOSED

## Attachment to L-04.3-1 Staff 68, part c)

### Expert Panel Review recommendations and responses

**Recommendation 1:** *The Panel recommends the JV continue efforts to refine their understanding of the project risks within their scope of work over the next several months and continue effort on mitigation strategies through the standby phase and into construction.*

Closed - June-14-2016. "Mobilization plan work continues and results are reviewed against the risk register at regular risk review meetings held bi-weekly at the working level and monthly at the manager level. The mobilization plan is part of the project P6 schedule and our risk review process is mature. For the purposes of RMO this action is considered to be handled via our schedule review process and should be considered complete from an RMO perspective." \*  
Ongoing, no new risks identified.

**Recommendation 2:** *The Panel recommends OPG continue efforts to refine their understanding of the complete envelope of all risks related to the RFR Project, including risk ownership, to avoid gaps and duplication over the next several months; and continue effort on mitigation strategies through the standby phase and into construction.*

Closed - Class 2 ensured this was done plus FOAK/FAW.

**Recommendation 3:** *A realistic working schedule with duration between the best achievable and the most likely schedule needs to be established to align project planning in both organizations. The earlier this schedule is in place, the more effectively the impact of task and logic changes can be managed going forward.*

No specific disposition found for this action; however, the project has completed significant work in this area

**Recommendation 4:** *The Panel believes retube waste processing remains a significant risk to the project. The Panel recommends OPG and the JV put in place a program to perform additional performance tests after factory acceptance testing and then to plan and allow time for comprehensive commissioning and "shake down" tests when the lines are assembled at site.*

Closed - April 4 - Plan in place, JV to continue until tool shipment. Complete. Plan established, PCD underway.

**Recommendation 5:** *As the Darlington RFR Project moves toward the implementation phase, it is important create a constructive working relationship between OPG Operations, the OPG Project Team and the JV.*

Closed - Recent workshop successfully held with JV with external 3rd party. Suites of escalation and/or alignment meetings are underway. For the time being this item can be considered closed, will resurrect if future issues dictate. Action complete. October 18, 2016 April 4 – JV & OPG continue to work towards a more constructive relationship. Escalation process now in place to discuss weekly issues.

**Recommendation 6:** *The impact of the contracting strategy on project execution and teamwork should be examined as it plays an important role in shaping behaviors of the parties.*

## Attachment to L-04.3-1 Staff 68, part c)

Closed - Although we have a few outstanding commercial issues there are currently no disputes relative to contractor behaviour at present. The pending process VP PACM is putting in place for rapid and timely resolution going forward will be the feedstock for any postulated changes to the contract should they be deemed necessary. Action closed. October 18, 2016. Several forums have been established between the Joint Venture and OPG to enable active and timely discussion of commercial issues. PCD'S are discussed weekly, a Senior Management Escalation meeting has been established and we are in the process of getting approval for a Directors alignment meeting.

Lastly, outstanding is building the runstream and expectations for formally managing the runstream for all issues. Performance will be measured by conformance with timelines for issues resolution as the primary metric. Action remains in progress.

**Recommendation 7:** *Establish a Darlington RFR RP organization early with streamlined project specific procedures. Invest in technology to increase RP effectiveness and reduce dose to both RP technicians and workers.*

In-progress TCD 2016 Dec 15- Further work to fully incorporate RP remains outstanding. A working committee has been established to identify, track and manage outstanding RP issues. It is suspected this committee will be mature by end of 4th quarter, this action to remain in progress until the process can be relied on to address all concerns. New due date of December 15. L. Laking for R. Brown October 18, 2016 RP staff have been embedded at the DEC and are working as part of the mobilization plan by overseeing mockup activities, actively participating in some field work. Effort to bolster the support will engage post the current Darlington outage. Further integration with the train the trainer and training will occur later 4<sup>th</sup> quarter. Action remains in progress.

**Recommendation 8:** *The mock-ups at the DEC are far superior to anything used on past retube projects. The Panel recommends the DEC be used to its full potential throughout the coming year to refine the processes and challenge the tooling to be used. Some aspects of the concerns identified by the Panel elsewhere in this report can be addressed through a well-executed Standby Plan.*

Closed - June 9 - Plan in P6, part of current work program. Mobilization plan in place. Post completion of Hard Preps, rehearsals & enhanced training will commence.

**Board Staff Interrogatory #69**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-9, page 7

The above reference refers to the use of Earned Value Management as the primary method for DRP cost management and monitoring.

- a) How will OPG monitor and track earned value for all contractors? Provide all written governing process and procedures and a narrative explanation including an example of how OPG will calculate SPI and CPI.
- b) How is OPG going to track the Project's schedule and the progress of contractors pursuant to the schedule? Provide all applicable written policies and procedures.
- c) How often are the contractors providing a schedule update to OPG?
- d) Describe OPG's process for managing or releasing float. Provide the written governance process, if any.
- e) Describe OPG's process for re-baselining the schedule, if necessary. Provide the written process and procedure, if any.
- f) Explain the float built into the overall project schedule and how it is allocated for each Unit.

**Response**

- a) Please see also the response to Ex. L-4.3-1 Staff-057:
  - The earned value management process is documented within Nuclear Refurbishment Earned Value Management N-MAN-00120-10001-SCH-007-R002 (see Ex. L-4.3-1 Staff-48a, Attachment 45).
  - All work completed within Nuclear Refurbishment (including all work performed by contractors) is completed under a work package. All direct work related work packages (i.e., work packages that include work done in the field) are planned in the scheduling system (Primavera 6). All work packages, including direct work related



- 1 work packages and level of effort work packages (i.e., Project Management), are  
2 captured in the cost tool (Ecosys).
- 3 • During definition of the projects, earning rules were established for each work  
4 package, including contractor work packages. These earning rules provide direction  
5 on what percent progress can be applied to a work package (and ultimately how  
6 much can be earned for a particular deliverable). The guidelines for the earning rules  
7 are included in the N-MAN-00120-10001-SCH-007-R002 (see Ex. L-04.3-1 Staff-  
8 48a, Attachment 45).
  - 9 • On a daily basis, schedule activities are updated indicating the status of work. The  
10 overall integrated schedule is updated (refreshed) once per week. The status of all  
11 activities (which is the lowest level of granularity within a schedule) is updated, and  
12 the percent complete for each work package is established. Once the vendors have  
13 submitted the work package percentage complete (in alignment with their earning  
14 rules), the project teams verify the reported progress. This percentage progress  
15 forms the basis of 'earned value'.
  - 16 • The Schedule Performance Index (SPI) is calculated by the percentage complete of  
17 the planned value to determine earned value. SPI is calculated as the Earned Value  
18 divided by the Planned Value in the schedule.
  - 19 • To calculate Cost Performance Index (CPI), Earned Value is determined by  
20 multiplying the percentage complete from the schedule by the cost planned value at  
21 the work package level. Cost Performance Index is calculated as the Earned Value  
22 divided by Actual Cost, as shown in Ecosys.
- 23
- 24 b) All contractors' schedules are integrated into a single Primavera 6 scheduling tool,  
25 controlled by OPG. Each schedule is linked by interface milestones and logically tied.  
26 Each contractor developed their schedule following a standard set of schedule codes as  
27 directed by OPG. They must also follow the same update cycle in order to measure  
28 progress and determine Earned Value. Refurbishment uses multi-level scheduling as  
29 described in Ex. D2-2-6, Figure 1, p. 3. Each Level 3 execution schedule is updated daily.  
30 Level 2 Work Packages are updated weekly as described in part a). A project baseline  
31 has been established for all contractors and schedule variance from baseline is measured  
32 on a weekly basis. Requirements are set out in N-MAN-00120-10001 SCH-11 Darlington  
33 Refurbishment: Schedule Management Plan for Integrated Level 3 Execution (Ex. L-4.3-1  
34 Staff 48a, Attachment 28).
- 35
- 36 c) As noted in parts a) and b) each Level 3 execution schedule (activities) is updated daily  
37 and the Level 2 Schedules (work packages) are updated weekly.
- 38
- 39 d) Schedule contingency is owned by OPG. Project schedule contingency within the planned  
40 outage duration (target duration) of the schedule is released via the Change Control  
41 Board, where the SVP Execution can approve up to a 5-day impact on critical path, and  
42 the SVP Nuclear Projects must authorize critical path impacts of over 5 days. Program  
43 schedule contingency beyond the target duration (i.e., within the high confidence  
44 schedule) is released via the Program Change Control Board, where the SVP Nuclear  
45 Projects has the authority to approve up to a 5-day impact on critical path. All schedule  
46 contingency released above that threshold will require CNO and CEO approval. Both the



1 Change Control Board and the Program Change Control Board are managed by the  
2 Project Planning and Controls Function to provide the first layer of independence on the  
3 schedule and to ensure appropriate record keeping and transparency of information flow.  
4 All changes are documented in a standard form.  
5

6 e) Schedule re-baselining is a controlled process managed under the Nuclear Refurbishment  
7 change management process documented in NR Program Change Management N-MAN-  
8 00120-10001-PC-12-R001 (Ex. L-4.3-1 Staff-48a, Attachment 27). Approval authority of  
9 the schedule change is dependent on the materiality of the impact to the Darlington  
10 Refurbishment Program, as noted in Part d) above. Baseline changes to program  
11 milestones are approved at the Change Control Board. Critical impact milestones and  
12 OPG Board commitment milestones are approved at the Program Control Board. Please  
13 see Nuclear Project Schedule Management N-MAN-00120-10001-SCH-R001 (Ex. L-4.3-1  
14 Staff 48a, Attachment 25) for additional information.  
15

16 f) At Release Quality Estimate (RQE) (November 2015), the contingency built into the high  
17 confidence schedule for Unit 2 was 5 months. Please see Ex. D2-2-8, Attachment 1, p.  
18 32, which shows the high confidence schedule for Unit 2 at 40 months and Ex. D2-2-6,  
19 Attachment 1, which shows the target duration for Unit 2 at 35 months. In the Unit 2  
20 Execution Estimate dated August 2015, filed at Ex. L-4.3-1 Staff-055, Attachment 1, the  
21 high confidence and target durations remained at 40 months and 35 months respectively.

**Board Staff Interrogatory #70**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-9, Attachment 2 page 12

Ref: Exh D2-2-6, Attachment 1

The first reference states that “[t]he current assessment from the Defueling team shows the best case for defueling is 90 days, the most likely (i.e. P50) is 113 days, and the 90% confidence level duration is 134 days.” The second reference shows the duration of Defueling as 113 days. OPG states in numerous locations in the evidence that it has a high level of confidence (P90) in the total DRP schedule.

Please explain the high level of confidence with the duration of the defueling of the unit (a critical path component) at 113 days.

**Response**

Exhibit D2-2-6, Attachment 1, depicts the planned outage duration (target duration), and not the high confidence schedule. Similarly, the reference to 113 days in Ex. D2-2-9, Attachment 2, p. 12 refers to the target duration for the defueling activities, and not the high confidence duration. The high confidence duration for the defueling activities is 134 days and includes contingencies for risks. An example of one of these risks is that, should a Primary Heat Transport Pump fail, it would significantly affect the target duration for defueling. Therefore, this risk is included as one of the risks in the determination of the high confidence duration using OPG’s methodology for calculating schedule contingency as described in Ex. D2-2-7.

OPG discusses the differences between the planned outage duration (target duration) and the high confidence schedule in Ex. D2-2-6, p. 5. Specifically, OPG states that it will manage day-to-day performance using the target duration, and that that schedule will be used to determine contractor incentives and disincentives.

**Board Staff Interrogatory #71**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-10, Chart 1

OPG has indicated that it has reclassified a number of projects from DRP to the Nuclear Operations Portfolio.

- a) Please confirm that the following table shows all the projects that have been reclassified and the correct total cost.

Project	Project #	Total Project Cost (\$M)
Darlington Operations Support Building Refurbishment	25619	62.7
Darlington Auxiliary Heating System	34000	99.5
Emergency Service Water Pipe and Component Replacement	73397	6.7
Primary Heat Transport Pump Motor Replacements/Overhaul	73556/80144	129.5
Highway 401 & Holt Road Interchange	73706	31
Total		329.4

- b) As noted in the EB-2013-0321 Decision with Reasons, issued November 20, 2014, the estimated total cost of the DRP at that time was \$12.9B (including interest and escalation). OPG has removed projects from the DRP scope, yet the total cost for the DRP is still \$12.8B (including interest and escalation) (reference D2-2-8, Chart 3). Please explain why the total cost of the DRP has not been reduced for these reclassified projects.
- c) Please explain further the rationale for reclassifying these projects from the DRP to the Nuclear Operations portfolio. Does OPG anticipate reclassifying any further projects?

Response

a) OPG confirms that the table shows all capital projects that have been reclassified as Nuclear Operations portfolio capital projects, as noted in Ex. D2-2-10, pp. 10-11. With the exception of the Highway 401 & Holt Road Interchange, the total project cost for all other projects listed in the table is correct. As stated in Line 32 of Table 1 in Ex. D2-1-3, the total project cost for the Highway 401 & Holt Road Interchange is \$28.6M.

b) The main purpose of the Release Quality Estimate (RQE) was to prepare a high confidence cost and schedule estimate based on the final scope to be managed during the Darlington Refurbishment Program (DRP). The results of RQE are a high confidence estimate for which the DRP's performance will be measured against.

The DRP cost estimate considered in EB-2013-0321 was prepared while the project was still in the Definition Phase. The cost and schedule estimates were not as well developed with several estimates still at the conceptual levels (Class 5 or 4). The final scope for DRP had not been established. For the 2015 RQE Business Case, OPG had an overall Class 3 estimate with the majority of projects at Class 3 or 2 based on a fully defined project scope, and had developed an initial integrated schedule including all contractors and scopes of work and was able to determine the critical path through the Unit 2 schedule (see L-04.3-2 AMPCO-85).

There were a large number of changes in the DRP estimate, including removal of the reclassified projects, between the estimate considered in EB-2013-0321 and the high confidence RQE.

c) Please see L-2.2-1 Staff-008, part c).

As part of the development of the RQE, OPG evaluated DRP scope to ensure that it was work that had to be done to extend the life of the Darlington units and that the work could not be done as part of normal life cycle management program. Where work could be done at another time and/or where it could be done as part of the normal station life cycle management program, it was reclassified to the Nuclear Operations portfolio.

Darlington Operations Support Building (OSB) Refurbishment was reclassified because it provides services that support the daily operations of the entire station. The project provides office space for operations support staff, technical services, security systems, IT, telephone network hub etc. to the station.

Darlington (DN) Auxiliary Heating System was reclassified because it provides reliable back-up steam to the entire station when it was placed in service. Back-up steam is needed to support irregular conditions such as an event where all four turbine units are shut down in the winter, to mitigate potential major equipment damage due to freezing.

1 The Emergency Service Water Pipe and Component Replacement was reclassified  
2 because the project was required to ensure a safe and reliable supply of emergency  
3 service water before, during and after refurbishment.  
4

5 The Primary Heat Transport Pump Motor Replacements/Overhaul was reclassified  
6 because the work was required to be completed as soon as possible (prior to  
7 refurbishment outages on certain units) in order to maintain station reliability.  
8

9 The Highway 401 and Holt Road Interchange Project was reclassified because the  
10 completion of this project was necessary to provide improved traffic flow for peak staffing  
11 during regular planned outages as well as during refurbishment.  
12

13 Now that the scope of the DRP is set as per the RQE, OPG does not anticipate  
14 reclassifying any further projects.

**Board Staff Interrogatory #72**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exhs D2-2-7, D2-2-8 and D2-2-10

OPG has provided copies of third party reports in the above referenced exhibits.

- a) Please provide a copy of any other third party reports regarding the DRP prepared during the planning phase that have not already been filed by OPG in EB-2016- 0152.
- b) Please provide a copy of all audit reports regarding the DRP.
- c) Will OPG receive reports from any other third party independent oversight groups involved in the DRP during the execution phase? What is the frequency? Will they generate written reports? Who will receive the reports?
- d) What is OPG's Audit program during the execution phase of the DRP? What areas will be audited? What is the schedule for the audits during the execution phase of the DRP? Who will receive the reports?

**Response**

- a) There are an extensive amount of third party reports regarding the Darlington Refurbishment Program (DRP) that cover technical details on a variety of topics. The following is a list of third party oversight reports regarding the DRP:

1) Modus/Burns & McDonnell – Definition Phase

Reports are provided as Attachments as listed:

- 1. Initial Project Assessment – Darlington Nuclear Refurbishment Project (August 13, 2013)
- 2. Report to Nuclear Oversight Committee – 4<sup>th</sup> Quarter 2013
- 3. Report to Nuclear Oversight Committee – 1<sup>st</sup> Quarter 2014
- 4. Report to Nuclear Oversight Committee – 2nd Quarter 2014
- 5. Report to Nuclear Oversight Committee – 3rd Quarter 2014
- 6. Report to Nuclear Oversight Committee – 4<sup>th</sup> Quarter 2014

7. Supplemental Report to Nuclear Oversight Committee Observations Regarding 4d Cost Estimate - 4<sup>th</sup> Quarter 2014
8. Report to Nuclear Oversight Committee – 1st Quarter 2015
9. Report to Nuclear Oversight Committee – 2nd Quarter 2015
10. Report to Darlington Nuclear Refurbishment Project – 3Q 2015
11. Report to Darlington Review Committee of OPG Board of Directors
12. Nuclear External Oversight Assessment Report Cost Management & Earned Value
13. Nuclear External Oversight Assessment Report Assessment of 4c Estimate and Cost Management
14. Nuclear External Oversight Review of OPG Risk Management Practices and Procedures – February 2015
15. Report to Board of Directors Board Retreat October 1-2, 2015
16. BMcD/Modus Recommendations 2Q 2015 Report to NOC
17. Nuclear External Oversight Assessment of OPG Operating Experience & Lessons Learned Practices and Procedures
18. Nuclear External Oversight Review of Darlington Refurbishment Schedule Management Practices and Procedures
19. Attachment B – Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013
20. Nuclear External Oversight Assessment Report of DR Team's Process for Developing the RQE Estimate (already filed at Ex. D2-2-8, Attachment 2)
21. Independent Oversight Team – Assessment of OPG Scope Definition and Management Process

2) Previous Ontario Minister of Energy - Independent Advisor

Reports are provided as Attachments as listed:

22. Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program - Q3 2014
23. Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program - Q4 2014
24. Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program - Q1 2015
25. Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program - Q2 2015
26. Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program - Q3 2015
27. Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program – Q4 2015

- b) OPG produces two types of audit reports that are applicable to the DRP: (1) Nuclear Oversight reports, and, (2) Internal Audit reports:

1) Nuclear Oversight

During the period of January 1, 2014 to September 30, 2016, Nuclear Oversight performed 45 Audits and Assessments (34 Audits, 11 Assessments) that included Darlington Nuclear Refurbishment in scope. Of those, 13 identified issues requiring corrective action within Refurbishment.

Nuclear Oversight works closely with the Line organizations being evaluated, including implementing processes that provide acknowledgement of the issues identified and achieving agreement and ownership of corrective actions.

The issues identified during this period consisted of deficiencies/gaps from a fleet or station perspective as well as specific to the refurbishment project. The areas requiring further corrective action included assessment of planning and design activities, conduct and implementation of plant activities, as well as assessment of programmatic effectiveness.

The following chart contains the list of the Nuclear Oversight Audits and Assessments that included Darlington Nuclear Refurbishment in Scope. All findings and associated management actions relevant to the DRP are provided in Attachment 28.

**Chart 1 – Nuclear Oversight Audits**

Audit #	Audit Title
2014-005	Work Protection
2014-006	Pressure Boundary Section 18
2014-008	PB Program Review (incl. CAP review surveillance)
2014-011	Procurement Engineering
2014-012	Human Performance
2014-017	Fire Protection Program
2014-018	Environment Programs
2014-020	PB Design Control (including PB Procurement Engineering)
2014-021	PB Control of Processes & Test Control and Material Management
2015-013	Software Program – Real Time Process Computing
2015-014	Environmental Management
2015-016	Fire Protection
2015-018	PB Design Control (incl: PB Procurement Eng. Aspects)
2015-020	Pressure Boundary Audit - Section 18
2015-021	Reactor Safety Program
2015-022	Project Management
2015-024	Items & Services Management, including Pressure Boundary
2015-029	Heavy Water Management



Audit #	Audit Title
2015-033	Configuration Management
2016-001	Health & Safety Management System Program
2016-002	Corrective Action Program
2016-004	Equipment Reliability
2016-005	Major Components
2016-008	Welding
2016-013	Risk and Reliability
2016-014	Environmental Management
2016-015	Conduct of Maintenance
2016-016	Records and Documentation
2016-020	Work Management
2016-021	Work Protection
2016-027	Integrated Aging Management
2016-028	DNR Project Management
2016-029	DNR Conduct of Engineering
2016-031	DNR Emergency Preparedness

**Chart 2 – Nuclear Oversight Assessments**

Assessment #	Assessment Title
2014-200	Darlington Nuclear Refurbishment (DNR) Engineering Activities
2014-204	Darlington Performance Assessing - Operations & Maintenance Readiness for DNR
2014-310	Contract Administration Assessment
2014-319	Fleet Performance Assessing - CMO 180 Day Follow
2015-202	Darlington Nuclear Refurbishment Chemistry
2015-205	DNR - Engineering
2015-206	DNR Contractor Safety Plan
2015-208	Darlington NLO Initial Training
2015-321	Follow-up to Human Performance Audit NO-2014-012
2016-208	Pressure Boundary Darlington Refurbishment
2016-209	SATM & Housekeeping Darlington Nuclear Generating Station ("DNCS")

2) Internal Audit

During the period of January 1, 2014 to September 30, 2016, Internal Audit performed 17 audits that included DRP in scope.

The issues identified during this period include (but are not limited to) deficiencies with documentation, unclear organizational accountabilities, contractor non-compliances, planning and scheduling issues, and financial controls.

The following table contains the list of the Internal Audit reports relating to DRP. All findings and associated management action plans relevant to the DRP are provided in Attachment 29 (confidential).

**Chart 3 – Internal Audit Reports**

Audit #	Audit Title
14-15	Administration of Contractual Documentation - Refurbishment
14-17	Finance's Control Over Darlington Refurbishment
14-18	Turbine Generator (TG) Critical Parts Procurement – Darlington Refurbishment Project
14-26	Darlington Station Readiness for Refurbishment
15-17	EPC Contractor Procurement Review – Darlington Nuclear Refurbishment Project
15-24	Invoice Review & Approval Process – DRP Projects
15-47	ES MSA Recovery negotiations Audit - Follow-up on 2013 Auditor General Findings
16-07	Darlington Nuclear Refurbishment Project Management Audit
16-08	Darlington Nuclear Refurbishment – Contractor Invoicing Audit
16-09	Darlington Nuclear Refurbishment On boarding
16-13	Darlington Nuclear Refurbishment Contractor and Subcontractor Management Audit
16-23	Darlington Nuclear Refurbishment– Retube & Feeder Replacement Construction and Tooling Audit
16-24	Darlington Nuclear Refurbishment Turbine Generator Engineering Audit
16-25	Darlington Nuclear Refurbishment Integrated Database for Project Reporting Audit
16-39	DNR Contractor Procurement – R&FR Project Audit

c) External oversight of the DRP is being conducted on behalf of the Board of Directors, the Ontario Minister of Energy, and OPG's President and CEO. This will continue throughout the Execution Phase:

- 1) Darlington Refurbishment Committee of the OPG Board of Directors- Burns and McDonnell

OPG's Board of Directors recently re-engaged Burns and McDonnell with Modus as subcontractors to provide independent oversight services during the Execution Phase. The Burns and McDonnell reports are submitted to the Darlington Refurbishment Committee of the OPG Board of Directors at their quarterly meetings.

2) Ontario Minister of Energy - Independent Advisor

Please see Ex. L-4.3-1 Staff-222 for description of the Ontario Minister of Energy's oversight during Execution Phase.

3) OPG President and CEO-Refurbishment Construction Review Board (RCRB)

Please see Ex. L-4.3-1 Staff-222 for a description of the RCRB. Reports are provided to OPG's President and CEO.

d) OPG's Audit program during the Execution Phase of the DRP is as follows:

1) Nuclear Oversight

Nuclear Oversight Rolling Audit Schedule Q3 2016 - Q3 2017 (Attachment 30) represents the current Nuclear Oversight Audit plan for the next five quarters. The DRP (see: Darlington Nuclear Refurbishment (DNR) column on the attached) is in scope for the majority of the planned audits. The Nuclear Oversight 2017-2019 Audit Plan is below:

**Chart 4 – Nuclear Oversight 2017-2019 Audit Plan**

AUDITS	2017	2018	2019
Pressure Boundary	X	X	X
Pressure Relief Valves			X
Conduct of Engineering – Design Authority	X		
Conduct of Engineering - Research and Technology	X		
Conduct of Inspection & Maintenance Services	X		X
Component & Equipment Surveillance			X
Software		X	
Items & Services Management		X	
Risk & Reliability			X
Equipment Reliability			X
Reactor Safety		X	
Project Management	X		
Major Components			X

Engineering Change Control	X		
Environmental Qualification	X		
Chemistry		X	
Welding			
Integrated Aging Management			
Decommissioning		X	
Nuclear Waste Management Program		X	
Nuclear Operations	X	X	X
Heavy Water Management			
Nuclear Operations (Fuel Handling)			X
Conduct of Maintenance	X	X	X
Work Protection		X	
Production Work Management		X	
Fire Protection		X	X
Training	X		X
Human Performance		X	
Corrective Action			X
Radiation Protection		X	
Health & Safety Management System Program			X
Environmental Management	X	X	
Nuclear Pandemic Planning	X		
Design Management			X
Nuclear Security (with Nuclear Safeguards)	X		
Radioactive Material Transportation		X	
Consolidated Nuclear Emergency Plan		X	X
Business Planning	X		
Records and Document Control			
Nuclear Safeguards (with Nuclear Security)	X		
Fuel			X
Managed Systems		X	
Conduct of Regulatory Affairs	X		
Independent Assessment (NIEP)			X
Component Equipment Surveillance (DNR only)		X	
Safety System Functional Audit (DNR only)			X

Nuclear Oversight audit reports are distributed to the senior management team within Nuclear (SVPs, VPs, Directors) and to line management who have been involved with audit.

2) Internal Audit

For 2016, Internal Audit will perform the audits set out in Chart 5 relating to the DRP. The 2017 to 2019 Audit Plan relating to DRP is provided in Chart 6.

**Chart 5 – 2016 Internal Audit Plan**

No.	Engagement Name	Status
1	DNR Onboarding	Complete
2	DNR Project Management	Complete
3	DNR Contractor Invoicing	Complete
4	DNR Contractor and Subcontractor Management	Complete
5	DNR Construction & Tooling - R&FR Project	Complete
6	DNR Engineering - Turbine Generator Project	Complete
7	DNR Integrated Database for Project Reporting	Complete
8	DNR Contractor Timekeeping	In Progress
9	DNR EPC Procurement	In Progress
10	DNR Project Revisions & Rework	In Progress
11	DNR Contractor Procurement - R&FR Project	Complete
12	DNR Project Cost Management System	In Progress
13	DNR Finance Controls	In Progress

**Chart 6 – 2017 – 2019 Internal Audit Plan**

Darlington Nuclear Refurbishment			
Year	2017	2018	2019
Program Management	Program Oversight & Reporting	Program Oversight & Reporting	Program Oversight & Reporting
	Vendor Productivity	Quality Management Program	-
Core Project Execution – Project Management	Retube & Feeder Replacement (“R&FR”) – Project Execution	Steam Generator – Project Execution	R&FR – Project Execution
	Fuel Handling – Project Execution	Turbine Generator – Project Execution	Turbine Generator – Project Execution
	Balance of Plant – Project Execution	-	Balance of Plant – Project Execution

The distribution for Internal Audit reports is as follows:

Reports are directed to:

- SVP, Nuclear Projects
- Other Executive Leadership Team Members (as applicable if their organization has ownership for actions)
- Process Owner for the Audit

Other stakeholders included on the distribution (copied) are:

- President & Chief Executive Officer
- SVP Finance, Strategy, and Chief Financial Officer
- Nuclear President & Chief Nuclear Officer
- SVP Nuclear Refurbishment
- VP Nuclear Finance
- Director Refurbishment Systems Oversight
- Director Nuclear Oversight
- Other impacted stakeholders (as applicable)

# Darlington Refurbishment Oversight Report



Solutions for Managing Project Risk

August 13, 2013



# Primary Conclusions



In our *Project Assessment of the Darlington Nuclear Refurbishment Project*, BMcD/Modus has found that the DR Project is appropriately advanced at this stage, with processes and procedures that comport with industry standards. The DR Project is also benefitting from:

- Scope Rationalization – Current efforts to right-size the Project's scope are occurring at an appropriate time and are necessary to remove stress from Engineering.
- Schedule – The schedule embedded in the 2014 Business Plan's revised planning assumptions appears to be reasonably calculated at reducing the Project's overall risk and likelihood for success.

The Project Team has an intense effort ahead and there is still an enormous amount of work to be done over the next year – both in planning and field execution (Campus and Outage Work) that will require significant focus, coordination and effort.





# Major Recommendations

## Scope and Schedule Optimization

- The DR Project's Scope needs to meet OPG's core commitments; process needs to be in place for life-cycle management and non-core scope removed from DR Project.
- Potential risks / opportunities related to revised schedule assumptions need thorough vetting.
- Scope optimization should be completed as soon as practicable to avoid unnecessary work and allow maximum time for planning of needed scope.

## Re-tube and Feeder Replacement (RFR)

- The next phase of estimating will shift from OPEX based on Wolsong/Lepreau to SNC/Aecon's specific plan for the DR Project – need more project-focused information to increase confidence in plan/estimate.
- DR Team should seek/obtain increased transparency from SNC/Aecon regarding risks, contingency and schedule/work flow to obtain best achievable schedule in Class 3 submissions.
- OPG and SNC/Aecon need to clarify requirements for project controls and reporting.

## Balance of Plant (BOP)

- Begin detailed design as soon as practicable to improve likelihood of mature cost estimate at RQE.
- Consider changing the procurement model to assign smaller bundles of work to the ESMSA contractors under existing terms and conditions.
- Provide more visibility to potential budget/schedule risks from upcoming scope defining inspections.



# Major Recommendations

## Campus Plan

- Significant management focus will be needed due to size, breadth and schedule urgency of Campus Plan work.
- Apply OPEX from D20 Storage Facility regarding upfront planning, schedule development, procurement and engineering and performance of ESMSA Vendors.
- Eliminate unnecessary projects from the program.

## Engineering

- Improve metrics for engineering to provide management with comprehensive view of progress.
- Progress work to detailed design as expeditiously as possible, including shoulder-to-shoulder work between OSS and EPC vendors.
- Prepare organization for oversight of detailed design and multiple review cycles.

## Budget and Schedule Development

- The 2014 Business Plan methodology will suffice for the Project's current level of maturity; however, we recommend that next year's 2015 Business Plan should be a full-program reforecast.
- Adherence to processes and procedures for developing cost estimates will assist management in understanding nature and risks of cost estimates.
- The current Level 2 Coordination & Control Schedule ultimately needs to merge into a single detailed Level 3 schedule for the Execution Phase.



# Recommendations – Functional Groups

## Project Management

- OPG's roles as (1) integrator and manager of a multi-prime project and (2) Design Authority need to be better understood by the Project Team.
- Break down silos and move toward managing as a Program rather than 7 independent projects.
- Right-size the Project Team and processes to incorporate and embrace OPG's oversight role on the Project.
- Build-up and involve construction team as early as possible.
- Clarify reporting lines of authority for matrixed Project Controls personnel to assert P&C's independence from Projects.

## Risk Management

- Risk collection and identification needs significant vetting to eliminate management concerns and appropriate score/evaluate risks.
- Raise level of importance within the DR Team by creating a separate, risk-focused functional group with a dedicated leader and a formal training program.



# Recommendations—Major Projects

## Turbine Generator

- Continue vetting of options for Turbine Generator work schedule and scope
- Increase focus on risk identification

## OPG Critical Path Work

- Review and vet schedule activities and look for risk/opportunities.
- Continue improvements to Fuel Handling system prior to start of DR Project .
- Continue Site Integration efforts.
- Review OPEX from upcoming unit outage.



# Next Steps – 3Q 2013

## Functional Groups

- Engineering – review of quality program and organizational changes.
- Project Management – Organizational review of the Project Team's needed resources/capabilities.
- Commercial Management – continue review of commercial options for multiple scopes.

## Project Controls

- Vet 2014 Business Plan.
- Review schedule and earned value development.
- Ongoing review of Risk Management Program.

## Major Projects

- RFR - Review plan based on OPEX from Wolsong, etc.; Review portions of estimate and contingency as available; Review commercial options.
- Balance of Plant – review progress/options for improving schedule.
- Campus Plan – review status, progress and potential OPEX.
- OPG Critical Path – vet Project Team's analysis; review of Outage performance.



## **Initial Project Assessment**

### **Darlington Nuclear Refurbishment Project**



**Burns & McDonnell  
Modus Strategic Solutions**

**August 13, 2013**

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## I. Executive Summary

On February 25, 2013 Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") were retained by Ontario Power Generation ("OPG") to provide External Oversight of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project"). As part of our services, BMcD/Modus provides the following Project Assessment of the DR Project in which we examine the DR Project's current status; evaluate the methodology the DR Project team ("DR Team") is employing for planning and executing the work; review and assess the DR Project's risks and challenges; and, provide certain recommendations where applicable for the DR Team and OPG's management to consider.

The DR Project is a complex undertaking for any utility. Fortunately, OPG is positioned to be the beneficiary of lessons learned from a number of critical past projects, most notably the Pickering A Unit 4/1 Return to Service ("PARTS"), as well as the prior CANDU life extension refurbishments that have been executed at Bruce Power, Point Lepreau and Wolsong. In fact, Wolsong provides the reference plant that is being utilized by the SNC-Lavalin Nuclear, Inc./AECOM Construction Group, Inc. Joint Venture ("SNC/Aecon") for purposes of formulating its estimate for the retube and feeder replacement ("RFR") work. For these reasons, BMcD/Modus has focused significant attention in this Independent Project Assessment ("Project Assessment") on the DR Team's incorporation of appropriate lessons learned and operational experience ("OPEX") into the DR Project's plan. In any event, the DR Project has many "first of a kind" aspects which must be taken into account in the planning and execution phases.

Based on our observations to date, BMcD/Modus believes the DR Project is appropriately advanced at this time to support its major goal of producing a Release Quality Estimate ("RQE") for final Board of Directors and Shareholder approval by October 15, 2015. However, the DR Team needs to effectively and efficiently manage a number of significant risks in order to achieve the necessary level of definition and project maturity required for the RQE.

The following is a brief summary of our observations regarding the DR Project's current and most significant challenges and risks.

- **Project Management Roles, Responsibilities and Readiness:** Thus far in the DR Project's development, the team has been working on developing the component projects (RFR, Turbine Generator, Balance of Plant and the like) as separate, individual projects. This approach is appropriate during the planning phase in order to ready each Project Bundle for execution. However, the challenge for the DR Team will be to shift from the "silo" mentality to operating as an integrated Project. Moreover, the choice of using a significantly different project delivery method (multiple Engineer, Procure and Construct ("EPC") contractors) than OPG has utilized on past capital projects means the DR Team has to define the processes, level of staffing and qualifications necessary for effectively managing the work.

The DR Team may experience some challenges in integrating and operating as a single, integrated, oversight management team. In our experience, the DR Team's current growing pains are commonly experienced by owners who engage in large EPC contracts for the first time. OPG's oversight of the Detailed Engineering and Planning & Assessing phases pose perhaps the most significant near-term risks, as these functions have typically been performed in-house by OPG on past projects. Moreover, OPG's most vital role during the Execution Phase will be to manage and coordinate the work of the multiple EPC contractors, a condition that typically provides a ready

source of change orders, delays and commercial disputes on projects of this type. Now that the scoping work is nearly complete, the challenge for the DR Team will be to migrate toward integration of the work into one unified Program—and such integration should occur as soon as possible.

The DR Team also needs to ensure that it has individuals with the expertise to manage the Execution Phase. Thus the DR Team should be looking to add those individuals who will be responsible for the construction of the DR Project sooner rather than later and integrate them into the Project planning process. It is important that the DR Team require the EPC Contractors do this as well.

- **Scope Definition and Budget/Schedule Status:** On March 5, 2010, Management identified the following DR Project's goals to the Board: (1) replacement of life-limiting components (such as pressure tubes) to allow OPG to operate the units for an additional 30 years, and; (2) replacement of components most effectively done in an extended outage.<sup>1</sup> Management assured the OPG Board of Directors Nuclear Oversight Committee ("NOC") that the DR Project had processes in place to control scope growth via the Project's Scope Review Board, which will "ensure that appropriate reviews (technical and financial) are being performed to ensure that scope is appropriate and minimized to the extent feasible to avoid increasing the complexity of the project and impacting the project's critical path."<sup>2</sup>

The DR Project's scope was derived from a deliberate process that included review of over 1400 separate Darlington Scope Requests ("DSRs") that were generated primarily by the Station and Project Engineering. These DSRs were reviewed and vetted, and ultimately were presented to the Project's Scope Review Board for disposition. The Project Team was mindful of OPEX from PARTS and intentionally took an expansive view of project scope, with the later intention of reducing that scope through a series of critical challenges, all of which were anticipated by the DR Project's processes.

In 2009, the DR Project's point estimate was \$7.724 B with a publically-announced range of \$6B to \$10B.<sup>3</sup> The DR Project's most current budget assessment, the 2013 Business Plan (as of 3<sup>rd</sup> Quarter 2012), identified a projected Project cost of \$9.273 B, reflecting growth of \$1.548 B, or 20%.<sup>4</sup> Direct work scope considerations within the Project's bundles accounted for \$421 M of this growth although the largest overall cost growth contributor is OPG's indirect management costs, which increased by \$626 M, or 72% over the 2009 budget. A driver for the increase in overhead cost was a decision by OPG to have the DR Project carry the costs for the Operations & Maintenance workers associated with the units being refurbished for the duration of the DR Project. In addition, there has been some ongoing internal debate regarding the scope of the DR Project in light of the Station's high standing with WANO, which may have driven some of the desire to increase scope.

Coinciding with the start of BMcD/Modus's engagement and changes in the DR Project's executive leadership, the DR Team recognized that the velocity of the scope additions and other management costs had the potential to adversely impact the DR Team's ability to execute the Project within the

<sup>1</sup> Update on Darlington Refurbishment Project (March 5, 2010) at p. 1 ("Background").

<sup>2</sup> Update on Darlington Refurbishment Project (May 18, 2010) at p. 2.

<sup>3</sup> DGNS Refurbishment Estimate Analysis (April 25, 2013) at p. 3.

<sup>4</sup> *Id.*

anticipated schedule and budget estimates. Key members of the DR Team were assigned to revisit the DR Project's approved scope with the intent of optimizing the Project's size. These reviews are ongoing at this time with decisions by the Scope Review Board and executive management pending. This "scrubbing" of the scope is timely, appropriate and necessary, and should result in greater confidence in the execution schedule and overall project costs. However, the DR Team must also take appropriate care to ensure that items not included in the Project's scope but are nevertheless needed (in some manner) for the DNGS stations' future operation and performance are captured in future O&M and Capital planning and are not dropped. Moreover, the DR Team must take a critical look at the Project's indirect costs in order to ensure that the associated management team has the proper skill-sets and is right-sized for its role on the Project.

The DR Team is also preparing different planning scenarios intended to achieve greater schedule certainty with less overall risk. The DR Team has adopted new planning assumptions for the 2014 Business Plan budget forecast that model elimination of the scheduled overlap of the execution phase of each unit, and in particular, isolating the performance of Unit 2. Given the past history of CANDU mid-life refurbishments, this appears to be a reasonable strategic decision.

- **Engineering Status:** Engineering for the RFR and Turbine Generator Projects are under EPC contracts that are each advancing with the contractors performing the detailed design work. The remainder of the engineering effort is currently focused on developing the requirements needed for procuring the rest of the DR Project's scope, and in particular, the Balance of Plant ("BOP"). In order for the RQE to be reliable, detailed engineering must be sufficiently progressed by the 2<sup>nd</sup> Quarter of 2015 for the DR Team to develop Class 2 cost estimates (cost estimates that are deemed to meet the criterion of the Association for the Advancement of Cost Engineering ("AACE") cost estimating standards).<sup>5</sup> Per the AACE standards<sup>6</sup>, to achieve a high quality Class 2 Estimate, detailed engineering needs to be between 30% and 75% complete overall in order to realistically determine contingency. The DR Team is mindful of the need to complete sufficient detailed engineering and Planning & Assessing prior to RQE. This goal will require significant work and some changes to procurement method, as discussed below.

The DR Project is currently developing engineering packages known as Modification Design Packages ("MDPs") for work not yet contracted (mostly for BOP work) that are precursors to detailed design. OPG has contracted with two external Owner Support Services ("OSS") vendors, AMEC and WorleyParsons, to augment its staff and develop the MDPs. OPG's engineering team has recognized the potential schedule problems and is attempting to expedite and optimize the efficiency of the MDP preparations as well as start the EPC contractors on detailed design packages. Additional modifications to the procurement process, such as earlier releases of smaller scoping packages, will be required to optimize the schedule and accelerate the beginning of detailed engineering.

As a part of its initial assessment of the DR Project's engineering capabilities, BMCD/Modus has also reviewed: the structure and depth of the OPG engineering organization; processes and procedures;

<sup>5</sup> AACE Class estimates, Class 5 through Class 2, are referred to herein as the "Class X Estimate".

<sup>6</sup> AACE International Recommended Practice No. 17R-97, Cost Estimate Classification System (November 29, 2011) at p. 2; AACE International Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (November 29, 2011) at p.2.

metrics for tracking work; and proposed methods for managing the OSS vendors. We have provided some comments and observations directly to the DR Engineering Team regarding optimizing the work flows and the development of Project metrics, and we have witnessed some improvements since the start of our engagement. There has been proper management focus on the issues that are unique to engineering. We will continue to monitor this critical work from a program management perspective as the engineering functions migrate from supporting procurement to project execution.

- **Project Controls:** The primary and associated subset of controls that the DR Team is establishing for tracking the planning and execution of the work are each in various stages of development. The following is a brief summary of the primary performance measurement tools the DR Team is currently developing:
  - Budget Development: The DR Team has a reasonably detailed game plan developed for achieving RQE and is generally following that plan. The current operative budget (2013 Business Plan) was developed on the basis of embryonic project definition and the range of uncertainty associated with that estimate was at no better than Class 5 level. The DR Team is currently in the process of developing its 2014 Business Plan, which is due to be released in the 4<sup>th</sup> Quarter 2013. There are a number of moving parts that could influence cost and schedule development over the next several months, including final determination of scope, optimization of the contracting strategy, the potential “unlapping” of Unit 2, staffing needs, and the like. The Project Controls Team is attempting to increase the level of rigor in the 2014 Business Plan development and this is a work in progress. We would expect the team to significantly ramp-up the level and quality of effort in conjunction with next year’s 2015 Business Plan, as more knowledge about the Project develops. Ramping up the effort will provide higher confidence in the Project prior to RQE.
  - Project Schedule Development and Methodology: The OPG Project Controls team has developed a “Coordination & Control Schedule” (“C&C Schedule”) that tracks the schedule activities at a milestone-based level. Although this tool should be sufficient for the Definition Phase, it is our understanding that the current process indicates that the C&C Schedule will be used through the completion of the Project. We believe that the C&C Schedule may prove to be too cumbersome once the Project moves to the Execution Phase. It is our opinion that the DR Project will ultimately be best served by a single, integrated Level 3 schedule that includes all activities for daily, weekly and monthly project management.
  - Cost and Earned Value Tracking: The DR Project is establishing new systems for tracking and projecting costs as well as tracking earned value (Proliance). The Project Controls Team planned to have these systems in place by spring of 2013 but implementation has proven more difficult than initially planned. In our experience, implementing such systems is frequently problematic, and OPG is doing so at a time when the DR Project is rapidly maturing. Until Proliance is functioning, the DR Team will continue to utilize manually-based controls for tracking costs. BMCD/Modus will continue to monitor the development of these systems and provide input and observations in regard to selected and reasonable “dipstick” checks concerning data fidelity and the like.

- Risk Management: The DR Team is in the process of improving its risk management program. The existing program with some contemplated modifications is generally consistent with what we have seen in the industry at-large. The Project's risk database has been populated by the individual Project and Functional groups and the DR Team has established certain forums (i.e. the Risk Oversight Committee) for evaluating related inputs. However, while the work to date represents a good start, there is significant development work remaining for the DR Team so as to be in a position to ultimately and reasonably address risk and risk mitigation:
  - Risk identification and associated scoring needs to be consistent on how individual risks are identified, evaluated, mitigated and monetized;
  - Per OPG internal procedures,<sup>7</sup> project contingency is to be based in large part on the project risk register. Therefore, it is critical that the risk team properly manage the risk register so as to ensure contingency is properly quantified;
  - The risk database is currently populated with large numbers of items that within the industry at large would ordinarily be viewed as management concerns as opposed to innate risks associated with the work;
  - The RADAR system that the DR Team uses to collect risks is cumbersome and does not interface with other databases—efforts to streamline the above have been very slow;
  - There needs to be some focus on the identification of potential “opportunities” that can be managed within the Risk Program.
  - Management should review its staffing and leadership of the Risk team to ensure that an effective, world class, sufficiently staffed and properly experienced team is in place.
- Electronic Data Management System (“EDMS”): Similar to Proliance, development of the EDMS is lagging behind the DR Team's intended implementation schedule. This, too, is not unexpected, but nevertheless must be cured as soon as possible. The EDMS is supposed to be available in the 3<sup>rd</sup> Quarter 2013. This system is a critical tool for managing the work of the contractors on-site and dealing with the considerable volume of information that is typically generated by a project of this magnitude.

Going-forward, BMcD/Modus recommends OPG consider re-unifying the Project Controls team under one umbrella. In order to maintain the necessary independence, Project Controls personnel should have a direct and singular reporting line to a central Director, and that individual should report directly to the SVP of Darlington Refurbishment.

- **Commercial Development**: OPG has entered into an EPC contract for the Definition Phase of the RFR Project (this includes Project Planning, construction of the Mock-Up facility, and engineering of the Tooling), Engineering and Supply of the Turbine Generator equipment, and intends to enter into several more EPC contracts for much of the remaining work. OPG's intended methodology for contracting the work is one that shifts certain performance risks to multiple EPC vendors for

<sup>7</sup> Nuclear Refurbishment Contingency Development and Management, N-MAN-00120-10001-RISK-05-R000 (July 19, 2012) at p. 4.

individual scopes of work that nonetheless leaves OPG as the overall manager and coordinator of these multiple EPCs. There are no contractual terms that serve to relieve all of the owner's risk, and no contractual penalties intent on causing contractors pain for a failed project that can ever fully compensate an owner for the consequences of such failure. As a result, the DR Team needs to embrace the proactive management of the contractors, which requires the team to effectively and transparently engage the contractors and hold them accountable for their performance, and to manage the interfaces between the various contractors so as to minimize potential disruption, all on an active nuclear site. While OPG has in place a good oversight plan, the key will be the actual execution. As a result, this item bears continuing and close monitoring.

- **Retube and Reactor Feeder Replacement:** The DR Team has devoted significant focus and financial investment in the RFR work, which comprises the DR Project's single-most important evolution and its most significant risk. The commercial agreement with SNC/Aecon establishes a methodology for developing a high-confidence performance schedule and cost estimate for the RFR work's performance that anticipates the submission and acceptance of four iterations of the Project's cost estimate, each with an increasing level of detail and certainty. The first two (Class 4 and 5 estimates) iterations focused on developing a Basis of Estimate that considers OPEX from prior refurbishment projects, and establishes Wolsong as its reference plant in regard to establishing work durations and sequencing. The remaining cost estimate iterations (Class 3 and 2 Estimates) will focus on SNC/Aecon's estimate specifically for Darlington. The Class 3 Estimate is intended to reflect SNC/Aecon's detailed work packages for the DR Project and the Class 2 Estimate will represent the final target price agreement with all risk/reward contingency identified.

However, progress to date in adequately preparing and vetting the RFR estimates has been mixed.

- SNC/Aecon's Class 5 Estimate approval was delayed by 6 months due to an apparent miscommunication between SNC/Aecon and OPG's RFR team. The team worked to recover the time lost by advancing the successor Class 4 Estimate, which OPG approved 1 month early on March 21, 2013. From our review of SNC/Aecon's Class 4 Estimate, it appears that the team has optimized the estimate of an as-built reference plant. However, the current estimate does not reveal significant improvements or maturity related to the quality of costs carried in the Class 4 Estimate as compared to that in the Class 5 Estimate upon which it was based.
- Moreover, the current RFR Class 4 Estimate is not commensurate with AACE's Standards of Practice. In some ways, the RFR Class 4 Estimate exceeds what is normally considered at Class 4 although the RFR Class 4 does not account for the DR Project's engineering definition or contingency. Per its contract with OPG, SNC/Aecon is not required to monetize risk until it prepares and submits the Class 2 cost iteration in May 2015. As a result, until RQE is derived, the overall DR Project cost estimate's largest component is progressing on a separate definition path which is not best practice in nature.

Significant work remains for SNC/Aecon to complete its work plan and associated cost estimate so as to meet the DR Project's standards. Additionally, there is very little room for lost time in the development of the Class 3 Estimate. The DR Team is advised to consider revisiting the method of identifying and monetizing RFR's risks as the overall cost estimate progresses so as to increase confidence in SNC/Aecon's cost estimate and reduce the potential for last-minute surprises emanating from the contractor.

- **Balance of Plant:** The work that comprises the DR Project's BOP scope is varied and split roughly in half between NSSS and conventional plant work. As of the 2013 Business Plan, this scope consists of ~200 DSRs that have been estimated to cost approximately \$503M. These include Core Scope, Non-Core Scope and all contingent items. By its nature, BOP work carries significant risk because it includes work on multiple systems in myriad locations and requires a wide range of craft workers. BOP work coordination is frequently a significant management challenge on a refurbishment project such as this one.

From the outset of our engagement, we have been concerned that the DR Team's intended plan for procuring the BOP was time-challenged, had too many different and unnecessary steps, and could ultimately over-complicate the DR Project if the scope and scale were not right-sized. As noted, Engineering, with the help of seconded staff from the OSS vendors, is developing MDRs for procurement of the BOP work. The DR Team's original plan was to package-up the MDRs into two large bundles (NSSS and Conventional) and put those out for bid between the two Extended Services Master Services Agreement ("ESMSA") vendors, ES Fox and Black & McDonald. Because of the pace of the MDR preparation, these bundles would not be aggregated for this bidding process until well into 2014. As a result, the vendors could not start detailed design and preparation of construction work packages to complete this work in time for OPG to develop a mature, detailed Class 2 Estimate relating to BOP cost in time for derivation of the RQE. The consequence of this would be that the RQE would either be late, or would be of a lower-quality than promised, with the cost estimates, schedules and execution plans for the work having less certainty. This in turn would, obviously, require greater contingency and present significant risk to the actual execution of the work.

The DR Team's leadership is currently examining an alternate method for procuring the BOP work. Since the ESMSA vendors' contracts have already been procured under a competitive process and each is qualified for the work, competitively bidding this work would likely not yield a significant price difference and would, in our view, cost the Project 6-12 months of valuable schedule time. The DR Team is investigating methods to flow work to the ESMSA contractors in smaller packages, in order to eliminate the time originally planned for bundling these packages together and for procurement, bid evaluation, selection and contract negotiation. This would allow the ESMSA vendors to get started now on detailed design instead of waiting until 2014. The DR Team is also looking at practical ways to integrate the ESMSA's design partners in the process as early as possible in order to begin detailed design. Our experience shows that this is the most prudent approach to the BOP work on a project of this type.

Finally, the team is evaluating the current BOP scope review to ensure that what is included in the DR Project meets the intent of the DR Team's commitments, and will be eliminating certain work that does not have to be performed in the DR Project. Each of these measures will help get BOP on track, and all of the above will be needed so as to keep the BOP detailed design off the critical path and improve the chance that the team will have a solid plan and estimate for BOP work in time for adoption of the RQE. In our experience, the method of releasing smaller bundles of BOP work as they become ready is the most prudent and effective means of reducing the risks inherent with BOP work, and in this case, because the ESMSA agreements are in place, would likely be the lowest cost option due to the schedule savings and risk avoidance.

- **OPG Critical Path Activities:** OPG is responsible for planning, directing and executing the work leading up to and after the completion of the RFR work. During the Vault Preparation period (from breaker open to the start of SNC/Aecon's work), OPG is responsible for defuelling and draining all of the systems, and OPG regains the lead in critical path activities in the start-up and commissioning phases. In all, the DR Team estimates that OPG will control the critical path 25% of the time (243 of 968 total days) of the breaker-to-breaker unit duration<sup>8</sup>. Many of the work items in OPG's scope have been performed before; however, some of the work, like defuelling, have never been performed at DNGS or by OPG and will be on the critical path. In addition, DNGS has unique challenges due to the fact the fueling machines that are needed to support the DR Project are also needed to maintain operations of the operating units. The DR Team is very aware of these risks and has made adjustments to the plan, most notably with refurbishment of the fueling machines prior to the opening of the Unit 2 breaker. The team is planning to continue to refine its schedule and sequence of events.

## II. Work Plan And Methodology

In accordance with Schedule 1.1(x) - Scope of Services to the Agreement between Ontario Power Generation ("OPG") and BMcD/Modus for Independent External Oversight Services for the DR Project dated February 25, 2013 (the "Agreement"), BMcD/Modus has developed a recommended Work Plan for the term of its two-year engagement. This plan was presented to the Nuclear Oversight Committee on May 14, 2013. At that time, BMcD/Modus was given authority to proceed with the development of an Initial Project Assessment of the DR Project. BMcD/Modus's Project Assessment is intended to address significant aspects of the DR Project planning and set-up and provide a status baseline as of the time of the report that BMcD/Modus will use to measure the DR Team's progress in future reports. This report will provide the results of our Project Assessment.

In order to develop our Project Assessment, BMcD/Modus has reviewed key project documents, interviewed OPG's key personnel and attended regular and special meetings, including the following:

- **Project Planning:** BMcD/Modus has embedded within the DR Team and has:
  - Attended both regular and special meetings with the DR Team to determine status of project's planning, development and integration of processes and tools, schedule development, contracting strategy and assess prominent risks specific to each project;
  - Reviewed key planning materials and summaries.
- **Processes and Procedures:** We have reviewed the Project Execution Plan and associated Project Management Processes and Procedures regarding their application to the DR Project and how they would be viewed in light of industry best practices.
- **Engineering:** BMcD/Modus attended and initiated meetings with the Engineering team to determine their approach, status, standards and plan for completing both short term (procurement focused activities) and long term (support of the Execution Phase). In addition, BMcD/Modus:
  - Assessed the DR Team's methods for tracking and documenting the status of critical design evolutions to ensure that selected metrics are providing an accurate gauge of engineering progress;

<sup>8</sup> DNGS RFR – Execution Phase Estimate Progression (June 21, 2013).



- Reviewed metrics for tracking engineering deliverables;
  - Reviewed management of external OSS vendors;
  - Provided suggestions, as necessary, to streamline the management of engineering, planning, assessing and procurement;
  - Evaluated whether the DR Team has actually incorporated lessons learned and OPEX into its project scope, and suggest other lessons learned from our team's experience that may be applicable;
  - Sampled general quality of engineering deliverables submitted by EPC Contractors and reviewed OPG's review and approval process;
  - Reviewed the plan to complete detailed engineering supportive of the adoption date of the RQE, which is essential to reducing the potential vulnerability to changes in price and schedule during the Execution Phase.
- **Determined Status/Progress of Scoping Activities:** BMcD/Modus has reviewed the DR Team's process for tracking and maturing scope, including:
    - Reviewing the DR Team's activities and results of scope definition and reviews, including observing and vetting of Gate Review processes.
    - Sampling of work product to determine methodology for scope rationalization;
    - Review of key documents in support of project scope definition, including commitments to BOD and variance reporting.
  - **Reviewed and Assessed OPG's Cost Control Systems and the Program Budget:**
    - Project Estimating
      - Reviewed and assessed the Gate Processes and related estimating of work orders;
      - Reviewed project estimating approach and sampled estimating work product from a form, format and process perspective;
      - Reviewed RFR vendor estimates for work for compliance to OPG's standards and best industry practices.
    - Reviewed and assessed the contracts, systems, processes and procedures the DR Team has in place for commercial conduct, including:
      - Change Management;
      - Notice and Notification of Changes in Scope;
      - Contract Change Orders;
      - Contract Payments.
    - Program Budget:
      - Reviewed the DR Team's processes and methodology for phased development of cost estimates and project schedule leading to the RQE.
      - Evaluated the DR Team's approach to preparing and maintaining the Baseline Schedule and Project Budget, and identified any approaches that might depart from industry-best practice and offer suggestions, as appropriate, regarding the tools and techniques that might be available to improve the overall process.
      - Reviewed and assessed the DR Team's current methodology for determining contingency for the Project.
      - Performed detailed review and vetting of aspects of the DR Project's 2013 Business Plan budget, including a "deep dive" into the details of the RFR Project's estimate.

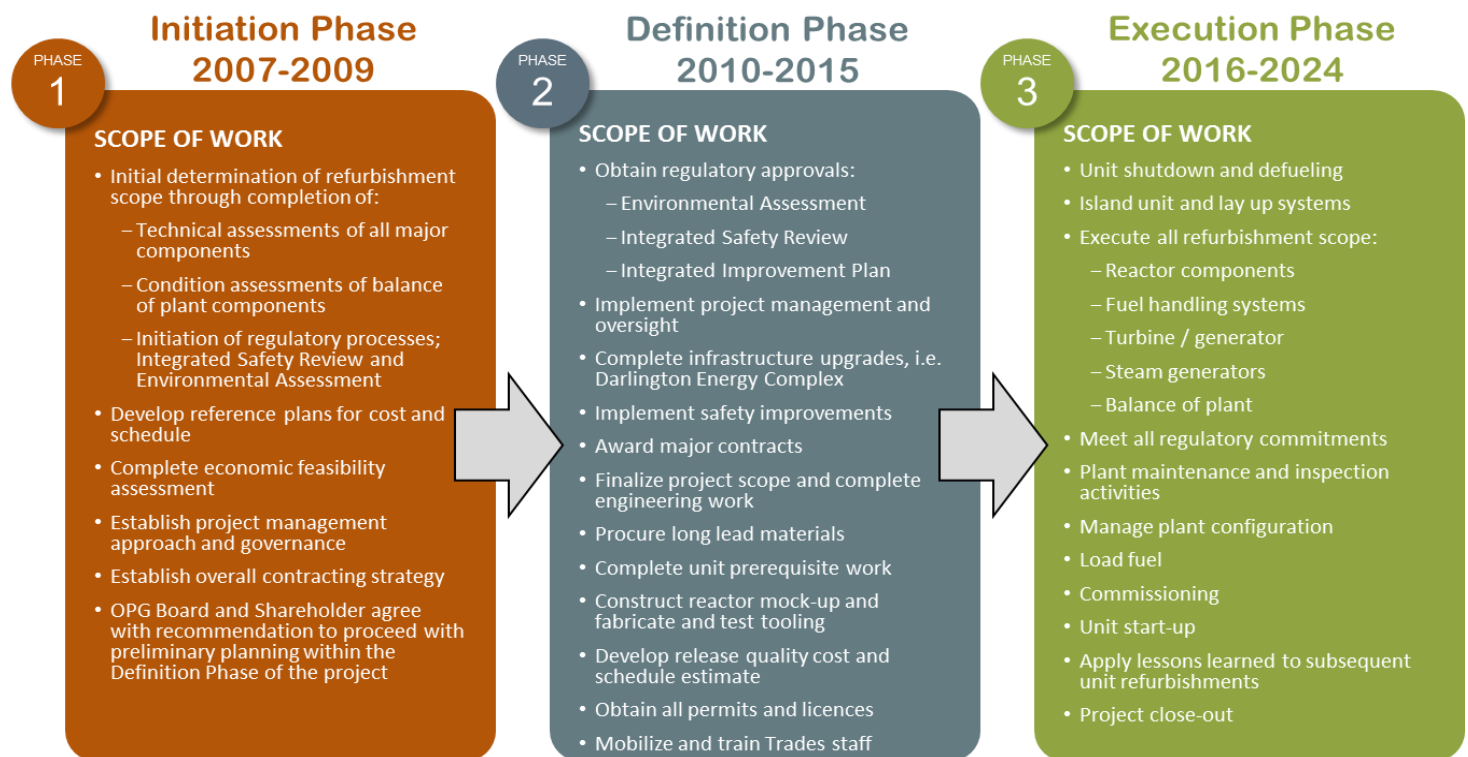
- Assessed development of project earned value system (Proliance)
- **Schedule Assessment:** BMcD/Modus reviewed the DR Team's utilization of scheduling techniques and "rules" in order to evaluate whether there is:
  - Clarity of critical path(s) and sub-critical path(s) for monitoring performance;
  - Proper alignment within the cost system and documented support of the Project estimate;
  - Adherence to proper scheduling practices for integration of P6 enterprise schedule as well as contractors' submission of baseline and updates to the Project Schedule;
  - Proper schedule integration among all projects and subprojects.
  - Review of current status of the DR Team's C&C Schedule.
- **Organization:** BMcD/Modus has identified the risk associated with the role OPG is playing on the DR Project.
  - Reviewed and assessed OPG's ability to provide the appropriate level of project oversight to the Project's EPC contractors without directing the contractors' means, methods and procedures;
  - Reviewed the current and planned staffing levels and generally assessed the team's capabilities;
  - Assessed OPG's ongoing challenges in adapting to a construction project environment and utilizing an integrated P6 schedule instead of using Passport for work management.
- **Contracting Strategy and Contract Terms:**
  - Reviewed Commercial Strategy to determine whether OPG is proceeding on a reasonable path based upon industry experience and practice.
  - Reviewed the RFP process and recommend ways in which the RFP development process can be streamlined, particularly with the BOP Scope.
  - Reviewed Contracts as they are negotiated to determine if OPG has adequately assessed contracting risks.
  - Observed Gate process to identify how commercial risks are being presented and understanding process for allocation of budget/contingency.
- **OPEX and Risk Management:**
  - Assessed the DR Team's processes for establishing and updating the risk management system and reporting emanating from that system:
  - Risk scoring and identification;
  - Risk mitigation and avoidance strategies;
  - Related strategies for same;
  - Contingency development and,
  - Training of DR Team on use of Risk Management tools.
  - OPEX:
    - Reviewed timing and method of OPEX incorporation;
    - Determined whether OPEX is being reasonably incorporated during the planning stage of contractor work by OPG and contractors prior to RQE;
    - Inspected SNC/Aecon Plan on implementation OPEX.

Attachment "A" is listing of the documents BMcD/Modus reviewed in preparation of this Project Assessment.

### III. Project Overview

#### A. Project History

The Darlington Nuclear units are currently predicted to reach their nominal end of service lives in 2019 to 2020. However, various factors from Darlington operations could result in the units reaching the end of life earlier or later than the present predictions indicate. In June 2006, the Ontario Government directed OPG to begin feasibility studies regarding the refurbishment of the Darlington Nuclear plants in order to extend their service lives. In late 2007, OPG commenced “Phase I” of the DR Project called the “Initiation Phase” in order to determine the preliminary scope of work for the Darlington Refurbishment project and to perform an economic feasibility assessment. Phase I was completed in 2009. OPG is currently in “Phase 2”, or the “Definition Phase”, which will continue until “Phase 3” called the “Execution Phase” begins in 2016. The three phases are detailed as follows:



Source: DR Project Team

OPG has chosen to manage the Darlington Refurbishment as a “Program”. According to Project Management Institute (“PMI”), “A Program is a group of related projects managed in a coordinated manner to obtain benefits and control NOT available from managing them individually.”<sup>9</sup> OPG’s stated overall commercial strategy for the Program is premised on OPG acting as the General Contractor and Program Manager for the full Program. Within the Program, there are seven discrete Projects, each with its own project management team (including functions that are matrixed, such as engineers, commercial managers and project controls leads). The seven Projects (also known as “Project Bundles”) encompass the following scopes of work:

- Retube and Feeder Replacement

<sup>9</sup> The Standard for Program Management, 2nd Ed.

- Islanding
- Fuel Handling/Defuelling
- Turbine Generator Maintenance and Controls Upgrade
- Boiler and Auxiliary Systems (Steam Generator Lancing)
- Shutdown, Layup and Services
- Balance of Plant

As of the date of this Project Assessment, the DR Team's major activities revolve around: (1) overseeing SNC/Aecon's development of the RFR Mock-up, detailed engineering and the Execution Phase plan and RQE project estimate; (2) completing procurement of the remaining scopes of work, including the BOP and Fuel Handling, which constitute a significant portion of the work; (3) identifying, and in some cases paring down, the scope of the work that will be performed within the DR Project; (4) preparing for the outages that will proceed the start of Unit 2's refurbishment; (5) developing the Project's schedule and budget for the RQE deadline. In this Project Assessment, BMcD/Modus has focused on these and other areas of risk.

## B. Project Management Development

OPG's ability to successfully plan and execute the DR Project will be due in large part on the DR Team. Therefore, our Project Assessment must necessarily include some preliminary observations regarding the DR Team. As of the date of this Project Assessment, the DR Team has 233 individuals in the following areas<sup>10</sup>:

OPG Staff	Headcount
SVP – NR	2
Engineering	107
Planning & Controls	42
Management Systems Oversight	7
Execution and Construction Planning	41
Operations & Maintenance	34

In addition, there is ongoing involvement and assistance provided from the Projects & Modifications and Station organizations as well as staff from other business units (OBUs) that are matrixed into the DR Project. The DR Team has been established with the responsibility of assessing, making recommendations to OPG's Senior Management with respect to the feasibility of refurbishing the Darlington units, developing the scope, schedule and estimate for the Refurbishment Program, and providing overall program oversight on the execution of all activities associated with refurbishment, including:

- Assessing the technical feasibility of refurbishing Darlington and operating it for an additional 30 years of post-refurbishment operations;
- Making recommendations as to the lead time required to be prepared to refurbish each unit,
- Defining the refurbishment scope;

<sup>10</sup> Program Status Report for Period Ending June 2013 at p. 16.

- Executing project planning including the development of contract management strategies, cost estimates, schedules, a full risk assessment, and a release quality estimate for the Project;
- Managing the refurbishment pre-outage planning and preparation activities;
- Provision of overall program oversight on all execution and commissioning activities; and
- Performing Project Closeout.<sup>11</sup>

The DR Team’s focus to date has been on the planning of the DR Project. We recommend the DR Team accelerate its plans to staff its construction and execution organization and integrate those individuals into the DR Team. At this point in the Project’s maturity (and in particular the RFR project), constructability reviews will be essential for further development of the Project’s Schedule, comprehensive work packages and detailed engineering. Additionally, it is likely that changes will emerge based on the constructability reviews, and the longer the DR Team has to adjust, the better. Getting the right personnel involved with reviewing and developing plans and processes up-front can prevent most (but certainly not all) of the late, high impact issues. OPG needs to insist that the EPC contractors build their Execution Phase organization as well.

### 1. OPG’s Oversight Role

OPG’s current contracting strategy, which will be discussed in more detail below, is dependent on the use of several Engineer, Procure and Construct, or “EPC”, contractors. OPG will take on the role of General Contractor and Program Manager, with the responsibility of contractor oversight and coordination. This is a risk laden role. This contracting strategy represents a considerable change in approach from OPG’s prior Large Capital Projects. The following matrix identifies how this approach differs from OPG’s approach to PARTS Unit 1:

Project Component	Responsible Party	
	PARTS Unit 1	DR Project
Scope Definition	OPG	OPG with assistance from external vendors
Procurement Engineering	OPG	OPG managing outside vendors
Detailed Engineering	OPG	EPC Contractors
Planning & Assessing	OPG	EPC Contractors
Construction	Contractors managed by OPG Construction Management	EPC Contractors with OPG as the Construction/Program Manager
Start-up and Commissioning	OPG	OPG

While the use of the EPC model for large capital projects is common in the industry at-large, it is more prevalent for owners to use a single contractor to perform all of the work. Here, OPG will have several EPC contractors performing discrete scopes of work that will require management and coordination by the DR Team. Furthermore, in our experience, the EPC model can have significant challenges for any organization. Our team has observed some of the typical growing pains on the DR Project that come with such a transition. It will require time for the DR Team to adapt to its roles and responsibilities under this new governance.

There is a “sweet spot” that all owners must find when engaged in EPC contracting for large capital expansion or refurbishing projects. Owners frequently assume that EPC contracts by their nature distribute all of the risk

<sup>11</sup> See Darlington Refurbishment Project Charter, D-PCH-09701-10000 R001 (June 15, 2009) at p.1.

to the contractors and therefore the owner proceeds to only passively engaged in the work. At the other extreme, there are owners who micromanage the work to the point that their invasiveness is tantamount to dictating means and methods to the contractors which usually ends in nothing short of disaster. Both of the above management styles have significant cost and schedule risks for owners, and generally lead to disappointing outcomes – finding the right balance is crucial. Additionally, the DR Project has an added layer of complexity since DR Team will be responsible for managing and coordinating several EPC contractors at the same time—all of which will be competing for the same space, labor and the owner’s time and attention. The DR Team has recognized that its new “oversight” role will be a challenge and its performance in the Definition and Execution Phases will have to be carefully and continuously monitored. We will continue to review the DR Team’s performance on this issue as more contracts are executed.

## **2. DR Team Leadership**

Shortly after beginning our role on the Project in late February 2013, OPG announced that Albert Sweetnam, the EVP of the Refurbishment Project had left the company. Through May 2013, interim management of the Project was assumed by Wayne Robbins, the Chief Nuclear Officer. There were no other changes to the DR Team during this time. BMCD/Modus observed no measurable ill effects from the former EVP’s departure.

In late May 2013, Bill Robinson rejoined the DR Project as the Sr. Vice President of Nuclear Projects after a short term as a project consultant. Robinson’s experience includes: leading the rescue of the Pickering A Return to Service of Unit 4 from significant cost and schedule overruns; management of the successful PARTS Unit 1 Project; leading a seconded team from OPG at Point Lepreau; and early development of the DR Project. His leadership should prove beneficial in the planning stages of the DR Project.

Dietmar Reiner is currently the SVP of Nuclear Refurbishment. Mr. Reiner has an excellent grasp of the Project’s strategy and accomplishments, and is keenly aware of the amount of work in front of the DR Team. He also appears to have the support of his team of direct reports and has instituted goals within the team related to transparency and effective communication.

## **3. Processes**

The DR Team continues to develop and refine the management processes necessary for the Project, many of which are discussed herein. The DR Team has developed, and continues to develop a plethora of process and procedure documents and guidelines—perhaps too many. The risks of having too many processes include needlessly creating work (which requires more people that add cost) and conditions for non-adherence. Additionally, it is our observation that many of the procedures are not fully integrated (within a particular group itself or to other groups within the DR Project), with accurate annotations to reference documents. Currently, the DR Team does not have a matrix or even a complete list of all of the processes, procedures, standards, guidelines, manuals and the like that have been developed for the DR Project. The DR Team has recently embarked on cataloging and re-doing some of the procedures and this, presumably, may clear the air, correct what needs to be corrected and impart clarity to the remaining. The existing Management Systems Oversight group should be able to provide necessary support in this regard. Throughout this Project Assessment we will provide our view of the development of the Project management processes to date and their relative effectiveness, given the current status of the DR Project.

### **C. Scope Definition**

An important early indicator of continued success is the DR Team’s adaptability to right-size and control project scope in order to meet the commitments to the Board of Directors (“BOD”), the Shareholder and the

public. Between the years 2009 to 2012, the DR Project's overall budget has grown by ~\$1.5B (2012 dollars) which is equivalent to ~20% of initial budget. The current point-estimate of ~\$9.3B (\$2012 dollars) in the 2013 Business Plan is approaching the upper boundary of the budgeted range of ~\$10.8B (\$2012) latest approved by the BOD. This total increase represents in large part scope growth of the DR Project. There are many reasons for this growth, including:

- OPEX, in particular from PARTS, which had significant cost overruns and schedule delays due to lack of scope definition at that project's outset has led the DR Team to conservatively identify a broad range of potential refurbishment scope;
- In the scope identification process, there appears to have been a tendency to increase scope to maintain the Station's WANO standing as well as over-commit to regulatory-driven modifications;
- As the scope of the Project has become more in-focus, the size of the Project Team has grown to match the effort represented;
- OPG decided to shift the OPS & Maintenance cost for each unit's operators to the DR Project while under refurbishment, which further added to the overhead costs.

The DR Team's SVPs have a firm understanding that, going forward, if scope is not effectively managed (and in some cases significantly reduced), OPG's management will be hard-pressed to deliver the DR Project at an acceptable cost. Below we discuss the progression of the DR Project's cost estimate, assess the current DR Team effort to examine and vet scope, and provide other recommendations for OPG to consider.

### 1. Budget and Scope History

BMCD/Modus's starting point in reviewing the DR Project's scope was to review the evolution of Management's representations to the BOD. The following summarizes the presentations that Management has given to the BOD regarding the evolution of the DR Project's budget and associated scope:

- On November 18, 2008, the BOD was presented an initial "medium confidence" cost estimate of ~\$4.9B including a 20% contingency. At that time, the basis of the cost estimate included a 2007 Pickering B Assessment; industry studies; and considerations emanating from OPG's own operating experience (OPEX).<sup>12</sup>
- In year 2009, Rev 3 of the cost estimate was developed by the Project Control Team which totaled ~\$7.7B<sup>13</sup>.
- On March 5, 2010, Management committed to the BOD that the DR Project's scope would be limited to: (1) replace life-limiting components (such as pressure tubes) to allow OPG to operate the units for an additional 30 years, and; (2) replacement of components most effectively done in an extended outage. Management assured the NOC that the DR Project had processes in place to control scope growth via the Scope Review Board, which will "ensure that appropriate reviews (technical and financial) are being performed to ensure that scope is appropriate and minimized to the extent feasible to avoid increasing the complexity of the project and impacting the project's critical path."<sup>14</sup>

<sup>12</sup> Report for Submission to Nuclear Generation Projects Committee (November 18, 2008) at p. 8.

<sup>13</sup> Report for Submission to Nuclear Generation Projects Committee (November 17, 2009) at p. 1.

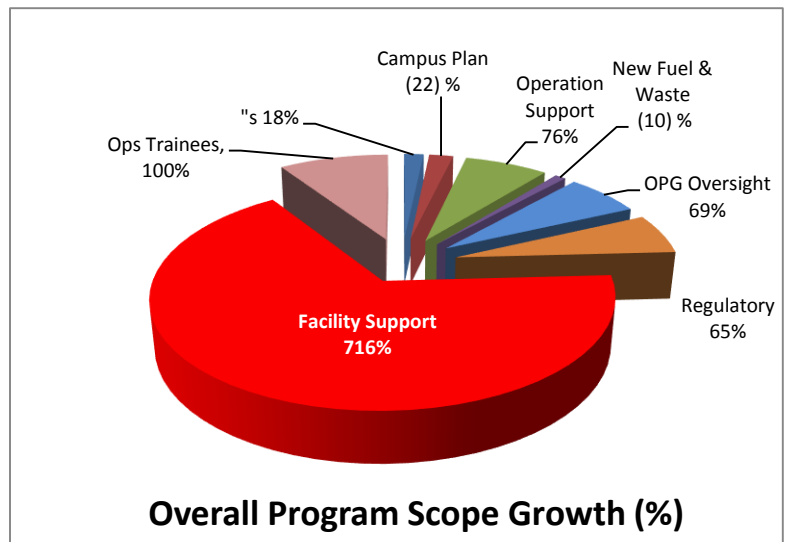
<sup>14</sup> Update on Darlington Refurbishment Project (March 5, 2010) at p. 1.



- On November 17, 2011, the BOD was presented with a cost estimate that was characterized as remaining in the range of ~\$6.3B to ~\$10.5B<sup>15</sup>. Additionally, the DR Team's 2012 Business Plan estimate was ~\$8.7B.
- On November 15, 2012 management presented its 2013 Business Plan cost estimate with a high confidence amount of ~\$9.3B in 2012 dollars, thus including escalation, which remained less than \$10B in 2009\$. There were additional details and explanation of variances within the materials presented with the 2013 Business Plan.<sup>16</sup>

Based on files made available, variances and explanations of overall Program scope growth between 2009 and 2012 are summarized below:<sup>17</sup>

- Operations Support grew by \$386M or 76% based on required human resource profile considerations, all as prepared by Operations and Maintenance Organization.
- OPG project management projections grew by \$443M or 69% based on enhanced definitions and refined organizational characteristics of each department. Currently, the project management estimate is ~20% of total direct costs.
- Regulatory expenses grew by \$71M or 65%, primarily due to CNSC fees.
- Facility Support grew by \$86M or 716%. Projected costs were reflective of corporate real estate (CRED) support costs at the Darlington Energy Center (DEC) along with business trade union (BTU) costs to maintain site facilities.
- Operation Training grew by \$27M or 100%.
- Project Bundles grew by \$568M or 18% overall, resulting from enhanced work definition; increased maturity; increased scope of the Turbine Generator Project and addition of safety improvement opportunity (SIO) projects.
- Campus Plan costs decreased by \$146M or 22% due to improved scope clarity.
- New fuel and Waste work decreased by \$34M or 10% due also to improved scope clarity.



The variances between the 2012 and 2013 Business Plans for the Project Bundles which comprise the bulk of direct costs are summarized below:

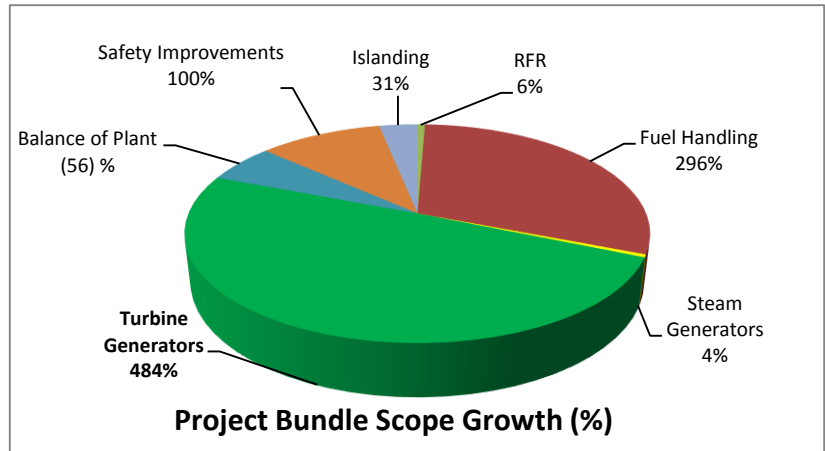
<sup>15</sup> Update on the Darlington Refurbishment Project Economics (November 17, 2011) at p. B-1.

<sup>16</sup> Update on the Darlington Refurbishment Project Economics (November 15, 2012) at p. 3.

<sup>17</sup> See DNGS Refurbishment Estimate Analysis (April 25, 2013) at p. 4.



- The RFR scope grew by \$154M or 6% via improved definition and development of a more refined cost estimate.
- The Fuel Handling scope increased by \$125M or 296% based on detailed review of Fuel Handling – Component Condition Assessment and continued scope clarification.
- The Steam Generator scope grew by \$7M or 4% due to a revised cost estimate.



- The Turbine Generator scope grew by \$287M or 484% due to the addition of the turbine control system and general scope finalization.
- BOP work reduced by \$207M or 56% due to significant validation of work scope placed elsewhere in the program.
- Safety Improvement work increased by \$175M or 100% due to the addition of SIO's.
- Islanding work grew by \$27M or 31% due to scope clarification and the development of associated cost estimates.

Overall, a variance review indicates that the larger cost increases as measured between the 2012 and 2013 Business Plans resided in the Functional groups, not the Project Bundles. This suggests that any attempt by the DR Team or Management to reduce scope must also involve a re-look of the corresponding Functional group costs as well.

## 2. Scope Review Process by DR Team

As noted, the DR Team is currently vetting the approved project scope. The following summarizes the process the team is using to rationalize the scope and right-size the DR Project.

### a. Process for Scope Determination

The DR Project's governance for scope review establishes the following Primary Objectives:

- Successful refurbishment of Darlington Station life-limiting components in order to allow Darlington to operate for 30 years beyond the current predicted end of service life.
- The Refurbishment Project will maintain and return the unit in the condition in which it is turned over.
- A successful refurbishment project requires delivery of all core and approved non-core scope within the high confidence timeline and budget established in the RQE and as documented in the Project Business Case Summary.
- Project cost and schedule as well as post-refurbishment performance will come under extreme scrutiny due to the high profile nature of this project and its impact on OPG's reputation.

- Where scope is approved by Scope Review Board, Nuclear Refurbishment may recommend inclusion of the scope and execution in a pre-refurbishment station outage.

The stated goal of this process is to “ensure that the proposed additions and/or deletions have undergone a thorough assessment based on the return on investment, impacts on plant safety, reliability, project schedule and cost, program resourcing, regulatory requirements and environmental impacts.”<sup>18</sup>

The DR Project’s scope was developed from review and vetting of 1,409 DSRs that were generated by the Station and Refurbishment Engineering. Based on OPEX from past refurbishments, including PARTS Unit 4, the team adopted an intentionally expansive view of potential scope inclusion so as to consider all options and avoid later surprises and/or scope additions that could adversely impact the DR Project’s success.

The process used to date for defining scope was based in part on accepting and classifying “Core” versus “Non-Core” scope. “Core Scope” is “work that must be done to achieve the Primary Objective” including (1) Regulatory; (2) Station Life Limiting Components; (3) Component Upgrades that can only be done in an extended outage; (4) Programmatic Work necessary to maintain the plant’s license; (5) Pre-requisites; and (6) Facilities and Infrastructure to support the DR Project. Non-core scope is defined as work that “Will be performed in the refurbishment period if it has no impact on the Projects Core Scope critical path, does not add risk to the successful completion of core scope, and where cost or resource efficiencies and station priority warrant the work to be executed in the refurbishment period.”<sup>19</sup> The Scope Review Board has been given the role of approving, deferring or rejecting the scope items based on multiple criteria.

#### b. Scope Status as of the 2013 Business Plan

The 2013 Business Plan’s scope definition and maturity level within each Bundle varies considerably. The following summarizes the monetized value of the DR Project’s DSRs for each of the Bundle in the 2013 Business Plan.<sup>20</sup>

Project Bundle	Number of DSRs	2013 Business Plan (\$000)
BOP	208	503,381
Campus Plan Infrastructure	23	234,566
Campus Plan Inside	10	75,569
Campus Plan Outside	17	252,198
Engineering Projects	42	203,443
Fuel Handling	76	237,963
In-Station Infrastructure	14	47,639
RFR	17	2,463,611
Safety Improvement Opportunities	3	103,000
Steam Generators	12	190,780
Shut Down/Layup	26	48,552
Turbine Generator	79	501,286
Unit Islanding	29	125,156

<sup>18</sup> Darlington Nuclear Refurbishment Program-Scope Control NK38-INS-09701-10001-R004 (December 12, 2012) at p. 4.

<sup>19</sup> *Id.*, p.8

<sup>20</sup> Scope Review as of June 20, 2013 at Table 1.

Project Bundle	Number of DSRs	2013 Business Plan (\$000)
Other	3	300
<b>Total</b>	<b>559</b>	<b>4,987,444</b>

The DR Team anticipates that it will generate additional DSRs that will need to be dispositioned and may add to the total end scope. Outside of discovery work that cannot be anticipated until the unit is under construction, the DR Team expects that additional DSRs will largely come from three sources:

- Component Condition Assessments ("CCA's"): The DR Team determined that many of the condition assessments performed in the developing the DSRs were incomplete. Project Engineering is currently re-evaluating the CCAs that appear to have shortcomings. It is not currently expected that these CCAs will yield a significant number of additional DSRs although this process needs to be continuously and closely monitored, and the interim results need visibility.
- Regulatory Requirements: There are certain regulatory issues that will require additional DSRs and/or modifications to existing DSRs. Most notable are additional requirements for fire protection work that was not initially anticipated. These additions are being assessed at this time.
- Scope Defining Inspections: The DR Project will be performing ~40 separate scope defining inspections during the upcoming pre-project outages. While the plan for the Project includes contingent scope and associated budget, there is a risk regarding the work scope that could be generated until these inspections are completed.

Based on our review of the development of the scope, it appears that OPG's methodology has cast a wide net for identifying all of the possible scope that could be included in the Project. The DR Team has developed effective metrics for bringing focus and attention to scope identification status and maturity via its "Health of Scope" ("HOS") reporting. These HOS reports highlight the life of a DSR until it is dispositioned. These metrics have been very helpful in bringing focus to the scope that lacks maturity and requires action.

The challenge for the DR Team now is to weed out the work scope that is not essentially done in refurbishment and ultimately define scope that is balanced to the original commitments to the BOD, the Shareholder and CNSC. Adding unnecessary work not only increases the Project's cost but aggravates complexity and risk. Reasonably balancing the scope with complexity, risk, schedule and budget concerns has the added benefit of allowing the DR Team to focus on the critical path RFR work which has been problematic in prior mid-life refurbishments.

As a result, the DR Team is currently reviewing the previously approved DSRs and bucketing them into one of three categories:

Must Refurbish in DR Project	Possible Deferral to Station for Life-cycle Management	Remove from Scope
<ul style="list-style-type: none"> <li>•Life limited components</li> <li>•Regulatory commitments</li> <li>•Drained/Defuel State</li> <li>•Refurbishment Support</li> <li>•Sustaining scope – 30 year replacements</li> </ul>	<ul style="list-style-type: none"> <li>•Station improvements with positive payback</li> <li>•Sustaining Scope that can be done outside of DR Project</li> <li>•Sustaining Scope – Manage as part of Life-Cycle Management</li> <li>•Sustaining Scope – Service Equipment, can be done online or during normal station outage</li> <li>•Station Support</li> <li>•Station Improvements – Likely payback</li> </ul>	<ul style="list-style-type: none"> <li>•Work not needed for ISR</li> <li>•Inspections determine scope is unnecessary</li> <li>•Work should be done under functional work program</li> <li>•DSR is for purchase of Capital Spares</li> <li>•Work with no relationship to Refurbishment</li> <li>•Work that must be done in VBO</li> <li>•Station Improvements – Payback Unlikely</li> <li>•Clean-up – work superseded</li> </ul>

In our experience, removing scope that was once nominally “in” a project is often a difficult proposition. The DR Team has engaged in two separate reviews, one conducted by key members of the team using the above considerations and a second “cold eye” review by Paul Pasquet, who is reviewing the scope in light of the necessary regulatory commitments. As of the time of this Report, these reviews are ongoing with the intent to present separate recommendations to the Scope Review Board for final review and disposition prior to the DR Team’s 2014 Business Plan presentation. BMcD/Modus has examined these ongoing processes, reviewed interim conclusions (to the extent those are available) and interviewed the principals involved, from which we can conclude that this effort is robust and likely to produce significant recommendations in reducing the Project’s scope.

### 3. Conclusions – Scope Status and Review

Since the inception of our engagement, BMcD/Modus has observed the DR Team’s increased focus on scope and all the related considerations. We have noted the direction and increased focus provided by the DR Team’s leadership. Assuming that the result of this effort is supported by a favorable economic analysis, BMcD/Modus believes these efforts are likely to result in a more achievable project plan with reduced overall risk. The following considerations should be kept in mind as the DR Team prepares its recommendations:

- Cost controls that the DR Team has put in place need to be followed in the future or scope creep will again threaten the success of the DR Project.
- Decisions regarding scope of the DR Project should be made as quickly as practicable so as to avoid the team expending effort on scope that will not be performed in the Project. Currently, Project Engineering is under stress to complete the procurement engineering work associated with undefined DSRs. If the DR Team can winnow down the scope as intended, such changes will reduce this pressure and make the final scoping effort more manageable and increased the likelihood of timely preparation of these packages.
- The remaining scope risks, including those resulting from future scope-defining inspections, need to be tracked in a transparent manner for the BOD so that there are no surprises.
- The results of this review need to be recorded in the AIDA database for future reference for rate proceedings and configuration management.

## IV. Functional Group Status

### A. Engineering

At the outset of our engagement, BMcD/Modus found the DR Project's engineering in a state of flux. The OPG Engineering Team was in the process of instituting new procedures and developing the organization needed to fulfill all of its necessary functions, its metrics and tracking methods of engineering product were in the embryonic stage, and it appeared that engineering was significantly stressed and behind schedule. However, the Engineering Team's performance indicators did not reflect this stress. Over the last several months, we have noted improvements in both reporting and production, though there are many challenges remaining in both areas. In this assessment, we have focused on defining the roles OPG's engineering will play, the current areas of focus, and recommendations for improvements for upcoming phases.

#### 1. Overview of Engineering Roles and Responsibilities

The Engineering Team (with its sub-parts Nuclear Safety, Design Engineering, Component Engineering, Engineering Projects and Reactor Engineering) is the largest of the DR Project's Functional Groups and fulfills a number of significant and evolving functions during the Project's lifecycle. Because OPG has chosen an EPC model, detailed engineering will be provided by the EPC contractors. However, OPG's Engineering Team retains responsibility for:

- Defining project requirements and design elements through development of the Design Modification Packages ("MDP");
- Identification of owner supplied long lead materials;
- Design authority approvals;
- Design completion assurance;
- Construction Completion Declaration
- Commissioning;
- Available for Service;
- DSR Closure.<sup>21</sup>

Currently, the Engineering Team's focus is on preparing procurement-related MDPs that are essential for defining OPG's requirements for the remaining scopes of work. This is an OPG-led function, though the Engineering Team is supplementing its efforts with the OSS Vendors, WorleyParsons and AMEC, in order to achieve a higher level of throughput. Once this phase completes, the Engineering Team will retreat into an oversight role in which its primary function will be to review and approve EPC design documents. OPG will take the lead again as the work moves out of the Execution Phase and into Commissioning. These myriad functions will require the Engineering Team to constantly review the mix of people and their specialties within the team. Management is currently evaluating the structure of the Engineering Team to meet these challenges.

Because OPG and the various EPC vendors each have responsibility for aspects of the design at various stages, answering the seemingly straightforward question of the DR Project's engineering status is a very complex equation. Nonetheless, as discussed below, the Engineering Team should endeavor to improve its reporting

<sup>21</sup> Darlington Refurbishment Project Unit 2 Major Work Streams (undated).

and metrics so that management and the BOD have a better and more precise handle on the status of the DR Project's engineering definition as the DR Project progresses.

## **2. Procurement Engineering - MDP Process**

Since the majority of the Engineering Team's current efforts revolve around the MDP activities, BMcD/Modus has reviewed this process, progress and issues. The OPEX that the Engineering Team has gathered from the MDR/MDP process needs to be considered as the DR Project's design advances.

### **a. Developing MDRs**

As noted, the DR Project's scope was assessed based on a wide variety of plant CCAs, life cycle management reports, system health reports, engineering backlogs and regulatory requirements in order to develop approximately 1400 DSRs. These DSRs were then evaluated to determine if the resulting scope of work would be a Maintenance Work Order, an equivalency evaluation, a Non-Identical Component Replacement or a Modification. If the disposition requires a modification, a Modification Design Requirement ("MDR"), Modification Outline and Conceptual Design Report are developed in accordance with the existing Engineering Change Control ("ECC") process. These evaluations of the DSRs netted 117 MDRs for engineering evaluation.<sup>22</sup>

According to OPG procedures, Engineering must prepare MDRs for the following purposes:

- New or existing Structures, Systems and Components;
- Engineered tooling;
- Permanent or temporary additions to existing facilities; and
- Permanently or temporarily re-defining a system design basis.<sup>23</sup>

In accordance with OPG's ECC process, the actual development of each MDR requires Engineering to review and account for such elements as:

- Nuclear Safety Design, Functional and Performance Requirements
- Interfacing Systems
- Design Limits and Strengths and Seismic Requirements
- Design Constraints and Constructability
- Environmental Qualification/Aging Considerations and Reliability Requirements
- Maintainability/Operability/Human Factor Requirements
- Periodic Inspection Requirements
- Safety Requirements
- Commissioning Requirements
- Standards and Codes
- Comparison with Similar Systems at Other Generating Stations

Initially, OPG planned to prepare the MDR packages with in-house, internal resources. However, OPG could not complete the volume of work and the number of MDRs required without additional engineering help. The

<sup>22</sup> Preparation of Needs Document N-GUID-00700-10002-R001 (2013) at p. 13; Modification Process N-PROC-MP-0090-R009 (2013) at p. 41, Engineering Change Control, N-PROC-MP-0001 (2013).

<sup>23</sup> Preparation of Modification Design Requirements, N-INS-00700-10007-R001 (2013) at p.3.

Engineering Team therefore contracted with the OSS vendors to complete the MDP development as augmented staff workers under OPG to support the RQE milestone. This, however, has led to increased costs for the development of the MDRs.<sup>24</sup>

#### **b. MDR/MDP Status and Metrics**

Despite the fact that the OSS vendors have now been engaged, Engineering is still struggling to meet the schedule for MDP development. In June 2013, OPG's Nuclear Oversight ("NO") group conducted a performance-based audit of the MDR/MDP and Design Quality Oversight process, the objective of which was to determine if the development of MDRs and associated MDP documents comply with governance, and to audit the Engineering team's organization. NO identified the schedule instability for the OSS Vendors work, noting that compliance with the MDR completion dates was "difficult to determine" because of the changing dates and metrics used for tracking engineering work.<sup>25</sup> While the then-current schedule showed engineering essentially on track, NO determined that the OSS vendors were trending well behind in the development of the MDR packages based on a December 31, 2012 schedule labelled as the "baseline." In all, of the 37 remaining MDRs, 19 were scheduled to be complete by June 30, 2013 per the original baseline schedule; though as of the end of June, only one MDR was complete. NO also found additional quality and accountability issues in the OPG Engineering Team's management of the vendor. These audit findings are being addressed by Engineering.

Engineering has ramped up its efforts in developing metrics, though these are still in the embryonic stage. The weekly engineering meeting with the team and the OSS vendors has increasingly focused on schedule performance and project "need" dates. There have been improvements in the reporting by the OSS vendors, though there is still noise within the earned value rules and counting of design products.

#### **3. Engineering Quality Programs**

The Engineering quality program is currently focused on oversight of the EPC vendor in-line with the original implementation model. Since very few of the projects have progressed past the procurement phase, the effectiveness of the quality oversight model implementation has yet to be proven.

OPEX from early implementation of the EPC model on the Campus Plan modification activities has led the Engineering Quality group to look into its methods of oversight activities of the OSS vendors and the MDP development process. Recent actions to address these quality issues include: a Self-Assessment,<sup>26</sup> a Nuclear Oversight Audit Report,<sup>27</sup> and a Common Cause Analysis regarding the quality of design engineering deliverables received from the OSS vendors.<sup>28</sup>

As part of the Common Cause Analysis, fifty-five SCRs were reviewed to determine the bases of the quality issues. The results were broken down into the following categories:

<sup>24</sup> See SCR N-2013-01589.

<sup>25</sup> Nuclear Oversight Audit Report – Darlington Refurbishment – Modification Design Requirements and Design Quality Oversight, OPGN NO-2013-005 T6.

<sup>26</sup> See SA NO13-00005.

<sup>27</sup> See OPGN NO-2013-005 T6.

<sup>28</sup> See Common Cause Analysis SCR N-2013-02294 (June 21, 2013) at p. 6.



SCR Category	# of SCRs	Findings
Quality of Product	27	Human performance error Issues; Lack of rigor during verification; Staff not sufficiently trained/qualified
Delays in Deliverables	16	Original schedule errors; resource availability
Procedure Adherence	13	Lack of understanding; Execution Mistakes
Expectations	5	Poor Communications

The conclusion from this Common Cause Analysis identified two themes related to MDP quality:<sup>29</sup>

- Human performance issues during the preparation and issuance of the design products; and
- Communication issues between OPG staff and the OSS Vendors.

Actions being taken to address the issues identified above are:

- Pursue opportunities to co-locate OPG and OSS vendor engineers at either the DEC or vendor facilities to improve communications;
- Get vendor engineering staff registered in the OPG TIMS system as qualified engineers;
- Refresher training for OSS staff with regard to OPG's ECC process; and
- Team building activities<sup>30</sup>

These issues are indicative of a team that is getting organized on the fly and under duress. The Engineering Team's leadership is taking this OPEX into account and is reshaping the organization, which should result in improvements. The BMcD/Modus team will continue to monitor the OSS and EPC vendors engineering services in these areas as additional MDP packages and EPC detailed design work products become available for review. In addition, we will monitor the Engineering Team's quality processes at the Program level to assess the DR Team's ability to ensure adequate oversight of the upcoming detailed engineering phase.

#### 4. Additional Observations and Recommendations

However its progress is measured, the DR Project's engineering effort is still in a very early phase. Engineering's current activities in developing the procurement packages are projected to continue well into 2014, and the team will have to adapt to monitoring the EPC's detailed design work that is underway. The current rationalization of scope and potential scope expansion from CCAs and regulatory scope will have an impact (both positive and negative) on the Engineering Team's work effort. Moreover, OPG will need to settle into an essentially new role of providing oversight of the detailed design process performed entirely by others.

For these reasons, BMcD/Modus believes it is essential for the Engineering Team to continue to refine its metrics, including earned value and schedule adherence. The reliability and quality of RQE will depend on the DR Team's ability to understand with confidence the Project's underlying level of engineering maturity. Currently, in part due to the fragmented distribution of the engineering activities between OPG, the OSS vendors and the EPC vendors, there is no metric that measures the integrated engineering effort (OPG + OSS

<sup>29</sup> *Id.* at p. 6.

<sup>30</sup> *Id.* at pp.8-10.



Vendor + EPC Vendor) such that the true status of the overall engineering effort is visible and can be understood.

There have been improvements over the last several weeks in the Engineering Team's metrics because the team is relying less on showing progress via work-down curves tracking completion milestones and more on interim key performance indicators such as SPI/CPI. In addition, the metrics better reflect the "need" dates from the various projects. There are still improvements needed and noise to wring out of the data, though the metrics are much accurate now than at the outset of our engagement. As the Project's C&C Schedule matures, we would expect that all of teams' metrics will be schedule-focused.

We have some additional high-level observations:

- As noted and discussed at length in the BOP section, OPG needs to examine a different delivery method for BOP work, one that allows the EPC vendors to begin detailed design as soon as possible. In conjunction with this change, the Engineering Team should review its processes to eliminate or reduce redundancy and the burdensome nature of elements of the MDR package development. One potential solution would be to limit the work by the OSS vendors and transfer some of these requirements to the EPC, so long as OPG's requirements are robustly detailed and established in accordance with ECC.
- The Engineering Team needs to review its and the other OPG groups' turn-around time for design approvals. There have been OPG-caused delays in approval of the OSS vendors' work, and the team needs to eliminate such constrictions where possible. The team should consider expanding its ball-in-court metrics to incorporate more granularity and visibility of the choke points in the chain.
- On the subject of engineering quality, BMcD/Modus recommends that an audit program be utilized to confirm that the EPC engineering vendors are adhering to their own QA/QC programs and that specific OPG quality requirements have been incorporated into the engineering practices utilized by these vendors (e.g.: Requirements Traceability Matrix).
- The Engineering Team should continue to evaluate the methods it will use for overseeing the development of detailed engineering by the EPC vendors. The OPEX from the Campus Plan work is informative in this regard and should be studied carefully.
- Developing comprehensive work packages is another function that has been exported to the EPC vendors. The Engineering Team will need to have sufficient resources available to handle questions and Requests for Information ("RFIs") from these vendors.

As the engineering effort continues, BMcD/Modus will provide both status updates and additional recommendations.

## **B. Commercial/Contracting Strategy**

### **1. Process**

OPG has chosen to use a combination of the multiple-prime and EPC project delivery methods. Here, each EPC "prime" contract equates to a Project within the DR Program. Each EPC prime contractor is responsible for coordinating and delivering the work covered by its particular scope of work (i.e. a Project or some portion

of a Project), but is not responsible for the entire Program.<sup>31</sup> Instead, OPG will take on the role of the Program Manager.

Under OPG's procedures, the Nuclear Commercial Development ("NCD") group coordinates an analysis with each Project Team and relevant stakeholders to develop a "Contracting Strategy" for each major work package. "A comprehensive contracting strategy takes into consideration factors such as the nature and scope of the work, the Supplier marketplace, potential longer term or broader commercial arrangements and results in a recommendation of the procurement approach, contract structure, pricing mechanism and the style and type of management to be adopted for the subsequent contract."<sup>32</sup>

Although each Project Team must perform a separate evaluation to determine the best contracting strategy, OPG has stated a strong preference for the EPC or hybrid versions of the EPC project delivery model, whereby a single contractor will perform the detailed engineering, equipment procurement and construction and installation work for a particular scope of work. OPG's key rationales for this choice are:

- This model gives OPG one point of contact (i.e. fewer interfaces and hand-offs for which the owner would be responsible to coordinate) and is "easier" to monitor and coordinate. From OPG's perspective, this also gives "one point of accountability" for complete delivery.
- This model can provide cost and schedule certainty to the owner prior to commencement of the execution/construction phase. This aligns with the DR Project's goal of having a high-level of definition for RQE.
- This model will enable OPG to concentrate its resources and efforts on rigorous project management and contractor oversight, which will be crucial to the DR Project's success.
- This model aligns with OPG's core business and overall future business direction, including staffing.<sup>33</sup>

Where applicable and relevant, we will discuss individual Project contracting strategies below. At this time, only contracts for the engineering and supply for Defuelling, RFR Definition Phase work (including development of the Tooling, construction of the Mock-Up and pre-construction estimate and schedule development), and the equipment supply and technical services contract for the Turbine Generators have been awarded and fully negotiated. The Execution Phase agreement for the RFR work has technically not yet been awarded (though it is anticipated that this work will be awarded to SNC/AECON upon agreement of the Target Price); and the final Target Price for this agreement will be subject to the ongoing RFR estimate development required by the Definition Phase contract.

Additionally, the ESMSA Contracts for the two intended BOP contractors have been negotiated and pre-Refurbishment work under these agreements is ongoing, although no Execution Phase work has been awarded to date. These contracts were awarded on the basis of competitive bid process, and the terms and conditions of these agreements were established for the purpose of simplifying future awards of the BOP work. The BOP section of this report provides additional detail regarding the commercial considerations in these contracts.

<sup>31</sup> The Campus Plan Projects have been excluded from the scope of the DR Commercial Strategy since they are being managed by Projects & Modifications, rather than the DR Team.

<sup>32</sup> See Program Contract Management Plan, NK38-PLAN-09701-1067- R000 (January 31, 2013) at p.5.

<sup>33</sup> See Darlington Refurbishment Program Commercial Strategy, NK38-REP-00150-10001-R001 (October 1, 2012) at p.11.

## 2. Additional Observations and Recommendations

As with any commercial strategy for a large capital project, there are risks associated with the multi-prime EPC model chosen by OPG for the DR Project. Many of these risks have been recognized and are being monitored by OPG, though they must be discussed on an ongoing basis as realization of some of these risks will impact the success or failure of the DR Project.

- With the multi-prime management approach, Owner's traditionally hire construction managers or program managers to coordinate the EPC contractors' work, and owner's engineers to review program compliance. OPG has chosen to fill these roles, and its success will be dependent its ability to employ a strong, capable and experienced construction management team that is able to effectively coordinate and track the work of such a large, complex project. We would also recommend that the DR Team integrate key construction management individuals into the DR Project Team as early as possible in the Definition Phase.
- OPG's preferred EPC contracting strategy is a new project delivery model introduced for the DR Project. It is also different from that used by OPG's vendors on past projects. Business cultural differences between OPG and vendors' management philosophies will have to be closely managed.
- The RFR contract dwarfs the other major project scopes, and there is a tendency to think of SNC/Aecon as the Project's full-wrap EPC contractor. This is not the case, and management needs to devote attention to the other projects to optimize adjacent project coordination and minimize interferences.
- The ESMSA vendors' performance and OPG's management of the vendors' work on the current Campus Plan scope has been mixed. OPEX from the D20 Storage Facility includes evidence of failures on both OPG's and the vendor's part to recognize that key details were missing from that project's definition which led to unrealistic schedule and readiness expectations<sup>34</sup>. The DR Team should examine these lessons learned going forward.
- The Program/Project approach has the risk of creating "silos" between the Project teams. Although each of the major Project Bundles are self-contained units, the Program must be managed by OPG as a whole, with a single, integrated schedule, cost control system and risk management approach.

Developing a contracting strategy for such a large project has to include a number of key variables. Some contracting approaches are more risky for the owner than others. Some are unsuitable for certain situations. Some strategies work for some owner organizations but do not work for others because the strategy depends on the owner's strengths. There is evidence that OPG took these major considerations into account in deciding on the contracting strategy it is following. However, this strategy will require some significant changes to OPG's prior large capital project mindset, and while growing pains are expected, the Project's success will be largely determined by OPG's willingness to embrace the role and recognize and control the risks associated with the chosen method.

### C. Project Controls

OPG's Project Controls team is responsible for essential functions of Schedule, Budget, Risk Management and Document Control. The following is our assessment of the development of each of these key elements to date.

<sup>34</sup> D20 Storage and Drum Handling Project: Modification Planning Lessons Learned Report, D-LLD-38000-1001 (March 4, 2013)

## 1. Project Controls Team and Structure

After Engineering, the DR Project's Project Controls team is the next largest functional group on the Project, and given the broad range of responsibilities the team has been given, this appears to be entirely appropriate. Project Controls is supporting the project-led approach with a core functional team and matrixed resources that have been embedded within the various Project Bundles. This was done to assist the Bundles in developing their respective schedules and budgets, though the efficacy of this model will likely wane as the Project continues to mature.

Going-forward, BMCD/Modus recommends OPG clarify the reporting lines of authority for Project Controls matrixed staff. Project Controls as essentially an independent function and those charged with that function are tasked with holding project managers accountable to integrated schedule, budget and risk standards. As an example, in the budget process, it is expected that certain puts and takes will occur between the Project Bundles. Project Controls needs to be the first-line-of-defense of the budget and broker these budget shifts with only the Project's overall best interests in mind. The matrixed Project Controls staff could be put in an uncomfortable position, having to work essentially for two bosses. In order to maintain the necessary independence, Project Controls personnel should have a direct and singular reporting line to a central Director, and that individual should report directly to the project's executive.

## 2. Schedule Development

### a. Process and Methodology

The DR Team has chosen a method for developing the Project's schedule that is unique in the industry at large. In accordance with the Program Schedule Management Plan<sup>35</sup>:

The (C&C Schedule) level 2 schedule covers the scope of work by Phase, Unit USI, and Type of work and contains full Critical Path Method (CPM) logic. It is referred to as the C&C schedule, or, Control and Co-ordination schedule, as this is the schedule which will be used, at the Phase and Unit level, to track the overall schedule status of the Program. It will be updated and controlled by OPG and based on the Contractors detailed Level 3 Schedules.<sup>36</sup>

In essence, the DR Team intends to use the Level 2 C&C Schedule as an integrated "look" of the schedule using Level 2 detail that mirrors (or hammers) the level 3 detail that the contractors are developing for work execution. In order to update and further develop the C&C Schedule, OPG's Schedule Team intends to summarize the contractors' level 3 schedule into a separate level 2 that contains an adequate number of activities with realistic activity durations to clearly show the sequence and logic in performing all projects, within the Program, at the Phase and Unit level, in a systematic manner. It will include all interfaces between OPG and contractor, and/or between contractors."<sup>37</sup> Notably, under this plan, the Level 3 detailed schedules from the contractors and respective work groups will not be integrated but only summarized at the milestone level. The eight<sup>38</sup> project bundles will each develop, maintain and update eight separate schedules with no interface logic ties between areas or bundles. The DR Team currently anticipates the C&C Schedule will

<sup>35</sup> NK38-PLAN-09701-10067 (January 31, 2013).

<sup>36</sup> Program Schedule Management Plan, NK38-PLAN-09701-10067-0004-R001 (March 27, 2013) at p.4.

<sup>37</sup> *Id.*

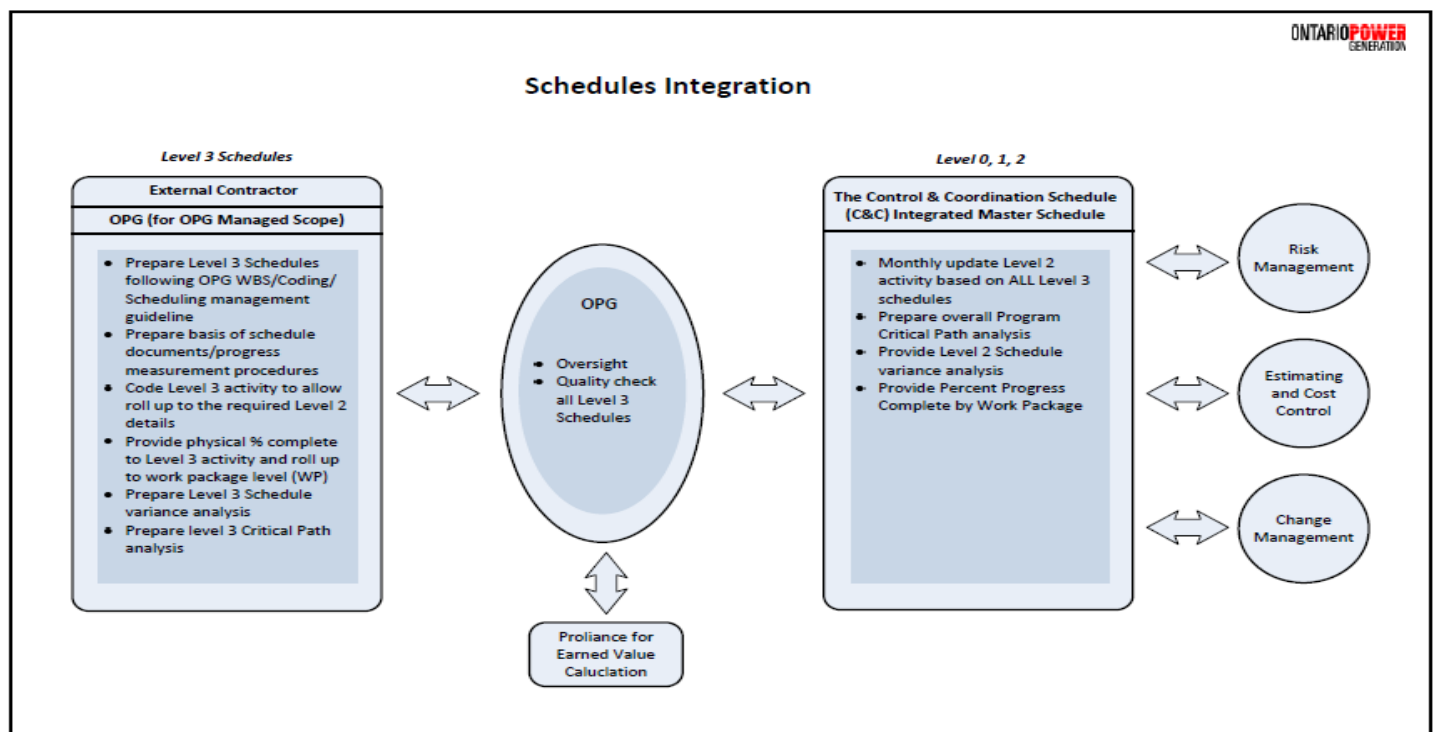
<sup>38</sup> For scheduling purposes, some of the SIO work is in a separate bundle.

consist of 5,000 tasks/activities in the Level 2 format, whereas the level 3 schedule, when developed, will consist of ~50,000 tasks/activities.

As articulated by the Project Team, the key drivers behind this unique methodology are:

- To allow for coordination of schedule activities at the summary milestone level. This is based on the Project Team's preference to manage the interfaces between the contractors and work groups at a higher, less granular level;
- To address OPEX from prior capital projects suggesting that the Project Team needs to manage the Project in a manner different from a conventional maintenance outage;
- To support OPG's desire for the exclusive ability to manage both overall and individual milestones that determine the contractors' schedule start dates, finish dates and float using the C&C Schedule.

OPG's *Program Schedule Management Plan* provides the procedure for developing the C&C Schedule from the Level 3 detailed schedule.<sup>39</sup> The diagram below identifies the flow of information from the Level 3 detailed schedules to the Level 2, C&C Schedule:



Some of OPG's processes follow typical scheduling practices: each bundle will have and update individual detailed Level 3 schedules with integrated Work Breakdown Structures ("WBS"); and assessment of critical paths and status updates will be based on an assessment of physical percent completion. These processes generally conform to frequent industry practices. Moreover, each Project Bundle will be responsible for updating its schedule to show its progress, and OPG will receive and coordinate the interfaces between the

<sup>39</sup> *Id.* at pp. 4-5.

Project Bundles through establishing and maintaining project milestones and touch points contained in the Level 3 Schedule.

While the C&C Schedule will work for the Definition Phase, it is our understanding that the DR Team intends to use the C&C Schedule as its prime schedule management tool through the Execution Phase. However, OPG's intended approach varies from what is typically seen in the industry for project execution in several important respects. By the Project Team's design, there will be no single integrated Level 3 schedule on the Project during the Planning or Execution Phases. Under this plan, instead of enmeshing these eight Project Bundle schedules, OPG has created the Level 2 C&C Schedule which "covers the scope of work by Phase, Unit USI, and Type of work and contains the full Critical Path Method (CPM) logic" and interface points. The DR Team's intent is that the C&C Schedule "will be updated and controlled by OPG and **based on** the Contractors detailed Level 3 Schedules." As shown in the diagram above, in order to monitor schedule progress, BMcD/Modus believes that this will cause OPG to monitor the eight separate Level 3 schedules and summarize the information into the C&C Schedule, as well as capture and record any changes to each bundle's schedule durations, adjacencies and logic (including the critical path). Typically, this level of integration is done electronically via an agreed automated roll-up of the schedule's Level 3 activities into a higher level 2 format. Such a Level 2 Schedule is typically not a stand-alone, calculating schedule, but merely a roll-up of the detailed Level 3 integrated, calculating schedule.

Maintaining a single Level 3 integrated, calculating detailed schedule network in P6 is standard in the industry because it readily provides the level of information needed for day-to-day management of the projects' work. The AACE's Recommended Practice 37R-06, which OPG's Schedule Management Plan uses as a reference document, states that Level 3 is the "first level that a meaningful critical path network can be displayed and the CPM schedule can be used to monitor and manage (control) the overall project work. Level 3 is a good level for the overall project control schedule since it is neither too summarized nor too detailed."<sup>40</sup> AACE recommends that the Level 3 schedule network "reflect the interfaces between key workgroups, disciplines, or crafts involved in the execution of the stage." BMcD/Modus agrees with and endorses AACE's conclusions. In our experience, a schedule for a project of this complexity needs a detailed logic network that is unconstrained and able to freely and readily calculate the critical path and sub-critical paths. As a result of our experience and widespread industry practice, we are skeptical that OPG's efforts at maintaining, updating and administrating the level 2 C&C Schedule will provide the management tool necessary for successfully coordinating and controlling the Execution Phase of the work.

#### **b. Status of Schedule Development**

The DR Team is currently developing the C&C Schedule by populating the detailed schedule network. The Project Information Management System ("PIMS") milestones for schedule development are: (1) Level 3 Schedule, "Revision A", April 15, 2014; (2) Level 3 Schedule, "Revision B", which will form the basis for the RQE, is scheduled to be completed in May 15, 2015; and (3) Final Level 3 Integrated Schedule, April 15, 2016.

The interim C&C Schedule was the basis of the presentation to the Refurbishment Project Executive Team ("RPET") on July 19, 2013. The following is an assessment of the current status of each of the Bundle components of the schedule, based on a review of the materials that were prepared for that presentation:

<sup>40</sup> AACE International Recommended Practice No. 37R-06 Schedule Levels of Detail—As Applied in Engineering, Procurement and Construction (March 20, 2010) at p.2.

<b>C&amp;C Schedule Status as of July 19, 2013</b>	
<b>Project Bundle</b>	<b>Current Status</b>
RFR	Level 3 is resource loaded with contractor staff needs, though there is a concern with contractor staffing to meet the work load in the Fall 2013. Program milestones for 'mock-up construction complete' are misaligned with the contract (by 61 days), with a CCF to be processed. RFR is currently evaluating inter-project ties and inserting outage milestones into the schedule. The RFR team was challenged to evaluate the number of activities with excessive float (600+ days) though the RFR team believes this float is realistic due to early performance of certain work. In addition, RFR will need to examine multiple activities with 500+ days of duration.
BOP	The schedule is currently reflecting pressure from MDR's for scoping, which are showing 89 days late. This may be due to logic ties rather than lack of progress and if so, will be corrected. However, as will be discussed in the BOP section, there is a significant risk that the current schedule logic will not support on-time completion of BOP detailed engineering. In addition, the schedule currently reflects that several inspection preparations are running behind schedule, though the BOP team assures that recovery plans are in place and as-planned completion dates are expected to be maintained.
Fuel Handling	The schedule for Fuel Handling is being revised to reflect the award of the Defuelling contract as well as certain changes that management has directed to move work forward, before the start of the DR Project's Execution Phase.
Turbine Generator	This bundle's schedule is not well developed at this time, as activity definition, sequencing and interface ties all require work. The current preliminary engineering activities are riding the data date with no rationale. The team reported that the RFP negotiations are impacting the schedule at this time.
Steam Generators	This schedule reflects the current maturity level, which is in the pre-contract phase.
Shutdown/Layup	New level 2 schedule was completed at the end of July and will be used as the target. The strategy is to use the existing ESMSA contracts and vendors for the work. The plans to support this procurement strategy are reflected in the target schedule.
<b>Functional Group</b>	<b>Current Status</b>
Operations & Maintenance	Much of the current work is to support project needs yet the activities are not tied (integrated) with the downstream project activities, consequently large amounts of float are shown. Significant O&M work that is required for the projects does not show up on the O&M C&C Schedule, which reflects an interface issue with coding and layout at level 2.
Licensing	Licensing schedule is organized by each project, activities are supposed to be extracted from the project schedules. This schedule needs further refinement from presentation layout to the definition of licensing activities for it to be a usable C&C schedule.



C&C Schedule Status as of July 19, 2013	
Nuclear Safety	There were a number of flaws noted with activity dates, % complete, float, descriptions, among other things. The activities are very short term focused, level of effort type activities. This schedule also needs further refinement for it to be a usable C&C schedule.

In the C&C Schedule meetings held during the week of July 15 2013, the Project Controls Team identified that schedule adherence and variance will be monitored against this version (July) of the level 2 schedule. There was a concern noted that the schedule fragments from OPEX on other projects are not being used to guide the logic and durations of schedule activities, the schedules are being developed from scratch. We noted a distinct difference between Functional and Project groups with the approach and degree of schedule development. The Functional groups in general have much more work ahead in their schedule development, with the Project Bundles being much further along. The current iteration of the Project schedule will be used to drive and measure the Definition Phase for the next 10 months. All schedule performance metrics will use this schedule as the interim baseline for measurement at the milestone level. As the Project Bundles mature, the schedule will continue to be populated with additional Level 3 schedules.

### c. Summary of Risks

Whereas the C&C Schedule is an adequate tool for the Definition Phase of the Project, BMcD/Modus is concerned with the schedule development plan that OPG is pursuing for the DR Project's Execution Phase. The following are some of these concerns:

- OPG intends that its C&C Schedule be its depiction of the interfaces between the eight Level 3 Project Bundle schedules, as described. At a minimum, this approach appears to shift significant burden onto OPG's Project Controls department to update the C&C Schedule to match the Level 3 schedules received from the contractors. This approach creates a risk that the C&C Schedule and the eight Level 3 schedules will not be fully aligned and manipulation of data will most likely be a daily issue as between OPG and its contractors. Moreover, the contractors may not accept the C&C Schedule as the Project's baseline schedule, which would create difficult issues when analyzing potential impacts and mitigation of delays and coordination problems.
- OPG's intent with the C&C Schedule is to give the contractors sufficient latitude to develop and "own" their respective schedules, and reduce the amount of interference (unintentional or otherwise) from OPG. However, in our view, the contracts executed to date do not present clear and unambiguous rules to hold contractors accountable in schedule development. The contracts rely on the parties reaching mutual agreement on the schedule which is a concept fraught with risk and difficult to achieve under the best of circumstances, and one which could ultimately result in the DR Project never having a baseline schedule. The contracts also reference AACE standards rather than identify specific requirements; however, there is a potential for confusion regarding OPG's exact requirements, as not all sections of these AACE standards are applicable and these standards are intended to be used as guidelines in the first place not requirements or obligations that OPG can enforce as the per OPG's Schedule Plan. OPG should consider revisiting its scheduling requirements for the contractors and clearly spell those out in all (current and future) contracts so that these standards are understood and dispositioned upfront and not held over for later mutual agreement.



- OPG's ability to obtain a sufficiently detailed Level 3 schedule from each contractor will depend on the amount of oversight the OPG team applies at a very early stage of development. As an example, the RFR contract requires SNC/Aecon and OPG to have a meeting of the minds on the schedule before it is accepted. OPG will have to similarly engage each contractor and police the schedule updates to ensure none are using techniques that could give OPG's management a false read of the Project's progress.
- As noted, OPG plans to limit the transparency of an integrated schedule in order to manage contractor float. While we recognize the importance of an owner maintaining proper float management when multiple prime contractors are working side-by-side, we do not believe that this is a sufficient reason for not having a fully integrated Level 3 schedule tool for coordinating and controlling the work. As an example, OPG will not be able to hold a "Plan of the Day" meeting with all contractors present because OPG intends to restrict viewing of the overall schedule. Moreover, to the extent that there are touch points between the contractors, and there will be many, OPG will have a difficult management task of communicating separately and individually with each party – even the best in the industry avoid this scenario. In our experience, limiting the transparency of the schedule risks the value of the schedule as an essential planning and communication tool needed to hold the contractors accountable.
- The level of resources OPG needs to maintain the C&C Schedule may be significantly underestimated. Our concern is that OPG will be utilizing resources in summarizing the detailed schedule that would be better focused on vetting of the contractors' schedule input.
- In the event a Project delay occurs in one of the eight bundles requiring a delay mitigation analysis, such analysis would need to use the Level 3 Detailed Schedule. However, if the Level 3 Schedule is not updated with interface logic, such an analysis would prove problematic at best. It would be very difficult if not impossible to perform an effective and convincing delay analysis using the Level 2 Summary Schedule, which was not developed by the contractors but is an owner controlled and developed document, all for the purposes to prove or disprove a delay claim.

In summary, BMCD/Modus sees significant risks associated with the plan for tracking the schedule using the currently adopted process, and we are skeptical that the end-product OPG intends to create will be a useful tool, let alone offset these potential risks.

#### **d. Summary of Recommendations—Schedule**

Based on the above observations, BMCD/Modus recommends the Project Team consider the following path forward with respect to the schedule:

- OPG's Project Controls team should continue populating the Level 2 C&C Schedule in the same manner with each Project Bundle submitting progressively more detailed Level 3 Schedules through RQE;
- OPG's Project Controls team should develop distinct rules for contractors to follow in the development of their level 3 schedules and have these rules clearly imbedded in all of the contracts;
- Continue using the C&C Schedule as a planning tool and as a tool for OPG management to measure the DR Project's status, critical path, and forecasted completion dates, through the current phase of project development until the Level 3 Detailed Schedule is completed;
- Continue developing the touch-points and milestones at Level 2 as the basis for the planning process;

- Once the detailed Level 3 schedule inputs from the contractors are sufficiently mature, OPG should revisit the issue of integrating the schedules from each Project Bundle into a single CPM network using the Level 3 Detailed Schedule;
- OPG should vet the internal resource requirement and model the amount of such that it will need for tracking and managing the schedule under both scenarios. The upcoming 2014 Business Planning review will be important for establishing the level of effort and resources needed for schedule development and maintenance; and
- OPG may choose to continue updating of the C&C Schedule, both as an interim Level 2 Schedule and as tool for OPG management to measure the Project's status, critical path, and forecasted completion dates if doing so provides OPG's management with a useful tool.

In summary, we are of the view that OPG is needlessly exposing itself to extra time, cost and management difficulties in proceeding along its contemplated course of scheduling after RQE. In this deviation from widespread industry practice, we doubt that the action will result in the Project Control tool necessary for tracking the work during the Execution Phase of the DR Project. We recommend that OPG consider developing a fully integrated level 3 schedule using progressive elaboration of the detail as the contractors' plans mature and automatically roll-up of the level 3 detail to the level 2 and summary schedules for management and reporting.

### **3. Budget Process and Status**

#### **a. Processes and Methodology for Cost Management**

BMcD/Modus has reviewed the primary processes, procedures, manuals and guidelines for budgeting and cost controls and found that the intent of these processes to generally comport with industry standards. However, the DR Team should review these documents for consistency and integration. The following summarizes our review of the more significant concerns related to the DR Project's cost control processes.

#### **i. Contingency**

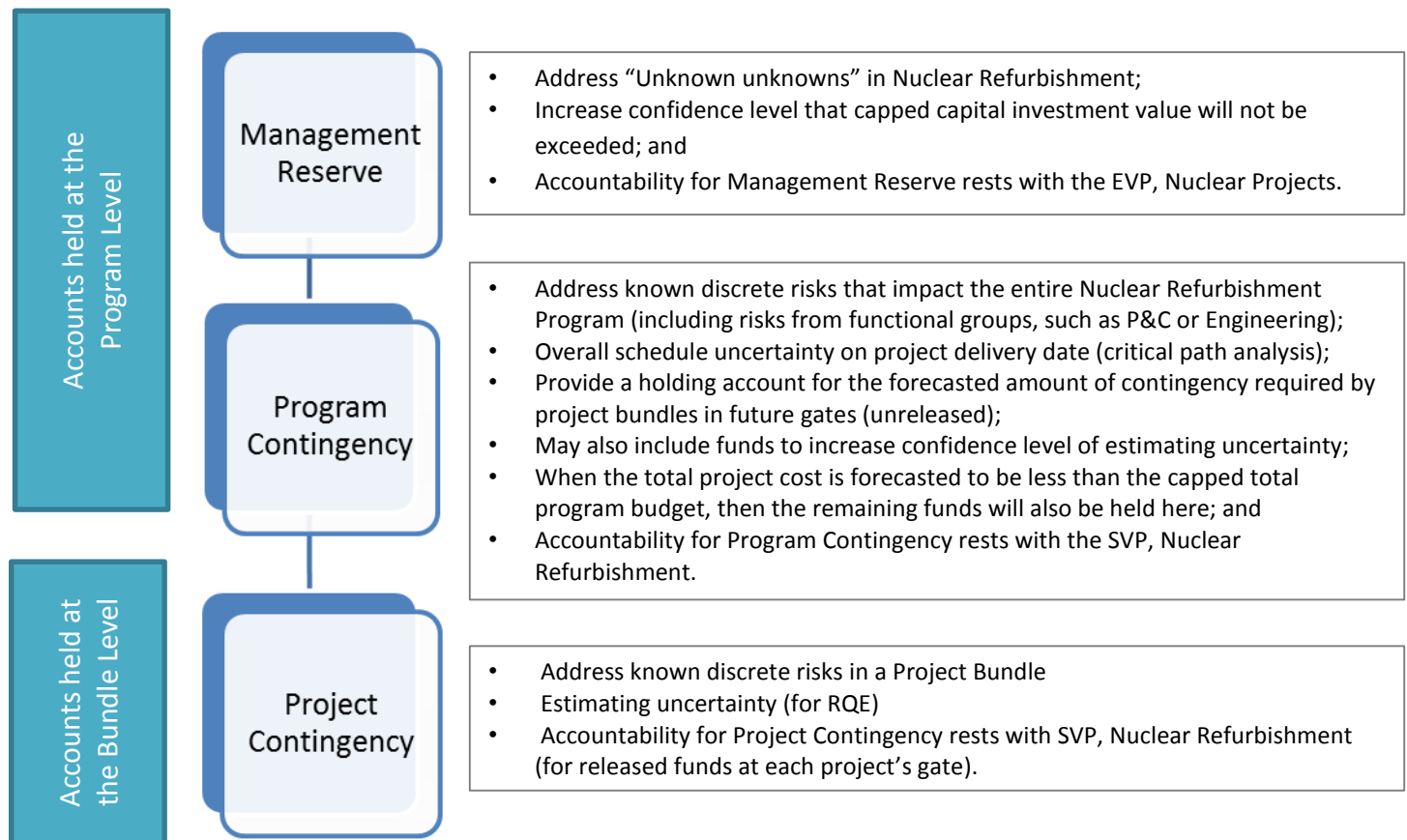
On June 26, 2013, the DR Team issued a "major" revision to its Contingency Development and Management Guide.<sup>41</sup> The revision was issued as work was starting on the 2014 Business Plan Business Plan estimate so that proper guidance could be provided to the Project Teams in developing each of their contingencies. According to the DR Team, Contingency Development and Management should be guided by the following principles:

- a) Uncertainty and risks in projects is a certainty – project managers are expected to identify discrete risks and be provided with the budgets to manage risks.
- b) There should be at least two classifications of funds to manage executive expectations, uncertainty and risks: One to manage identified and documented "known unknowns", and one to manage "unknown unknowns".
- c) Risk management must be a living and iterative process requiring frequent monitoring and control as project circumstances are always changing

<sup>41</sup> Nuclear Refurbishment – Contingency Development and Management Guide, N-MAN-00120-10001 Risk-05 R001 (June 26, 2013).

- d) Contingency development should be based on a justifiable risks, properly documented and determined using an approved process
- e) Contingency usage must be justifiable, properly documented, and requested via an approved process that allows for proper reviews and levels of approval
- f) Contingency or Management Reserve approvers must understand the impact of this usage on the remaining risks on the Project and as well on the overall program.<sup>42</sup>

Based upon these principles, the DR Team has established three contingency pools from which contingency funds may be drawn: 1) Project Contingency; 2) Program Contingency; and 3) Management Reserve. Below is an illustration of the purpose, scope and accountability for each type of contingency:



In determining the appropriate amount of contingency, the guideline recommends the use of a probabilistic approach, or Monte Carlo simulation method, which is the industry standard for mega projects. However, a probabilistic approach depends upon the organization having a comprehensive and reliable risk assessment and risk management program. As a result, the quality and effectiveness of OPG's Risk Management Program is very important for overall cost control.

As we will discuss in more detail below, based upon our review of the operative procedures and guidelines as well as interviews with the Project Managers and the Risk Section Manager, the Risk Management Program is

<sup>42</sup> Gary Rose, "Strategic Direction for Nuclear Refurbishment Contingency Development and Management" (undated).

comprehensive and well within industry standard. However, we have concerns regarding its execution, including risk identification and the updating, scoring, maintenance and management of the risk register, all of which need to be closely integrated. Making OPG's risk register the foundation of the Project contingency analysis potentially transfers quantifying risk and the exercise of estimating contingency not only away from the cost estimating function, but from the contractor to the owner. As yet, we have not had a chance to fully review how the items in the risk register are monetized and how contingency is actually calculated; the opportunity to do so will come with our vetting of the 2014 Business Plan budget process.

## **ii. Gate Review Process**

The Gate Review process is intended to ensure that all work is rigorously defined and adequately vetted at a series of gates which correspond to relative maturity of that sub-project.<sup>43</sup> The ultimate goal, as described by the DR Team, is for all work to meet the standards of Gate 3 prior to approval of funding for execution; further, that all work on the DR Project will be at the requisite level for Gate 3 approval by the RQE date.<sup>44</sup>

Based on our review of the estimating, contingency and gate review processes, the Gate Reviews appears to be adequate for use if all associated paradigms are identified and adhered to. As an example, the Gate Review Board has continuously rejected the Gate 2 submission from the Turbine Generator Team for its lack of completeness and failure to meet the Project's standards. We would recommend RPET to use this as a living example for holding the DR Team accountable as the requirements of the gate reviews increase and more projects will be advancing to Gate 3.

The Gate Review process is consistent with that seen in the industry at large. Nonetheless, as noted in this report, BMcD/Modus has particular concerns regarding the BOP scope's readiness for Gate 3 by October 2015. This has less to do with the gate process than the current schedule and pace of scope definition evident within the BOP work.

## **iii. Cost Management and Project Reporting**

The implementation of Proliance, which the DR Team intends to be the primary tool for reporting earned value, has been delayed and is currently only in the embryonic stages of its development. As a result, we have not yet been able to evaluate it as an effective project tool. Only one Project Bundle RFR, has an earned value process that is up and running and system bugs are still being worked out. Three other projects—BOP, Defuelling, and Turbine Generator—have reportedly been readied for import into the earned value system. However, there is evidence that the Turbine Generator team is not on board with or committed to the earned value process or, more basically, even to Proliance.

It should also be noted that based on our industry experience with clients employing similar systems to Proliance, it will most likely take months or quarters to get the earned value system up, running and purged of reporting noise. Therefore, it could be some time before OPG receives any meaningful data out of Proliance.

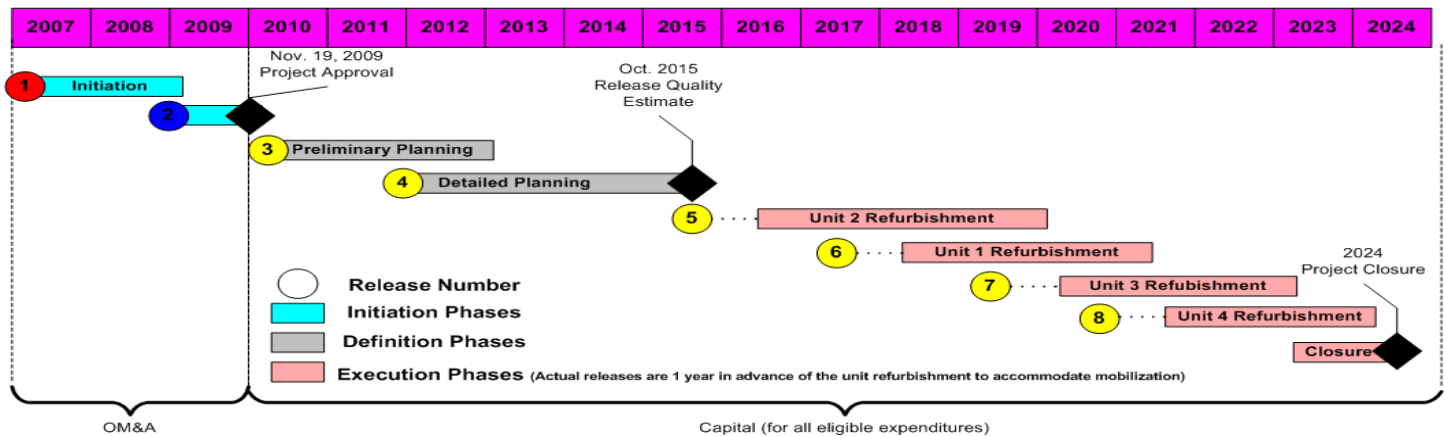
## **b. Review of 2013 Business Plan**

The current DR Project cost estimate is in the form of the 2013 Business Plan which the DR Team presented to the BOD for approval in the 4<sup>th</sup> Quarter of 2012. This Business Plan was the most recent in a series of yearly

<sup>43</sup> Nuclear Projects Gated Process, N-MAN-00120-10001-GRB-R000 (November 28, 2012).

<sup>44</sup> Darlington Program Update, February 27, 2013, at p. 71.

funding requests, the purpose of which is to provide the Board with an update on the status on the DR Project and to request approval of the revised overall release strategy and funding to proceed to Detailed Planning within the Definition Phase of the Project as identified below:



This release strategy provides the BOD with built-in “off ramps” in the event the DR Project’s economics cannot be supported, and requires the DR Team to provide the BOD with yearly requests for Definition Phase funding.

The base assumptions embedded in the 2013 Business Plan are as follows<sup>45</sup>:

- First unit Refurbishment Start date – October 2016
- Duration of Refurbishment (4 units) – 36 months each, 88 months total
- Estimate shown is in overnight \$2012M (excluding interest and escalation)
- Estimate is based on scope approved by the Scope Review Board, contractor cost, and OPG costs
- As contracts are awarded and contractor estimates are refined, the Project estimate is updated
- Contingency is based on an assessment of cost estimate uncertainty (price, quantity, productivity) as well as an assessment of discrete project risks
- Refurbishment will perform oversight of EPC vendors and will operate the unit during the refurbishment period.

The Project Bundle estimates underlying the 2013 Business Plan (exclusive of BOP) were characterized as Class 5, and there is evidence of scope (and scope bucketing) uncertainty in the comments adjoining the estimate’s line items. The estimates for the Functional Groups were drawn from high-to-medium level staffing plans for each of these groups. As noted in the earlier discussion of Scope, the Functional Groups’ plans changed from the 2012 to the 2013 Business Plan, reflecting a larger Execution Team with greater External Oversight, Project Controls and Engineering costs<sup>46</sup>.

<sup>45</sup> *Id.* at p. 18.

<sup>46</sup> *Id.* at p. 17.

### c. 2014 Business Plan

#### i. Revised Planning Assumptions

On June 4, 2013 OPG's Senior Management determined that the DR Team needed to analyze for planning purposes a potential alternative schedule scenario in which:

- Unit 2's Execution Phase would begin as originally planned October 2016
- Unit 1's Execution Phase would begin after the commencement of Unit 2
- Units 1, 3 and 4 construction would overlap by 19 and 17 months
- The total Refurbishment Project window would be 108 months

The drivers behind this new set of planning assumptions include reducing the complexity and risk of performance in as many ways as reasonable and allowing OPG to fully integrate lessons learned from the first Unit into the execution of the remaining Units. As of the time of this Report, the DR Team is engaged in its 2014 Business Plan review in which the team plans to reflect the result of this evaluation. It is our understanding that this work will continue into the 3<sup>rd</sup> Quarter of 2013 and culminate in a recommendation to the BOD to be presented during the October 2013 BOD meeting. We will continue to monitor this effort to its conclusion.

BMCD/Modus recommends the following in tandem and/or support of this decision:

- When presenting information to the BOD, OPG management must adequately document, present and otherwise explain the nature of its cost estimates and appropriately characterize the same before the BOD, all in a transparent manner. The BOD would benefit from the DR Team developing new and meaningful metrics that trace and meaningfully report on scope, cost and planning variances going forward.
- It is our understanding that the DR Team intends to segregate the estimated variances in the 2014 Business Plan estimate that were caused by scope increase/decrease from those emanating from the revised planning assumptions. This will be helpful but the Project Teams and Functional groups must be supportive.
- In keeping with the revised planning assumptions, the DR Team is training a critical eye on BOP scope. As discussed elsewhere in this Report, the DR Team should examine a different project delivery method than originally planned in order to optimize the BOP schedule, in particular the schedule for developing detailed engineering and construction work packages that will form the basis of Class 2 estimates needed for RQE.
- It is likely that if approved, the revised planning assumptions will result in some commercial reworking of the JV Agreement with SNC/Aecon. If Unit 2 is performed as a stand-alone without overlap, there will be some budgetary puts and takes that will likely impact the target price. BMCD/Modus recommends that OPG use this opportunity to consider amending the JV Agreement to incorporate other changes that could result in greater transparency, cooperation and risk reduction in the RFR project.

## **ii. Basis of Estimate**

BMCD/Modus has sampled some of the preliminary materials that are currently being assembled in support of the 2014 Business Plan reviews. Based on this in-flight review, it appears that the vast majority (64%) of the individual estimates that will make-up the 2014 Business Plan are still characterized as Class 5, while 19% are at Class 4 including RFR, which we discuss in detail in the related section. Seventeen percent (17%) of the DSRs have not been estimated to date. Based on this information, it would not appear that the level of maturity has greatly increased from the 2013 Business Plan to the 2014 Business Plan.

## **iii. Process**

The 2014 Business Plan assessment will not be a full re-examination of the DR Project's underlying cost estimates. While at this stage, given the DR Project's overall maturity, this refresh of costs is appropriate, we nevertheless recommend that the DR Team engage in more rigorous effort in connection with next year's 2015 Business Plan cost assessment as a pre-cursor to release of the RQE. Because of the expected leap in clarity in regard to project definition over the next several months, the DR Team should be tasked with considerably narrowing the uncertainty cost band around project cost – there is no reason to delay this to the timing of the of the RQE release.

## **d. Recommendations—Estimating and Budgeting**

In summary, while the DR Team has made reasonably good strides toward establishing cost controls and driving compliance and accountability from a process perspective, there are some areas (scope definition, contingency development and management) where improvements can be made. The following are selected recommendations in this regard:

- The DR Project's estimating process needs to more closely adhere to AACE guidelines, and do so with greater uniformity. Since RFR is the test case for the other project cost estimates, the team needs to ensure that adequate vetting of the RFR estimate is accomplished as the cost estimate moves toward the RFR Class 3.
- The Risk Register needs to be streamlined and otherwise vetted including how and why some categories of risks are translated into contingency.
- Estimating and risk management functions need to be better aligned with regard to deriving contingency.
- Proliance needs to be implemented as soon as possible to ensure the cost and schedule management systems and reporting are aligned and in sync. This is critical to ensure data fidelity as the bundles move through the gate review process and move toward RQE and execution.
- The number, mapping and consistency of the various cost control processes and procedures should be reviewed by the DR Team, with an eye toward simplifying and streamlining such procedures.

In developing and characterizing its cost estimates and contingency, management reserves and allowances, OPG needs to adhere to unified and consistent definitions. In the absence of clarity, the organization will almost certainly continue to use the terms in interchangeable manners and thus run afoul of good practice. OPG has chosen AACE for reference guidelines and it needs to align to them in all cases, both internally and in contractor operations. As we discuss in the section related to RFR, inconsistent application of processes can



lead to unnecessary confusion and thus a misunderstanding at the management level with respect to the rigor behind the cost estimates presented to it.

#### 4. Risk Management/Lessons Learned/OPEX/AIDA

##### a. Status of the Programs

The DR Team has established its Risk Management Program which is generally consistent with those commonly encountered on other projects and complies with published literature such as the Project Management Book of Knowledge (“PMBOK”)<sup>47</sup>. The Risk Management Program focuses on the key elements of: (1) Risk identification; (2) Likelihood of Occurrence; (3) Impact; (4) Mitigation and (5) Monitoring. To date, the DR Team has focused on the following activities:

- Developing written procedures<sup>48</sup> derived from corporate documents<sup>49</sup> and establishing a risk management organization infrastructure;
- Creating a central risk register to assemble and document identified risks, results of assessments, response plans (mitigation activities) and status. The risk register is an Access database called RADAR (Risk Assessment Database and Register), which is maintained by a small Risk Group that is part of the Project Infrastructure section of the Refurbishment Planning and Controls organization;
- Initiating a Risk Oversight Committee (“ROC”) comprised of RPET and various subject-matter experts that meets at least quarterly to provide oversight of program and project risk management activities.



On a separate path, SNC/Aecon and the OPG RFR Project Team are developing and vetting their own risk register as part of the RFR estimating process. Development of this RFR risk register is required under the specific terms of the JV Agreement and is based in large part on the OPEX and lessons learned from prior refurbishments. It will be used for monetizing a component of SNC/Aecon’s target price for the Work.

OPEX and lessons learned are key sources of input for identifying risks within the Risk Management Program. To make full use of the OPEX from past refurbishments, the DR Project has established a formal process and procedure<sup>50</sup> to capture and communicate OPEX and lessons learned that assist in identifying and managing the risks.

In addition to the Risk, OPEX and lessons learned programs, the DR Team also has established a formal program for ensuring that assumptions, actions and decisions associated with the refurbishment are properly

<sup>47</sup> PMBOK is published by the Project Management Institute.

<sup>48</sup> Nuclear Refurbishment Risk Management, N-MAN-00120-10001-RISK-04-R000 (July 25, 2012), Nuclear Projects Risk Management Process, N-MAN-00120-10001-RISK-R001 (November 22, 2012).

<sup>49</sup> Darlington Refurbishment Risk Management Plan NK38-PLAN-09701-10067; Project Risk Management Standard, OPG-STD-0062.

<sup>50</sup> Darlington Refurbishment Lessons Learned And OPEX Management, N-MAN-00120-10001- RISK-06 (July 19, 2012).



assessed and that follow-up actions are documented and managed<sup>51</sup>. This information is collected and recorded in the Assumptions, Issues, Decisions and Actions (“AIDA”) database, which is maintained by the Risk Group. The purposes for recording significant assumptions and decisions include: “To Exhibit prudence and oversight in the decision making process and in the validation of key assumptions impacting NR”; and “To maintain an auditable trail for future review and reference.”<sup>52</sup>

To mitigate cost and schedule risks, the DR Team has established a Contingency Program<sup>53</sup> which provides for developing contingency from quantitative and qualitative analysis of risks residing in the Risk Registers and in functional area business planning. A more detailed analysis of the Contingency Program is discussed in Section IV.C.2.a.i.

## b. Processes and Methodology

The process that the DR Team is using for developing the source data, analysis and presentation of risks is generally consistent with that observed in the industry at large although there are some issues with the quality of the information that DR Team needs to correct. Below we describe the component parts of the Risk Management Program.

### i. Risk Scoring Process

The DR Team has populated the Risk Management Program’s databases through facilitated brainstorming sessions, individual input and review of OPEX and lessons learned from other projects. The Risk Group aggregates and reports specific risks in individual projects or department RADAR files. High level “global” risks that have the potential to impact the viability of the whole Refurbishment Program are included in a Program Risk Register. Each Program risk is “scored” by assigning a number to reflect the probability of occurrence based upon the following rating system:

Probability Rating ->	1	2	3	4	5
Qualitative	Improbable	Unlikely	Possible	Likely	Probable
Quantitative	< 10%	10% - 30%	30% - 70%	70% - 90%	>90%

In addition, the consequence of each risk is “scored” relative to its potential impact on cost as depicted in the table below.

Impact Rating ->	1	2	3	4	5
Qualitative	Minimal	Minor	Notable	Substantial	Major
Quantitative (Cost)	< \$5M	\$5M - \$50M	\$50M - \$200M	\$200M - \$500M	>\$500M

Similar ratings are developed for schedule impact and risk manageability (i.e. ability to mitigate or control the risks). Different rating scales may apply to the individual Project Bundles and Functional groups. The final individual Risk score is determined by multiplying the probability of occurrence by the highest of the impact ratings for cost, schedule or manageability. The “heat map” below is a graphical representation of the probability and impact combinations that yield a risk score. The color coding depicts the severity of the risk relative to likelihood and impact.

<sup>51</sup> Nuclear Refurbishment Assumptions and Decisions Management, N-MAN-00120-10001 RISK-07 (March 5, 2013).

<sup>52</sup> *Id.*

<sup>53</sup> Nuclear Refurbishment – Contingency Development and Management, N-MAN-00120-10001 RISK-05 R001 (June 26, 2012).

Consequence					
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
	1	2	3	4	5
	Probability				

EPC contractors supporting the DR Project must also prepare a Risk Management Plan for identifying and managing contractor related risks. Scoring of risks can be somewhat subjective as risk tolerance can vary from person to person. In our review of the various Project risk registers, we have observed wide variances in scoring practices. This may lead to difficulty by the management team to accurately identify and assign the proper amount of contingency necessary to cover these risks.

## ii. RADAR and OPEX Databases

The DR Team developed the RADAR database to be the central depository of OPEX and lessons learned from external sources to OPG (e.g. the CANDU Owners Group, Bruce, the Institute for Nuclear Power Operations (“INPO”)) or within OPG (e.g. Pickering, Operations & Maintenance, and the DR Project itself). A refurbishment OPEX management database is maintained by the DR Project’s Program OPEX Single Point of Contact (“SPOC”) in the Refurbishment Planning and Controls Risk Group. The OPEX SPOC gathers and screens OPEX and lessons learned items, enters the information into the database and distributes the new entries to the local departments and projects. Responsible departments and projects then assess applicability and respond to the OPEX SPOC regarding how the item will be addressed. The OPEX SPOC issues a quarterly OPEX/Lessons Learned Summary Report to document quarterly Lessons Learned and actions planned or taken to address significant items.

## iii. AIDA Database

The DR Team has established the AIDA database as storehouse of all of the DR Project’s major assumptions and decisions. This database is intended to support OPG’s future rate proceedings as well as be an adjunct to the plant’s configuration management.

All of the DR Project’s significant assumptions are supposed to be entered into the AIDA database by submittal of a prescribed form to the DR Project Planning & Controls Risk Group. A similar process is used for significant decisions. However, the decision entry process (“Decision Record and Analysis Summary” – DRAS) requires a benefit-cost analysis and progressive approvals based on the potential impact of the decision. The DR Project Planning & Controls Risk Group is responsible for providing oversight and support throughout the assumption and decision management program. Action items that arise from meetings or individual submittals are entered in the actions database, which is also processed and maintained by the DR Project Planning & Controls

Risk Group. As noted below, the DR Team has not fully updated AIDA, which compromises its overall usefulness for its intended purposes.

### c. Summary of Observations

A sound Risk Management Program is critical to the success of a complex project such as the DR Project. The DR Project intends its Risk Management Program to function along such lines. The DR Project's reporting to the BOD and management has been focused on risk identification. While there are good aspects of the DR Project's Risk Management and associated programs, they have not yet been developed to reach their full potential for supporting project objectives. In part, this is due to the maturity level of the DR Project program. A number of the concerns raised herein have been recognized by the DR Project Risk Group and selected action is underway. However, curative actions need attention at this time. The following issues are presented:

- **Risk Identification and Scoring Issues:** Many of the identified risks are really "concerns" stemming from potential inadequate management and thus serve to only clutter the Risk Register – contingency should not be added for poor management, rather, better management should be added. For example, Program Risk No. 300: "The risk is that the Campus Plan schedule may not be fully integrated with the Refurb schedule". Within the industry, the above would only be seen as a risk resulting from poor management, and not an innate work risk. Cluttering the register with false risks is energy consuming and serves no productive purpose. In addition, there is evidence of wide ranging ambiguity and inconsistency in the risk titles and descriptions which leads to uncertainty in understanding the risk that may in turn lead to misplaced mitigations.

Moreover, the rules that the DR Team are using exhibit a broad range of probability (30% - 70%) and could mask serious differences in likelihood of occurrence scoring. A risk with a probability of 31% is given the same score as one with a probability of 69%. While the risk analysis process is not precise, the opportunity exists to inappropriately score a risk in this broad range.

- **Tools for Risk Management Program:** The software systems used for Risk Management and related programs (i.e. RADAR, AIDA, OPEX) are cumbersome with limited capabilities and do not interface well or cross reference with each other. This limits effectiveness as a management tool and causes inefficient use of personnel time. Efforts by the IT group to improve this critical system are essential at this time.

There are a number of shortcomings in the various databases that the Risk Group is tasked with maintaining. For example, the AIDA database is conceptually an excellent tool that should help OPG immeasurably in future rate proceedings. However, our pulsing of AIDA's content identified a number of significant gaps in the information that has been stored within the database. In addition, we noted a number of entries of questionable value (e.g. numerous entries state "the assumption is that identified criteria with regards to (an event) will be met"). Also, many of the entries border on events that should be considered "risks;" however, there is no indication that a corresponding risk was created in the Risk Register.

The OPEX and Lessons Learned program is good, but the OPEX database is not fully integrated with RADAR and AIDA database. This disconnect could cause important OPEX and lessons learned issues to be lost or ineffectively tracked. The DR Project Risk Group's plan for creating an integrated, user friendly and accessible system will remedy this.

- **Opportunities:** A good Risk Management Program also attempts to identify “opportunities” and provide for a proactive response to improve the likelihood of the “opportunity” occurring. No such opportunities have been observed in the DR Project RM Program, suggesting that latent opportunities may be out there.
- **Contingency:** The DR Team is currently implementing a revised contingency process. However, properly implementing and managing the program will be a challenge, considering the above concerns regarding resources in the DR Project Risk Group, training, risk definition ambiguity and RADAR database capabilities. Performing stochastic analyses to calculate contingency is appropriate. However, it is a complex process that could yield inconsistent results. The issues identified herein need resolution in order for the stochastic modeling that will form contingency recommendations to be accurate and consistent.
- **Lack of Metrics:** The Risk Management and associated programs have a less than desirable number of meaningful metrics to provide management with a sense of the maturity or fidelity of the underlying the data and the DR Project’s performance.
- **Staffing and Leadership:** The Refurbishment Planning and Controls Risk Group is lean and staffed with capable but relatively inexperienced individuals - several staff are Co-ops or interns. The DR Project’s philosophy appears to be for the individual projects and departments to perform the majority of Risk Management duties and related work, while the central Risk Group serves only an administrative, support and oversight role. This creates a condition that at the end of the day, risk management is viewed as a collateral duty of project or department personnel which dilutes and diminishes the attention focused on risk management efforts, given other duties of such entities. A recent self-assessment of the DR Project Risk Management program concluded that *“Darlington lacks the resources to achieve the desired dynamic risk culture”*. Despite that conclusion, the accompanying recommendation advocates no curative action.

In a related note, training for Risk Management and related programs is occurring in an ad hoc manner, and the resultant issues addressed in this report reflect its ineffectiveness.

#### d. BMCD/Modus Recommendations—Risk Management Program

Based on the above observations, BMCD/Modus recommends that the Project Team consider the following with respect to the Risk Management and associated programs:

- **Provide Direction on Risk Scoring and Evaluation:** The DR Team should decide whether all Risk Registers “concerns” that rely on existing management processes should be considered innate “risks” with associated analyses, mitigation actions and tracking. The team should also consider whether the definition of risk should include a phrase such as: “...for which there is no management structure of process to address”. The team should vet all DR Project’s Risk Registers and identify those entries which fail to rise to the level of a true risk and consider removing such items as appropriate by closing the risk or transferring it to an action item list.

The team should seek to eliminate ambiguity in risk descriptions, prepare and distribute a short instruction for responsible risk owners to review and revise their risk descriptions. Alternatively, the team should consider assigning several technical writers to review risk descriptions and interface with the responsible risk owners to clarify the descriptions. Also, to avoid inconsistencies and to preclude “gaming”, contingency derivations should be performed across all areas by a qualified centralized

group with adequate resources and detailed procedural requirements. Finally, the team should consider revising probability scoring to include specific points rather than ranges (e.g. 10%, 30%, 50%, 70% and 90%).

- **Address Leadership Issues:** Many of the concerns raised in this section of the report would likely be addressed by appointing or hiring a strong, experienced, and assertive central Risk Program Coordinator with an established track record of success, endorsed by senior management. The risk manager should have well-defined responsibilities (e.g. oversee RM, OPEX, AIDA activities on a day-to-day basis, proactively advocate the documentation of decisions, assumptions, lessons learned, etc., eliminate ambiguity and inaccuracies of database entries, facilitate consistency in risk analysis/scoring and in contingency development, conduct training, etc.). Also, the DR Team should consider performing a staffing analysis to ensure that the Risk Group is right-sized with the appropriate skill sets.

OPG should also consider elevating the Risk Group in the DR Project organization to give it more stature and to demonstrate that senior management considers Risk Management, OPEX Management, Decision and Assumption Programs to be serious and extremely important elements of a successful Nuclear Refurbishment.

- **Expedite the IT organization's efforts with the Various Databases:** The DR Project needs IT support to develop the needed Risk/OPEX/AIDA software systems pursuant to the recommendations of the Risk Group.
- **Address AIDA Database Gaps:** The DR Team should clearly define the requirements of the AIDA Database, review the existing database for conformance with such requirements, and revise the database as required.
- **Training Gaps:** The DR Team should consider developing and executing a comprehensive Risk, OPEX and AIDA training program. This training would foster an understanding and acceptance of the importance of these programs, stimulate proactive participation and encourage the identification of opportunities in the Risk Registers. Once effective training is initiated, consideration should be given to establishing an internal communication program to keep people informed and to sustain appropriate employee interest and participation.
- **Metrics and Trend Charts:** The DR Team should review (and develop or re-develop) appropriate metrics to effectively track various elements of the risk management program.

## V. Major Project Bundles

### A. Retube and Feeder Replacement

The DR Project's largest single cost component is the Retube and Feeder Replacement ("RFR") project, which comprises the Project's critical path and represents the largest risk to the Project's overall execution. OPG is the fourth utility to perform a mid-life refurbishment of CANDU reactors, and all of the prior unit refurbishments have experienced a number of significant delays, cost overruns and/or performance issues. Thus, understanding the risks and lessons learned from these prior projects is an essential part of developing the RFR cost estimates.

The RFR project is organized into three phases:

(1) *Definition Phase*: pre-outage work beginning February 1, 2012 and to be completed before the first plant outage in 2016. It also includes the development of specialized tooling and the design and construction of a reactor mock-up for training purposes, prior to refurbishment.

(2) *Execution Phase*: actual specialized fieldwork associated with each of the station's four reactors, including the removal and replacement of 480 pressure tubes, calandria tubes, 960 end fittings; and 960 feeder pipes the reactor components and includes training and tool maintenance for each of the four DNGS units; and

(3) *Commissioning Phase*: plant commissioning and support as required and directed by OPG.

On March 1, 2012, OPG awarded the RFR contract to SNC/ Aecon (the "JV Agreement"). The JV Agreement is for the Definition Phase of the RFR Project that will be performed from 2013 to mid-2016. The current value of the SNC/Aecon contract is estimated at over \$600 million. Once the Definition Phase is completed, OPG and SNC/Aecon will determine the cost to complete the Execution and Commissioning Phase work and if such cost is acceptable, OPG will award the remaining contract work for the Execution Phase.

### 1. RFR Cost Estimates

The JV Agreement requires SNC/Aecon to develop a series of progressive cost estimates based on AACE *cost estimate Classification System* for the Execution Phase. Per the JV Agreement, the timeline for developing and submitting the progressive cost estimates spans a period of about three years beginning on August 1, 2012. Submission of each progressively classed cost estimate (i.e., Class 4, 3 and 2) is contractually due on June 15 of each year, starting in 2013. The final Class 2 Estimate is intended to form the basis of SNC/Aecon's Target Price for the Execution Phase.

The intent for the progressively classed cost estimates is to absorb all lessons learned through mining-out OPEX along with other information developed during the Project's Definition Phase, all as it becomes available, validated and approved by OPG. The JV Agreement established as part of this progression of estimates a process whereby the successive classes of estimates proceeding to the final Class 2 Estimate specifically exclude consideration of contingency. The JV Agreement at 3.5 states, "Every Execution Phase cost estimate prepared in accordance with this Agreement will not include any contingency amount." However, the JV Agreement also states that the estimates at every level will follow AACE guidelines, and those guidelines include calculation of contingency.

The parties' intent in the JV Agreement is to use the risk register to help develop and manage the Target Cost. OPG and SNC/Aecon will mutually determine and agree on the risks to be included on the risk register. Once there is an agreement, the Target Cost can only be increased for those risks that were identified (unless the risk is an excusable event). As we previously discussed, the procedure dictated by the JV Agreement actually conflicts with the AACE guidelines as well as the processes established by the DR Team for scope and cost "gating."

Nonetheless, as with all cost estimates for the DR Project, as the knowledge that forms the basis of the estimate matures, the RFR Team must present the resulting revised estimate under the DR Project's Gate Process. The intent of this process is to ensure that all important aspects of the estimate under scrutiny have been adequately vetted before proceeding further.



## 2. BMcD/Modus Review of RFR Cost Estimates

BMcD/Modus has examined the two RFR estimates to date to evaluate: (1) the efficacy of the vetting process for the DR Project's most significant scope of work; (2) the status of the RFR's estimate and how it should be viewed by OPG's Management; and, (3) draw broader conclusions regarding the methodology the DR Team has established for review, vetting and challenging estimates in general. To more fully understand the methodology and procedures used for development of the Class 5 and Class 4 Estimates, BMcD/Modus has met with the key members of the OPG RFR estimating team.

In conjunction with its oversight responsibilities, BMcD/Modus has reviewed various OPG's procedural and process documents, certain PowerPoint presentations and the cost estimates. A list of these documents appears in Exhibit A.

### a. Basis of Estimate – Class 5

SNC/Aecon's Class 5 Estimate was initially submitted on August 1, 2012 in accordance with its Project Estimating Plan.<sup>54</sup> OPG observed considerable shortcomings in this initial estimate submission. Most notably, OPG found that contrary to the contractually prescribed methodology for developing the cost estimate, SNC/Aecon embedded several prohibited cost items, such as contingency and overhead within the base cost estimate. As a result, OPG rejected SNC/Aecon's initial Class 5 Estimate. The total of the rejected Class 5 Estimate was \$2.841 B, which OPG determined to be "too high".

As identified in the Estimating Plan, which reflects the current understanding between the parties for the development of the estimates, the root causes of the disconnect between SNC/Aecon and OPG were:

- The detailed basis of estimate were not agreed upon before SNC/Aecon started;
- The original Estimating Plan was too high level;
- SNC/Aecon did not clearly understand the basis for OPG's intended estimating process;
- SNC/Aecon's estimating resources changed, resulting in lost continuity;
- Inadequate and untimely collaboration over details in the estimate.<sup>55</sup>

The remedy for these early process failures was the parties agreed that "schedule and estimate [for the successive estimating packages] to be prepared as ***ideal without risks, contingency & factors per the Agreement.***"<sup>56</sup> The basis for the next iteration of the Class 5 Estimate was a Process Flow Diagram ("PFD") that was derived entirely from OPEX and largely from Wolsong, which was then reviewed and monetized based on the associated level of effort. "In the Class 5 Estimate the critical path activity durations were established on adjusted OPEX durations, based on a percentage average adjustment representing 'ideal' productivity for all [Direct Field Labor or "DFL"] activities equally applied, without contingencies or allowances."<sup>57</sup> The only adjustments to the DFL categories were to adjust the size, scale and to some extent the work rules that represented the difference between Wolsong and Darlington at a very high level.

SNC/Aecon submitted the revised Class 5 Estimate on December 21, 2012. The revised Class 5 was \$1.512 B. Within the industry, the approved Class 5 Estimate would be considered appropriate in defining the reference

<sup>54</sup> DNGS RFR Project—Project Estimating Plan 509407-0000-00000-33IM-0001 R3 (March 21, 2013).

<sup>55</sup> *Id.* at p. 18.

<sup>56</sup> *Id.*

<sup>57</sup> *Id.* at p. 17.

plant for an estimate of this type. The modifications to the process produced what was intended by the JV Agreement—a jumping off point for estimating this work, based on OPEX and in consideration of process improvements that should come from the repetitive nature of this work.

#### **b. Basis of Cost Estimate – Class 4**

The goal for the Class 4 Estimate was for SNC/Aecon to state and OPG to validate the primary costs consisting of vault DFL and the Owner Specified Materials (“OSM”). SNC/Aecon presented an estimate based on “individual OPEX validations” with “100% of all DFL activities on the PFD critical path series. . .analyzed and validated assuming ideal productivity without contingencies or allowances for unforeseen disruptions.”<sup>58</sup> In other words, the Class 4 Estimate was intended to be a validated, perfect-world reference plant with all risks wrung-out. Each DFL activity on the Project’s critical path for the Class 4 Estimate was individually validated, as opposed to the Class 5 Estimate procedure wherein only an average adjustment factor was used, based on OPEX sampling. The vetting of the above described activities was memorialized in specific estimating reports called *Mini-Estimate Reports*.

As stated, each of the Class 5 and Class 4 Estimates utilized information from previous OPG projects (OPEX), *looking backwards*. The primary outside referenced project used for the Basis of Estimate (“BOE”) was Wolsong Unit 1 (2009-2011) OPEX. Below are select estimate considerations:

- OPEX information has been adjusted for quantities and assumed optimum shift work hours and other patterns.
- In the estimate, all work is deemed executed under *ideal* conditions and thus actual *poor productivity* has been excised (based on a review of OPEX information).
- All contingencies and risks have been removed from the estimate.
- OPEX data from the Bruce Restart project and Point Lepreau has been used, as appropriate, when no other data is available.
- OPEX information has been adjusted to reflect existing Ontario Labor Agreements.
- Generally, DFL parallel path activities (i.e., non-critical) have not been robustly re-assessed but have been minimally reviewed so as to determine if they have *gone critical* as a result of CP duration changes made when moving to Class 4 from Class 3.
- Percentage allocation for support services, training and Project Management Team (“PMT”) labor have been carried forward based on the Class 5 Estimate.

Utilization of the above methodology has resulted in a project estimate modeled under *best theoretical* performance conditions. However, the Class 4 Estimate was essentially devoid of more refined cost estimates specifically for Darlington that include productivity factors and contingency identification.

<sup>58</sup> *Id.*



### c. BMcD/Modus's Analysis of SNC/Aecon's Cost Estimates

#### i. Cost Estimate Variance Analysis

The monetary changes noted from the approved Class 5 to Class 4 Estimate were minor: these variances total ~\$139.6M or 9.23% growth from the Class 5 Estimate amount. The most significant difference from Class 5 to Class 4 Estimate were changes to the work day ("WD") durations for critical path work activities in the vault, as summarized below in Table A:

<b>Table A - Critical Path Summary and Variance</b>				
<b>Vault Summary Series</b>	<b>Class 5 Durations (WD)</b>	<b>Class 4 Durations (WD)</b>	<b>Variance (WD)</b>	<b>Basis for Variance</b>
Pre-Requirements	32	92	60	40 WDs added to SNC/Aecon schedule for bulkhead installation; 6 WDs added for PHT work; 14 WDs reconciliation of critical path
Feeder Removal	44	55	11	13 WD added for one parallel task (Feeder Cabinet Removal) changed to critical path; 3 WD added for a new critical path task - Feeder Monorail; -5 WD deleted for reduction of Feeder Removal activity.
Fuel Channel Removal	219	223.5	4.5	Re-evaluation of OPEX related to critical path activities.
Inspection	75	82	7	Re-evaluation of OPEX related to critical path activities
Feeder Installation	97	79	-18	Re-evaluation of OPEX related to critical path activities
Fuel Channel Installation	138	138	0	No changes
Post-Requirements	18	63	45	20 WD added due to the addition of bulkhead removal. 26 WD added due to new execution strategies for four critical activities. -1 WD reduced due to re-evaluation of OPEX related to critical path activities.
<b>TOTAL</b>	<b>623</b>	<b>732.5</b>	<b>109.5</b>	

From a cost perspective, the impacts of these revisions were as follows:

- Bulkhead activities and associated cost in both the Pre-Requirement phase and Post-Requirement phase are now included in Class 4 Estimate whereas these costs were not included as scope in the Class 5 cost estimate (\$73.2M or ~4.84%). OPG has shifted this scope from the Islanding Project to RFR, and thus does not represent a major impact to the overall DR Project's budget.
- Escalation to 2013 dollars is included in the Class 4 Estimate (\$38.4M or 2.54%) per the JV Agreement.
- Other miscellaneous changes (\$29.9M or ~1.85%):
  - OSM decreased based on actual vendor feedback and quotations.
  - Feeder installation duration/hours were significantly reduced as a result of more detailed analysis when compared to the Class 5 Estimate.
  - Tool decontamination and packaging increased in Class 4 level
  - Non-Destructive Examination, Phased Array Testing and Shielding scope was added to the Class 5 Estimate.
  - Letter of Credit costs increased due to a calculation error in the Class 5 Estimate.

The relatively minor change to the cost estimate from Class 5 to Class 4 reflects the parties' goal to perform "100% validation" of the critical path PFD activities that are the foundation of the estimate. It is not clear as to why this work was deferred to the Class 4 Estimate, and the production of the estimates one-after-the-other indicates that this was a continuous effort that may not have justified two separate deliverables or classifications. The variance between the estimates is not reflective of any real increased level of project definition, at least according to AACE Recommended Practices. The most significant change between the two estimates, the bulkhead scope (\$73.2M), was a part of the DR Project, but the scope was shifted to SNC/Aecon after release of the Class 5 Estimate.

BMCD/Modus does not question that SNC/Aecon's estimate is nevertheless better as a result of this validation. However, both OPG and SNC/Aecon should seek to define and classify future estimates with greater precision and traceability to the established processes for the DR Project. If the parties proceed as anticipated in the JV Agreement, this issue will be cured with the Class 3 Estimate, which will be premised more on the specific definition of SNC/Aecon's DR Project Execution Plan and less on the theoretical model that is the heart of the Class 4 Estimate.

## **ii. Estimate Quality Assurance**

The Class 4 Estimate was developed in accordance with SNC/Aecon's Project Quality Assurance Plan. The OPG Estimate Quality Assurance process includes selection of qualified estimating team members who have hands-on experience with CANDU RFR refurbishment beyond available OPEX information. From our review, it appears that the team included or otherwise drew upon Subject Matter Experts with relevant expertise for the purposes of consulting with and advising the OPG estimators. Another level of oversight was provided by SNC/Aecon's Review Team for the purposes of validation of OPEX information and also to ensure complete in-depth scope coverage in the estimates. The cost estimate was also reviewed by a cold-eye Peer Review Team to catch any errors or omissions that SNC/Aecon's Team members may have over looked.

In our view, the OPG cost estimate team exhibits a reasonable composition of talents including experience mix. However, as is true with most nuclear refurbishments, the DR Team will be constantly challenged as the Project progresses.

In order to test the quality of the estimate, BMCD/Modus randomly sampled several line items of cost in the Class 4 Estimate. As a result of this sampling, we found some minor inconsistencies, such that the OPG team should consider assigning a quality resource to scrub estimate sheets for errant inclusions or exclusions, as well as perform quality checks on spreadsheet formulae and the like so as to end up with the most reliable work product reasonable. This is industry best practice particularly on projects involving repetitive work.

### iii. Observations Regarding the RFR Estimates

As noted above, we do not believe that the current SNC/Aecon estimate does not comply with the standard definition of a Class 4 Estimate as such definition is used by AACE, or the industry at large. SNC/Aecon's Class 4 Estimate is based almost entirely on a scale-up of a reference plant (Wolsong) with all known or perceived imperfections removed (an issue itself subject to considerable ambiguity). In developing this "perfect" theoretical estimate, SNC/Aecon and OPG intentionally (and in accordance with the JV Agreement) overlooked central considerations of the AACE guidelines identify for classification of estimates, as summarized below:

- ***The Class 5 through Class 3 Estimates do not include contingencies amounts.*** Per AACE Recommended Practice 18R-97, the expected (+/-) accuracy ranges for Class 1 through Class 5 cost estimates have meaning only after application of contingency (typically at a 50% level of confidence).<sup>59</sup>
- ***Project maturation was not considered in the Class 4 Estimate.*** Per AACE Recommended Practice 18R-97, and in line with industry practice, the maturity level of project definition is the primary determinant of an estimate class – maturity level generally comprises engineering percent complete. For example, in a Class 5 Estimate, the expected level of project definition (as measured by engineering) would range between 0 to 1% of total engineering being complete. For example, a key deliverable for measuring engineering percent complete would be number of completed block flow diagrams. Similarly, for a Class 4 Estimate, the expected level of project definition would range from 1% to 15% of total engineering complete and key design deliverables would include a number of completed block schematics, process flow diagrams (PDFs) for main process systems and preliminary engineered process and equipment lists.
- ***That SNC/Aecon and OPG did not follow AACE for the Class 4 Estimate is intentional, as the JV Agreement's language would preclude classification of these estimates within AACE.*** OPG Management should recognize that this very large and significant portion of the DR Project is being measured, estimated and monetized in a manner that is different from the other scopes of work on the Project. However, as noted, this is by contractual design, as SNC/Aecon is not obligated to provide monetized input regarding the items in the Risk Register until the conclusion of the target price negotiations, which is scheduled for May 2015.
- ***The development of a "perfect" reference plant comes freighted with ambiguity.*** To the uninformed observer, SNC/Aecon's Class 4 Estimate could appear to represent a model for the best possible

<sup>59</sup> AACE International Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (November 29, 2011) at p. 2.

outcome (aka optimal performance) for the DR Project. However, the current Class 4 Estimate actually represents a model of “perfect” performance that the DR Team believes is unrealistic to expect in the real world at any location, even perhaps Wolsong. Further, the “reference plant” is actually not Wolsong (which, to date, represents the most successful RFR project from a schedule standpoint) but a modified Wolsong absent approximately 19% of its as-built durations, then scaled-up to match the Darlington parameters. Thus, OPG may well be subject to managing the Project to a wholly unrealistic mile post.

- ***Ultimately, BMcD/Modus recommends that OPG focus on the value derived from the Class 4 Estimates not on whether it meets AACE’s definition of a Class 4 Estimate.*** The RFR work is different from many major construction scopes whereas the AACE classification is ordinarily applied to work that is largely repetitive and akin to a manufacturing process in which tooling, reliability and assembly-line precision is required. Developing an estimate that summarizes the best possible performance of such an operation has significant value.

OPG should be extremely cautious in regard to characterizing its current estimate as being anything other than *current best efforts toward compliance with the AACE estimate classification scheme*. The current estimate nevertheless has great value and should be viewed as a useful benchmark as OPG progresses to an AACE Class 3 Estimate where the cost estimating work product must shine, no excuses allowed.

#### **d. Class 3 Estimate Progression**

The starting point for development of the Class 3 Estimate is the Class 4 Estimate and the Project Estimating Plan. From this point forward, the Class 3 Estimate will be *looking forward* utilizing well-defined Process Flow Diagrams (PFDs), preliminary Construction Work Packages and applicable N-Procedures that are unique to the DR Project and based on SNC/Aecon’s view of constructability. This methodology change could result in task-based duration and man-hours variances; indeed, it could result in improvements from greater knowledge and improvements to the tooling that will be tested in the mock-up. The Class 3 estimate’s efficacy will be determined by the completeness and availability of detail within the design, procurement, mock-up facility and tool testing work efforts, all of which will facilitate progress to the requisite depth and accuracy.

Any developing variances (to the extent existing) will be logged and vetted within the Class 3 Estimate progression cycle. The Class 3 Estimate will be structured as an integrated program to allow for further progression to Class 2 Estimate. OPG expects that the Class 3 Estimate will reflect the SNC/Aecon’s estimate of 100% “wrench time” based on the maturation of the DR Project’s design and the proving-out of the tool set in the mock-up. SNC/Aecon and OPG will further review certain mitigation strategies and actions to reduce risks in the Execution Phase which will be monetized in the Class 2 Estimate.

As stated previously, the Class 3 Estimate will use the Class 4 Estimate as the basis for further development and some important activities and aspects of that effort will include:

- The establishment and maturation of key inputs that will drive the estimate (e.g., Process Flow Diagrams, Engineering and Construction Work Package development and Risk Register).
- A review of the experience and OPEX during the Class 5 and Class 4 Estimate work effort and adjustment of processes and methodology, as appropriate, for continued development of the Class 3 Estimate.

- Compliance with the next level of AACE estimate-classification-requirements as further underscored by OPG procedural documents.
- Identification of major variances as between the Class 4 and Class 3 Estimates.
- Examination, reassessment and refinement of the Risk Register associated with the Class 3 Estimate.

These steps are anticipated by the JV Agreement and should result in a further-refined estimate.

### 3. Risk Program and Contingency Development for Target Cost

The Risk Register plays a very important role in the development of the Target Cost for the Execution Phase of the Project. As discussed above, it is not anticipated that the RFR Contractor's Execution Phase estimate will include contingency until submission of the Class 2 Estimate. The contingency amount will be determined using a probabilistic approach based in large part upon identification of risks on the contractor's risk register. The JV Agreement sets forth the following requirements for the development of SNC/Aecon's development of the Risk Register:

Prior to the submission of each such Submittal, during the preparation of the relevant Risk Register, OPG and the Contractor will work cooperatively towards achieving OPG approval of a final Risk Register by the date specified in the Definition Phase Milestone Schedule. Contractor will develop such Risk Register through a series of workshops that will be facilitated by OPG's authorized representative or an independent third party.

The risk analysis workshops will follow the following methodology:

- (a) Holistic risk analysis;
- (b) Schedule risk analysis;
- (c) Cost risk analysis; and
- (d) Independent third party review.<sup>60</sup>

Additionally, it appears that the final risk register is subject to agreement between the EPC Contractor and OPG. The importance of the risk register is laid out by Section 3.5(g) of the Contract:

(g) **Effect of Agreement on the Risk Register.** Once OPG and the Contractor reach agreement on the Risk Register, no Amendment will be made to the Execution Phase Milestone Schedule, the Execution Phase Target Cost, the Submittal Schedule, the Execution Phase Target Schedule or the Execution Phase Fixed Fee to address a risk that arises during the Execution Phase and that is not identified on the Risk Register attached as Exhibit 3.5(g) (other than risks related to excusable delays as set out in section 5.2(a), or a change in Applicable Laws as described in section 4.4, or as otherwise set out in an approved Project Change Directive or an Amendment). However, OPG will compensate the Contractor for Reimbursable Costs incurred for any Work required to address any such risks that have an impact on the Execution Phase Work and that were not identified on the final Risk Register.

<sup>60</sup> RFR EPC Contract at Exhibit 3.5, Section 14.

SNC/Aecon is progressively refining its Risk Register as the EPC cost estimate progresses through the various AACE estimate classifications. As of May 1, 2013, the Risk Register contained some 329 identified risks. In the further development from Class 5 to Class 4, SNC/Aecon and OPG analyzed 169 (51%) of these initial risks, while 44 (13%) were not analyzed. In addition, the parties agreed to add 116 (31%) additional risks to the register. Of significance, the Risk Register contains non-productive work activities that SNC/Aecon identified from OPEX and stripped from the Reference Plant in Class 4. SNC/Aecon has not fully developed its Risk Register (nor does it have an obligation to do so at this time) to allow OPG to begin vetting the necessary contingency. OPG should consider accelerating the pace at which SNC/Aecon monetizes the Risk Register so that OPG can apply appropriate contingency at the project level sooner than the JV Agreement anticipates.

#### 4. Recommendations – RFR Cost Estimate

Based on our review of the progression of RFR estimates to date and our understanding of the DR Project's next steps, BMCD/Modus has drawn the following conclusions:

- AACE Classifications: Going forward, OPG should seek to clarify the guidelines used for establishing the RFR's BOE which are inconsistent with the terms of the JV Agreement. The primary estimating guidance for SNC/Aecon consists of:
  - AACE Recommended Practice Number 34R-05 - Basis of Estimate with an accuracy band of -30% to +50%.
  - OPG Instruction N-INS-00400-10001 R01 "Estimate Developing"
  - Exhibit 3.5 of the SNC JV Agreement

However, as defined by the JV Agreement, the Class 3 Estimate will not include contingency of any sort and as a result, the associated AACE accuracy bands will not be applicable. From a process standpoint, OPG should seek to clarify the application and appropriate use of these various standards and guidelines in the Class 3 Estimate so as to avoid potential confusion, inconsistency and communication problems during the next phase of the RFR estimate development.

- Metrics for Estimating Progress: The DR Team should strongly consider implementing meaningful metrics that are simple and user-friendly in order to effectively and realistically monitor progression of SNC/Aecon's Class 4 to Class 3 estimate during the next 12 months. Such metrics can track the progression of the estimate in lock-step with the overall maturation of the RFR project, which will have the associated benefit of providing management with key health indicators. One example would be to measure engineering progress by using planned vs. completed drawings in various categories (e.g., P&IDs) on a monthly basis. Another example might be to use work down curves for Engineering and Construction Work Package development.
- Monetizing SNC/Aecon's Project Management Costs: A major outlying cost to be determined in the Class 3 Estimate is SNC/Aecon's management and overhead costs. In Section 1.1.3 of Appendix D-10 of the Class 4 Estimate, the Specific Cost Estimating Report indicates that the percentage cost add-on for foremen management and supervising foreman management and PMT remained unchanged from the Class 5 Estimate. No new information was presented, such as monetization of an organizational chart to support a progression to a Class 4 Estimate. As SNC/Aecon most likely has historical experience suitable for use in meaningfully quantifying these cost items, the earlier the look at it, the better. With respect to SNC/Aecon's Support Services, in Section 1.1.2 of Appendix D-11, of the Class 4 Estimate, the Specific Cost Estimating Report shows that the percentage cost add-on for Support Services (SS)



remained unchanged from Class 5 Estimate. No new information has been presented to suggest a meaningful progression. Again, SNC/Aecon should have historical experience to use and progress the estimate in this regard.

- RFR Risk Register: Considerable work remains in identifying and monetizing risks in the Risk Register specific to the RFR work.
  - The OPG estimating group should be used as a resource to help vet the monetizing of risks as performed by SNC/Aecon. By comparing the SNC/Aecon's assessments to its own, the OPG team will be better equipped to make informed decisions on the reliability of the SNC/Aecon contingency work product.
  - The Execution Phase Risk Register for the Class 4 Estimate contains 329 identified risks at various levels such as low, medium, high and very high. The list is too long and appears redundant yet will most likely grow with the passage of time. As stated elsewhere, for a project of this complexity and importance, OPG should consider bringing on board an experienced risk manager with a solid construction background so as to best manage the Risk Register.
  - As noted, OPG should consider revisiting the contractual scheme that currently prevents SNC/Aecon from monetizing risks until the creation of the Class 2 Estimate and the target price.

## 5. RFR Schedule and Plan Optimization

### a. RFR Schedule Status

RFR's overall schedule development is significantly ahead of the other Project Bundle Teams, particularly in the evolution of the detailed level 3 schedule. The RFR team is involved daily with SNC/Aecon's detailed schedule and monitors development and update progress against the milestones and level 2 activities weekly. Nonetheless, as noted, there are some issues with the RFR's status in the schedule that need to be addressed, including a number of activities with excessive float (600+ days) though the RFR team believes this float is realistic due to early performance of certain work. In addition, RFR will need to examine multiple activities with 500+ days of duration.

Since RFR is on the critical path, it is good that its schedule is farther ahead so that the bugs can be worked out well in advance. Because this team is so far ahead of the others in the planning and schedule development area, the RFR team has encountered technical schedule formation issues that the other teams have not yet encountered. In some cases, Project Controls has not been made aware of some of these issues and is busy establishing rules and criteria for overall project planning and schedule development. These rules do not always address the problems encountered early by the RFR team and are sometimes contradictory to the direction already chosen by this team. As a result the RFR team has to rework previously developed schedules, formats and/or codes. The most affected area of development thus far has been the summary level 2 schedule for RFR. More attention needs to be given to the RFR schedule team's handling of these issues as they are true indications of future project issues.

Some conflict has developed between the RFR Bundle Team and the OPG Project Management Team (and potentially some of the other Bundle Teams) due to this misalignment of progress and not just in the area of scheduling. This conflict is mainly due to the somewhat isolated nature of the teams in the area of project management and schedule development. This is not unusual early in the life of mega-projects like the DR

Project. Because the individual scopes of work are so large and unique that they warrant individual bundle teams, it is the nature of these groups to focus on and attack their scopes somewhat independently. However, we see the issues that have developed with the schedule maturation as further evidence that the DR Team needs to break down silos and move to a unified Program approach.

### **b. Planning Opportunities**

Now that SNC/Aecon has developed the reference plant work plan that forms the basis of its estimate, the team's attention will be focused on developing the specific plan for the DR Project. In doing so, SNC/Aecon and the OPG RFR team should maintain one eye on the OPEX from Wolsong and Lepreau while looking for ways to optimize the plan to move the planning assumptions from *best achieved* to *best achievable* plan. As an example, in our review of the Wolsong OPEX and how it was used in formulating the Class 4 Estimate's BOE, it appears SNC/Aecon has not accounted for the likely productivity improvements OPG will achieve from the revised volume reduction strategy.

From our team's OPEX (Wolsong, Pickering and other relatable plants), there are certain improvements that we believe the team should consider, including:

- In the fuel channel removal, SNC/Aecon should consider a process improvement over Wolsong and remove channels from both sides of the reactor. Doing so could improve the critical path by as much 8-9 days and could lessen overall dose.
- There are certain tool fixes that CANDU Energy made due to performance issues at Wolsong; we will be interested in seeing how these fixes result in better tool performance from the start of the work.
- Distinguishing the Wolsong OPEX from volume reduction from the newly minted plan from SNC/Aecon to see if adequate time and risk has been squeezed from the plan.

As SNC/Aecon's plan is further fleshed-out, we will examine the revised plan for time duration, manpower and manhours for the individual components of the work against the as-built from past refurbishments. In addition, BMcD/Modus has other recommendations for OPG to consider, including:

- Requiring SNC/Aecon to add CANDU Energy personnel who were particularly helpful and effective in the Wolsong project.
- Having a team from OPG working shoulder-to-shoulder with CANDU Energy and tool supply subcontractors in learning the operation of the tools, which we believe will aid OPG in decision-making during the Execution Phase.
- Obtain and rationalize the complete set of Wolsong and other stations' OPEX through the CANDU Owners' Group.
- Begin challenging SNC/Aecon regarding its bandwidth to support multiple refurbishments at once in light of its past performance and likelihood of Bruce Power deciding to go forward.

### **B. Balance of Plant**

Balance of Plant ("BOP") scope for the DR Project consists of DSR's for plant modifications of the following plant areas and systems:

- Pre-refurbishment Work



- Safety & Control Systems
- Reactor Component Systems
- Conventional Systems
- Common Systems
- Special Programs.

For the Execution Phase, the BOP team is working to combine DSRs into these systems to the extent possible. In addition, much of this work is considered “contingent scope” and the necessity of its performance will depend on the outcome of scope defining inspections that will be carried out during upcoming outages. Therefore, as is often the case in refurbishment projects, the scope that comprises the BOP is the most difficult to plan, which can lead to problematic schedule and cost estimate issues.

The DR Team attempted to anticipate the typical issues with BOP in its contracting model, though some of the initial assumptions it made are not materializing. There is a significant risk that absent changes, the BOP work—and in particular, detailed engineering work performed by the EPC contractors—will not advance quickly enough to provide management with a high-quality estimate at RQE.

As a result, the DR Team is currently investigating methods for improving the schedule for BOP scope definition, which in turn should yield a higher quality plan and RQE. However, doing so may require a significant change in the planned project procurement and delivery method. The following summarizes the strategy, status of the BOP work, and recommendations for improvements, many of which are currently being pursued by the DR Team.

### 1. Current Contracting Strategy

As memorialized in DR Team’s Contracting Strategy for Balance of Plant the BOP Team “determined that the preferred approach for [BOP work] is to collate as much bulk work as possible to best leverage existing Extended Services Master Service Agreements (“ESMSA”) and Engineer, Procure, Construct (“EPC”) concepts, and to separate out specialized work by exception for alternative sourcing strategies.”<sup>61</sup> By implementing this strategy, the DR Team seeks to simplify the BOP procurement approach for an “inherently complex collection of work that doesn't fit well into existing DR projects” and minimize the risk inherent in OPG integrating a large number of separate but inter-related packages of plant system work.<sup>62</sup> The ESMSA contractors are ES Fox and Black & McDonald. These contractors were chosen through an RFP process which allowed OPG to negotiate both the contract terms and the rates in a competitive environment. [REDACTED]

After reviewing multiple options for executing this strategy, the DR Team decided to bulk BOP work into two major EPC packages made up of multiple DSRs: (1) nuclear side system work (“NSSS”) and ii) conventional side system work. Scoping of the work is occurring via development of MDR/MDP packages by Project Engineering and the OSS vendors. The BOP Team’s intent is to bid the work between the ESMSA vendors on a “Secondary Compete” basis. The Secondary Compete is intended to identify which of the vendors is most qualified for the work, and the possibility exists for only one vendor to emerge with the

<sup>61</sup> See Contracting Strategy for Balance of Plant, NK38-REP-09701-10102 (March 19, 2013) at p. 4.

<sup>62</sup> *Id.*

entire BOP scope. The BOP Team rejected the option of bidding each individual system in smaller packages due to OPEX that such a method could increase field execution rub points and integration issues and put OPG in the position of having greater management and oversight of the work.

The DR Team's evaluation also considered whether to open competition beyond the ESMSA vendors, though the team concluded that the utilizing the existing vendors had a number of advantages: (1) contracts were already in place based on an open, competitive negotiation; (2) the work under the BOP contracts would be similar in type to the work that the ESMSA contracts were intended to control; and (3) an open bid competition would require significantly more scope definition from OPG than time permits.

The DR Team recognized there were certain risks with this contracting strategy, among which are:

- Because of the scope definition timeframes, the BOP work was already behind the other projects. The DR Team's strategy was premised on "bidding the work via ESMSA secondary compete once scope reaches 70% has been developed" rather than waiting for completed scope definition from the OSS vendors.
- The ESMSA's Terms & Conditions ("T's & C's") existing master agreements were fully negotiated, but there was a risk identified that these contracts "may not be sufficient to address the needs and risks for the BOP project scope of work to be done during refurbishment execution outage." The DR Team is planning on approaching the vendors to see if this is the case.
- The DR Team is concerned that the ESMSA contractors' capability bandwidth may not be large enough, and the team has identified a risk that the vendors may need additional competent resources.
- Labour relations remain a risk as there are still items subject to CPA decisions.
- The DR Team appears to understand that there is a risk of owner interference due to "the large volume of plant system work and the continuing development of project scope."

From a purely strategic basis, OPG's concepts for the BOP model fit within that frequently seen in the industry for such work. However, BMCD/Modus has a significant concern that there is an assumption that enough time exists in the schedule for OPG to: (1) wait to bundle the scope into two large packages of work before even starting the procurement process, which will take some 8-12 months based on current progress; (2) engage in a Secondary Compete between two vendors whose pricing is the same and who have areas of specialty which are likely to dictate which vendor will perform a particular scope of work; and, (3) develop detailed engineering and comprehensive work packages with enough definition to develop a Class 2 Estimate in time for the RQE.

## **2. Scope, Engineering and Schedule Status**

Two major factors are complicating the confidence with the BOP work at this time: (1) scope is still a moving target; and (2) an optimistic, very tight plan for scope definition and procurement of BOP work is currently at risk.

### **a. Current Scope and Possible Reductions**

The work that comprises the DR Project's BOP scope is varied and split roughly in half between NSSS and conventional plant work. As of the 2013 Business Plan, this scope consisted of ~200 DSRs that have been estimated to cost approximately \$503M. It should be noted that the BOP line item for the 2013 Business

Plan reflects a total of only \$161M with a reduction from the 2012 Business Plan of \$207M<sup>63</sup>. This “reduction” was actually a scope shift to the Turbine Generator Bundle, and the remaining BOP scope was in other categories (SIOs and Contingent scope, among others).

In part because BOP is a basket of disparate scopes, it has been subject to increases since the Project’s outset. Based on interviews with the members of the DR Team, the BOP work has expanded to its current state for a number of reasons, including: (1) DSRs were approved for work that should have been considered Life Cycle Management; (2) DSRs were erroneously tagged as Core Scope; and (3) Sustaining Scope definitions were expanded to include items that are outside of the DR Project’s commitments.

There is increasing concern that the BOP scope had grown to such an extent that it was threatening the DR Project’s viability. The result of the observed scope creep, as expressed in the Darlington Refurbishment Independent Scope Review is, “the volume of scope is contributing to an increasing risk to OPG’s ability to successfully refurbish the Darlington units, in terms of cost and schedule. The volume of work will add complexity to the Refurbishment project which may not be necessary, when considering the life-cycle management program at Darlington, i.e. some work may be best performed online or in an outage, managed by the station with utilization of Portfolio funds as required, before or after the refurbishment outage period.”<sup>64</sup>

The DR Team’s review of BOP scope is ongoing at this time. We discuss this review in more detail in Section III.C.2, above. However, we do note here that the review has already netted tangible results. As an example, the BOP team has recently studied the valve program and identified an 80% reduction in the number of valves the team was anticipating replacing.<sup>65</sup> It is likely that the team will reduce the BOP scope overall, which will serve to enhance the chances of the DR Project’s success.

## **b. Schedule Status**

The PIMS Milestone Schedule from January 2012 indicated that detailed design for major components of BOP work would extend well into 2015-6, which is inconsistent with the DR Team’s RQE goal. The C&C Schedule’s iterations have shown some improvement over those dates; however, in April 2013, the C&C Schedule showed MDR preparation for BOP scopes of work was likely to occur through 2013 and into the 1<sup>st</sup> Quarter of 2014, and procurement activities into late 2014.

In addition, the BOP’s actual progress is running late against this extremely tight plan. BOP has missed three major milestones needed for defining its scope due to process-related issues.<sup>66</sup> Current projections (as of June 30<sup>th</sup>) in the C&C Schedule show as many as 89 MDR packages are running later than expected, and that 18 of 40 MDPs needed for BOP procurement were completed. The BOP Project Team has recognized that the current progress with MDR/MDP packages is a significant risk “to support EPC contracting timelines for BOP, leading to schedule delays or the need to proceed with RFPs at risk.”<sup>67</sup> Moreover, the future scope-defining inspections are looming and could create more scope revisions. To

<sup>63</sup> DNGS Refurbishment Estimate Analysis (April 25, 2013) at p. 4.

<sup>64</sup> Terms of Reference Darlington Refurbishment Independent Scope Review, NK38-REF-09701-10004-R000 (May 23, 2013) at p. 2.

<sup>65</sup> See NK38-CORR-09701-0465000 (May 28, 2013).

<sup>66</sup> See Program Status Report for period ending June 2013 at p. 61.

<sup>67</sup> *Id.* at p. 62.

date, 166 of 355 planned scope defining work orders are completed.<sup>68</sup> The BOP Project Team identified “The risk is that BOP scope defining inspections are not completed or completed late resulting in the inability to finalize scope and subsequent delays to awarding EPC contracts.”<sup>69</sup>

### 3. Observations and Risks

By its nature, BOP work carries inherent risks which the DR Team attempted to mitigate with its strategic model. However, the BOP schedule has matured and we are concerned that the scoping work is not moving at a pace necessary to carry out the original plan. In particular, BMcD/Modus sees a significant likelihood that the BOP work will not mature to the extent necessary in time for a high quality estimate at RQE. The most problematic areas and consequences are as follows:

- It does not appear that there is enough time to wait for the MDRs to be finished (even at the 70% level) for bundling of the work into two large BOP packages and enter into a planned Secondary Compete process. The schedule is further tightening due to the later completion of the MDR packages, and the procurement process, even if streamlined, adds 3-6 months to an already tight schedule.
- [REDACTED]
- Because BOP scope is still a moving target, it is entirely likely that even if the scope were “bundled” it would only change again, up or down, and even deductive change orders can be costly and problematic. If bundling the scope is intended to improve the quality of the ESMSA vendors’ plans and estimates for performance, scope uncertainty will negate such an advantage; thus, waiting for the scope to be bundled only delays the start of the detailed design of packages that are sitting on the shelf, some of which are there now.

There are also performance-related concerns that should be examined and mitigated, including:

- There have been questions regarding the ability of the two ESMSA vendors to handle the amount of work that could come from the BOP contracts. This would present an additional reason for avoiding a Secondary Compete process, as it is unlikely OPG would be comfortable with one vendor having a monopoly of the BOP scope. If the work is equitably split between the two vendors, neither vendor would have work that should stretch their capacity.

<sup>68</sup> *Id.*

<sup>69</sup> *Id.* at p. 60.

- There have been questions raised regarding both the contractors' performance on the Campus Plan work and the ESMSA contracts' terms and conditions. These are valid questions, though both vendors have performed larger projects for OPG in the past with success. The DR Team should hone in on the reasons for any suboptimal performance and work out any barriers to success on the broader DR Project scopes, as necessary.
- The nature of BOP work requires schedule and physical coordination between the BOP and the other EPC contractors. OPG needs to recognize its role in this regard of coordinating this work so that interference is limited.

#### **4. Recommendations—Balance of Plant**

The biggest risks to the BOP work right now are scope and schedule. To mitigate the schedule issues, OPG should consider a different contracting approach that would jumpstart the detailed design of the BOP packages; also, consider reducing the scope of those packages to the absolute minimum needed to meet the DR Project's commitments. As part of this strategic refocus, the primary drivers for a revised strategy should be: (1) meeting schedule commitments; (2) reducing potential interference to the RFR contract, and (3) creating flexibility to handle emergent work, schedule perturbations, scope shifting and scope revisions. Without this level of focus on the schedule, it is very likely that the DR Team's commitment to present a high-quality estimate at RQE, at least for the BOP work, will not be met.

As a result, BMcD/Modus recommends that OPG take all reasonable efforts to increase schedule certainty for the BOP work by awarding and assigning smaller packages of the work on a qualifications-based criteria with cost-plus contract terms as soon as reasonable. In this model, the ESMSA could be assigned or awarded projects before the OSS vendor has completed the MDP package for a given modification. This scenario allows for efficiency gains for the ESMSA engineers, who could be involved at an earlier stage of development, which could reduce the re-performance of engineering effort and increase the constructability of the selected modification solution. This structure also allows for easier shifting of packages between the vendors (or other entities) if contractor bandwidth remains a risk. Moreover, if the 2014 Business Plan revised planning assumptions are adopted, the BOP work schedule will have to be the most fluid and allow time for discovery work.

To the extent that there is concern over the cost, OPG could consider using the final as-built price and schedule from Unit 2 to fix or target price more elements of the contract for the later units. By this point, the majority of performance risks will be known and the scope for the remaining units will presumably be substantially identified, allowing for much earlier and more robust planning.

The most pressing problem with the BOP work is the start of detailed engineering necessary for providing management requisite confidence in connection with the RQE. Without changes to the current procurement strategy, this problem will almost certainly manifest itself in a lower quality estimate at RQE than intended. This will cause the DR Team to request greater contingency and have less confidence in the Execution Plan for the work. In our experience, the method of releasing smaller bundles of BOP work is the most prudent and effective means of reducing the risks inherent with BOP work, and in this case, because the ESMSA agreements are in place, would likely be the lowest cost option due to the schedule savings and risk avoidance the DR Project would yield.

## C. Campus Plan

BMcD/Modus has reviewed the status of the ongoing work at the DNGS station that is being performed as pre-requisite work for the DR Project. The Campus Plan work includes a wide variety of infrastructure projects OPG intends to aid in the refurbishment of DNGS or improve the reliability of the station from a life cycle management perspective. The most significant current Campus Plan work consists of the following new facilities that are being designed and built by the ESMSA contractors and managed by the Projects & Modifications group:

- D<sub>2</sub>O Storage Facility
- Low Pressure Service Water Line Relocation
- Water and Sewer
- Maintenance Facility
- Boiler House
- Refurb Island Annex
- Retube Waste Processing Facility
- Power and Electrical.
- OSB Refurbishment
- SIO – Emergency Power Generator (EPG3)
- SIO – Powerhouse Steam Venting System
- SIO – Containment Filtered Venting System<sup>70</sup>

These various scopes of work vary from commercial buildings to more complex technical undertakings, and include work that OPG has performed before (Dry Storage) to entirely new evolutions. The one critical thing these projects have in common is they all must be completed prior to breaker open on Unit 2. Thus, these projects represent a significant risk to the overall DR Project, due in part to the number of projects, their relative complexity and the amount of work left to be done (from planning to execution).

BMcD/Modus sees the evolution of the Campus Plan (including Facilities & Infrastructure Projects) as highly significant for multiple reasons: (1) many of these projects are essential predecessors to the overall DR Project; (2) these projects provide an early test of the capabilities of and new processes employed by the DR Team; (3) these projects allow for an early assessment of the ESMSA contractors' effectiveness and readiness to perform on the broader DR Project; and (4) these projects will provide valuable OPEX for the future work as some of these Campus Plan projects (D<sub>2</sub>O Storage Facility in particular) have encountered significant challenges.

### 1. D<sub>2</sub>O Storage Facility

The following is a summary of the current status of the D<sub>2</sub>O Storage Facility, which is the most significant and mature of the Campus Plan projects. There are some of the significant events that have occurred to date and the lessons learned that have already been captured for the team's examination.

#### a. Background

The D<sub>2</sub>O Storage Facility will provide storage capacity for water removed from the units during refurbishment. The building consists of multiple tanks for Primary Heat Transport (PHT), Moderator and TRF Feed storage,

<sup>70</sup> Projects and Modifications Division Performance Report, June 2013

and has been sized to accommodate the volume of water from two of the Darlington units. This building has a complex design, is time sensitive, has a significant capital cost (\$110 million budget) and employs one of the anticipated key contractors (Black & McDonald) such that its execution provides a good template for much of the work on the DR Project.

The current schedule identifies the following key milestones:

- Detailed Design Complete by Black & McDonald/RCMT by August 30, 2013. The DR Team currently reports that this date will not be met, and mitigation plans are in place to lessen this impact.
- Low Pressure Service Water Line Relocation, which is needed to clear the building's footprint, is planned to be performed during the D1341 Outage and complete by November 9, 2013
- Start of Tank installation – October 9, 2013
- Substantial Completion – February 15, 2015
- Available for Service – April 15, 2015

The DR Team believes that the baseline schedule had approximately 6 months of float, though some of the current design issues will reduce this float. Nonetheless, there are certain delays that have already been incurred that need to be mitigated to ensure the timely completion of the facility. Challenges to date in the planning and design phase have included:

- MDRs Lacked Scope Definition: The initial MDR for procurement of the EPC contract lacked specificity.<sup>71</sup> As a result, OPG's Engineering reworked the MDR with more specific requirements. This experience with MDR resulted in significant process and quality improvements to the MDR process for procurement of the remaining DR Project modification scope, and was a primary driver in Engineering's budget variance against the 2013 Business Plan.
- Project Schedule: The D20 Storage Facility's schedule included unrealistic durations for detailed design work, the root cause of which was the original bid package lacked meaningful information and definition.<sup>72</sup> As a result, Modification Planning, which was scheduled for a scant 2 months, actually required 6 months, and recovery schedules were also missed along the way.<sup>73</sup>
- Completion of Detailed Design: To overcome the earlier schedule issues, OPG's Engineering Team has dedicated five engineers to provide oversight of the drawing preparation. This bears monitoring, as OPG will not have the resources to provide this level of oversight to the EPC vendors for the other Project Bundles.
- Procurement: Black & McDonald's purchasing of long-lead Class 3 valves on-time is also at risk. This is systemic procurement problem, as these valves are in short supply industry-wide.

<sup>71</sup> See D20 Storage and Drum Handling Project: Modification Planning Lessons Learned Report, D-LLD-38000-1001 (March 4, 2013)

<sup>72</sup> *Id.*

<sup>73</sup> *Id.*



- **Planning & Assessing:** The delays to engineering and procurement are likely to ripple into the completion of detailed planning packages. BMcD/Modus will continue to monitor the package development.
- **Construction:** Ellis Don is the civil subcontractor and has been “daylighting” the excavation for some time in order to expose the buried services in this area of the site. Progress has been slower than planned due to the buried lines being found in different locations than shown on the as-built drawings, a configuration management issue dating back to the original construction of DNGS. Also, direct buried cable is being uncovered where cable trenches are shown on the drawings. These issues should be expected where excavations are undertaken in other areas of the site.

The DR Team appears to have responded to these challenges by increasing the active management of the contractor via daily meetings, additional schedule focus and more aggressive review of the engineering product. OPG has also assisted Black & McDonald in correcting some of its safety practices on site.

#### **b. Key OPEX/Lessons Learned/Risks**

The following are critical OPEX from the D20 Storage Facility that DR Team should take into account for the remaining Campus Plan work and the DR Project in full:

- **Corrective Actions to the MDR Process:** D20 Storage Facility was a leading indicator the DR Team used to revise the MDR development process, which is now significantly more robust as a result.
- **Planning Milestones:** A primary finding in the D20 Storage Lessons Learned report is the work for the project was under inordinate time pressure and the team lacked “managerial courage to recognize when [the] schedule is unrealistic for the required deliverable and to escalate.”<sup>74</sup>
- **Management of Contractors:** The mitigation plans in place to recover the D20 Storage Facility have required significant management focus. While these mitigation plans have partially mitigated the impact to the schedule, BMcD/Modus sees a potential concern with the DR Team’s bandwidth to deal with larger and more significant issues that are sure to arise on the DGNS Refurbishment Project. Moreover, the DR Team is evaluating the extent to which the vendor’s performance is contributing to the issues with the D20 Storage Facility, as OPG intends to award a significant amount of work to Black & McDonald.
- **Impact of Design Delays:** As a result of the delays to detailed design, the D20 Storage Facility has lost float and the window for Planning & Assessing is shrinking. A key lesson learned from PARTS Unit 4 is that Planning & Assessing requires adequate time and focus or the field work will suffer.
- **Management of Engineering Deliverables:** The method being used to track engineering deliverables and the metrics used by Projects & Modifications and OPG Engineering should be examined for its effectiveness and possible export to the larger DGNS Refurbishment Project scopes of work. The OPG review cycles and the metrics capturing these cycles should be reviewed.
- **Configuration Management:** There have been buried services and underground conditions that were not accurately captured in the site plans. While it is virtually routine for site work to be adversely

<sup>74</sup> *Id.*, p. 10



impacted by unforeseen underground conditions on a decades-old utility site, the concern is that some of the configuration management issues materialize in other Campus Plan projects.

- **Procurement of Long Lead Valves**: Based on the D20 Storage Facility and the industry at large, the DR Team should examine how it is both determining and tracking long lead materials, whether or not these materials are being supplied by an EPC vendor. The DR Team needs to have proper tracking of such materials in order to establish reasonable schedule milestones and hold the vendors accountable for their performance.
- **ESMSA Performance**: As noted, the D20 Storage Facility as well as the other predecessor Campus Plan work provides an opportunity to fully examine the performance of the ESMSA vendors, and just as importantly, the management techniques that the DR Team is using. To date, the DR Team has added more staff, in particular engineering, and instituted additional accountability forums (more meetings, etc.) to manage this work. The DR Team is examining what has been effective and whether the assumptions in the current management plans for the broader DR Project need to be adjusted. Considering the additional resources and management focus that have been needed thus far on the D20 Storage Facility, BMCD/Modus would also recommend OPG focus on both the qualifications and right-sizing of the DR Team as part of such reviews.

The D20 Storage Facility is the most notable of the Campus Plan projects because of its size, complexity and history of problems to date. Each of the Campus Plan projects present risks, and mitigating those risks will require significant management focus.

## 2. Pre-Requisite Work

A leading indicator of site readiness for the refurbishment is the execution of pre-DR Project work orders during the IPG and planned outages approaching the first unit execution. While planned outage execution of pre-refurbishment work orders has been successful, performance of the normal “T-Week” activities are resource constrained by the station. Subsequently the pre-refurbishment work orders are not getting priority for execution by the station Maintenance organization and are requiring the use of no-station personnel for assessing and work order preparation. The addition of the refurbishment work is straining the organization and will require additional resources and continued focus by the station management for refurbishment work orders to get station priority.

This conclusion is supported by Audit OPGN NO-2013-002, Equipment Reliability determined that performance of the Managed System Controls for sustaining ER is not fully effective (Yellow). Finding 1.1 Deficiencies in Preventive Maintenance Implementation 2) Darlington, found that Preventive Maintenance (PM) was deferred for Fuel Handling (FH) equipment due to lack of parts resulting in equipment failures.<sup>75</sup>

These activities and other Campus Plan work will require additional focus.

## D. Turbine Generator

### 1. Scope

The Turbine Generator Project consists of five scopes of work:

<sup>75</sup> Level 2, SCR D-2013-05089 was initiated to document this finding.

- **Steam Turbines and Turbine Auxiliaries**: inspections, repairs, and/or replacements of High Pressure ("HP") and Low Pressure ("LP") turbine components and a number of turbine auxiliaries;
- **Generator and Generator Auxiliaries**: inspections, repairs, and/or replacements of generator components (including generator stator rewind) and a number of generator auxiliaries,
- **Moisture Separator Reheater ("MSR")**: inspection, overhaul, and/or replacements of MSR internals and auxiliaries (e.g. strainers, valves);
- **Turbine Control Upgrade**: replacement of the obsolete analogue Steam Turbine Electronic Control ("STEC") System, includes entire Turbine Supervisory System with modern design (digital system); and
- **Generator Excitation Upgrade**: replacement of the obsolete Generator Excitation system controls with modern design (digital system) and a set of additional Generator Excitation and Protection equipment to resolve obsolescence.<sup>76</sup>

It is our understanding that the DR Team developed the Turbine Generator Project scope of supply based on a review of the station's operating history and OPG's OPEX with the equipment, and results from CCAs. The Project's Scope Review Board gave its approval for these scopes of work and the Turbine Generator Project Team achieved Project Gate 0 on March 5, 2011.

OPG's original cost estimates anticipated that the total estimated value for the Turbine Generator Project would be approximately \$510M with a base cost of \$365 M<sup>77</sup> and \$150 M for contingency. The contingency amount included cost for scope that may ultimately be required depending on the outcome of certain planned inspections. OPG acknowledged that much of the Turbine Generator scope could be performed as a part of its regular inspection and maintenance program, but decided to add it to the DR Project at that time "for efficiency to minimize outage schedule."<sup>78</sup>

## 2. Contracting Strategy

The original contracting strategy contemplated bundling all of the scopes of work into a single EPC contract. The Original Equipment Manufacturer ("OEM") of the Darlington turbine generator sets, auxiliaries, and controls is Alstom Power ("Alstom").<sup>79</sup> This is highly specialized equipment designed which Alstom designed and supplied as an integrated system for the Darlington Station. Alstom was judged to have the optimal technical knowledge, expertise and full understanding of the complexity of the Turbine Generator Project scope of work. The DR Team identified the following major risks associated with not awarding single source contract to Alstom:

- **Execution Risks**. **Darlington Turbine Generators are specialized and unique in North America custom designed for Darlington**, and the OEM has provided parts, specialized services and engineering for the last 25 years. Hence, if a non-OEM that does not have knowledge or expertise respecting this highly specialized equipment provides the work in question, it will lead to significant execution risks.

<sup>76</sup> Contracting Strategy for Turbine Generators, N K38-REP-09701-10021 (August 31, 2012) at p. 6.

<sup>77</sup> This amount was revised to 346 M with the 2013 Business Plan estimate.

<sup>78</sup> N K38-REP-09701-10021 at p.8.

<sup>79</sup> The Darlington Turbine Generators were actually originally designed, manufactured and installed by Brown Boveri Canada Inc. ("BBC"). BBC was bought by Asea Brown Boveri ("ABB") and subsequently Alstom Power purchased ABB.

- **Integration Risks.** The interface of the Control systems and Generator Excitation with the Turbine Generator Hydraulics is paramount. Turbine and Excitation Controls replacement involves interface with a large number of field devices, components within the hydraulic system and excitation power system, and the respective auxiliaries. **The risks of the said pieces of equipment not integrating properly with each other are significant if a non-OEM provides the work in question.**
- **Compatibility Risks.** Due to excellent performance of the turbines, OPG is able to take advantage of a cost effective **piecemeal retrofit** rather than a complete steam path retrofit. Reverse engineered components may drive compatibility risks, further costs during commissioning, and lost revenue that could be significantly higher than reverse engineering costs.
- **Operational Risks.** If OPG retains a non-OEM to provide the work in question, the resultant mix of OEM and non-OEM components will lead to increased operational risks of the units post refurbishment. In the worst case, forced loss rate may be impacted.<sup>80</sup>

As a result, OPG intended to sole source the Turbine Generator EPC work to Alstom while in parallel, preparing an RFP package that would allow OPG to pursue a competitive bidding process as a backup option in the event that the negotiations with Alstom broke down or stalled.<sup>81</sup>

In fact, OPG was unable to negotiate a full EPC contract with Alstom. [REDACTED]

[REDACTED] As a result, the DR Team revised its strategy so that it sole sourced the engineering and equipment supply to Alstom, and will competitively bid and negotiate the construction portion of the work in the first quarter of 2014.

On March 27, 2013, OPG entered into an Engineering Services and Equipment Supply Agreement with Alstom Power and Transport Canada Inc. [REDACTED]

[REDACTED]. We have not performed our own analysis to verify this fact.

### 3. Summary of Observations/Risks

- The Turbine Generator Project includes scope that is commonly performed in the nuclear industry, and while there are always risks from discovery work and examining the condition of critical components, if the Project is properly scoped and procured, it shouldn't become headline news for the DR Project.
- The award to Alstom on the basis of its unique qualifications to refurbish the DNGS turbines was a sound decision and one that mirrors how other utilities make such decisions. The move to separate the construction from the engineering and procurement parts also appears to be sound, given the price OPG received.
- The DR Team is currently reviewing an option to move the performance of the Turbine Generator control work on Unit 2 to a later time. The key driver for this decision would be to simplify the work in

<sup>80</sup> Memorandum Re: Darlington Refurbishment Turbine Generator Project - Single Source Justification Approval Request by Todd Josifovski, Turbine Generator Project Director (March 18, 2013).

<sup>81</sup> N K38-REP-09701-10021 at p. 8.

Unit 2 and focus the team's attention on RFR execution. BMCD/Modus recognizes the logic behind this option and it should be strongly considered, and management needs to robustly document whatever decisions are made.

## **E. OPG Critical Path Activities**

As noted, the DR Team estimates that OPG will control the critical path 25% of the time (243 of 968 total days) of the breaker-to-breaker unit duration<sup>82</sup>. Many of the work items in OPG's critical path scope have been performed before; however, some of the work, like defueling of the Darlington Units, has never been done by OPG, and here, it will have to be performed under enormous schedule pressure.. The DR Team is very aware of these risks and has made adjustments to the plan, most notably with refurbishment of the fueling machines prior to the opening of the Unit 2 breaker. The team is planning to continue to refine its schedule and sequence of events. The following is a summary of some of the DR Team's current efforts to organize and plan the critical path work.

### **1. Site Integration Planning**

The DR Team's success in managing the critical path will depend on developing a cohesive and well-managed team that integrates the Project and Station personnel. BMCD/Modus monitored the integration plans and activities of the site integration team supporting these efforts.

Site Integration Plan meetings are focused at the management level which is appropriate given the time to the execution window. The initial integration plan was functionally based around the organization being reviewed for transition to refurbishment, Chemistry & Environmental, Safety, Design Engineering, Systems Engineering, EP, Licensing, etc. The initial presentations to the site are complete and while providing a broad based format for discussion of general personnel requirements and management structure, but contained few actionable items.

The Site Integration meeting agenda focuses on the near term actions required for the DR Project readiness with organizational transition plans discussed as a subtopic. The first integration topic covered is "Top Five Milestones." These Milestones were chosen by the leadership team and cover the near term actions, owners and due dates to support the milestone completion:

- Scope Frozen at Work Order level
- Improve Fuel Handling Reliability
- VBO Preparations
- Major Site Projects
- Development of Transition Plans

Once all actions are resolved for these priorities, the Site Integration Team will focus on additional strategic considerations and specific support for each of the DR Project Bundles.

### **2. Defuelling/Fuel Handling/PHTS Bulk Drain**

OPG's portion of the Vault Preparation window is currently assessed at 88 days and consists of the following activities:

<sup>82</sup> DNGS RFR – Execution Phase Estimate Progression, June 21, 2013.

- Breaker Open – 1 Day
- Defuel – 62 Days
- Primary Heat Transport System Bulk Drain – 25 Days
- Airlock Open – 1 Day
- Vault Turn-over – 1 Day
- Moderator Bulk Drain – 25 Days

The DR Team is currently assessing each of these durations. The Fuel Handling systems present unique challenges due to the fact the fueling machines that are needed to support the DR Project are also needed to maintain operations of the operating units. In addition, there is a concern that the station and OPG lack specific operational experience with performing these evolutions under schedule pressure. The team has taken some significant steps since the outset of our engagement to address certain key risks:

- The DR Team's leadership and the CNO recognized the risk of fuel machine reliability and availability could not only impact the project but also the support of the operating units during the project. The FH Team was directed to move forward the work needed to refurbish the fueling machines before the Unit 2 outage.
- Much of the work originally planned for Project will be included in earlier outages or performed on-line.
- Primary responsibility for the defuelling was turned over the Station to manage. There are some risks that have been raised regarding resource availability and support.

B&McD/Modus sees OPG's decision to place the responsibility of the fuel handling system and equipment reliability and for the defuelling of the reactor on Operations as sound and likely to reduce project risk. For the revised plan to work, the Fuelling Machine Operators (FMO's) will need to familiarize themselves with the new Universal Carrier and the different tooling used for defuelling channels with different flow rates. This is a relatively minor addition to the current expertise of the FMO's. BMcD/Modus also sees the benefit of charging the Projects & Modifications and fuel handling maintenance groups with upgrading the fuel handling system and equipment, returning them to the required level of reliability (the as-designed system performance) and for placing the Service Area Rehearsal Facility (SARF) back into service. Consequently, Operations now has the responsibility to turn over a defuelled reactor to the Refurb team.

The planning and organizing of these reliability projects, on top of the routine operations staff work, will need to be addressed from a staffing and funding perspective. Our current observations indicate that the planning for Defuelling tool design is sound, with float included in the schedule for tool design modifications to be made should problems occur during the prototype testing.

Once the breaker is opened, defuelling the reactor core will be the critical path activity. In addition to fuel handling system and equipment reliability there are other key items that should be addressed in order to minimize the time taken to defuel the reactor. B&McD/Modus recommends that the following be considered:

- Staffing for continuous three trolley fuelling/defuelling capability (24 hours/day; 7days/week);
- Fuelling/defuelling across shift changes and breaks.

The remaining Vault Preparation work is being examined for opportunities to improve durations and sequencing.

## VI. Summary of Recommendations

In the foregoing, BMcD/Modus has attempted to identify for the DR Team a number of recommendations based on our current assessment of the Project's risks. The most significant of these recommendations are summarized below:

Issue	Risk/Opportunity	Recommendation
Scope	The DR Project's scope exceeds the commitments made to the BOD and Shareholder.	<ul style="list-style-type: none"> <li>Continue the process of reducing and optimizing the Project's scope.</li> <li>Reach a consensus on the scope as expeditiously and reasonably as possible so as to reduce the DR Team's work load and unneeded churn.</li> <li>Once the scope recommendations are adopted, the team will need to re-review the schedule to ensure the logic network is sound.</li> </ul>
Engineering	The schedule and pace of procurement related activities may not support a high-quality estimate at RQE.	<ul style="list-style-type: none"> <li>Review strategic considerations for procurement of remaining scope.</li> <li>Consider early "shoulder to shoulder" work by EPC design partners to expedite the start of detailed engineering and constructability reviews</li> <li>Review and prepare for likely RFIs from EPC vendors during the Planning and Assessing Phase.</li> </ul>
Project Management	The Project oriented focus has created management silos that could make integrated program management difficult, resulting in contractor/owner interferences.	<ul style="list-style-type: none"> <li>As the Project matures and contracts with vendors are in place, the DR Team should increase the level of program integration.</li> <li>Address the fact that the Execution Phase may require individuals with different skills for OPG to effectively manage the contracts.</li> <li>Clarify reporting lines for matrixed Project Controls Personnel.</li> <li>Actively seek to assemble the Execution Phase team as soon as possible.</li> </ul>
Schedule Development	The DR Team plans to implement a C&C Schedule at Level 2 for management which could create a number of coordination issues during the Execution Phase.	<ul style="list-style-type: none"> <li>Continue development of the C&amp;C Schedule through the Definition Phase and migrate to a fully integrated Level 3 schedule for the Execution Phase.</li> <li>Redirect the Project Controls Team's efforts from the C&amp;C Schedule work to that of monitoring the developing Level 3 schedules from the contractors.</li> </ul>

Issue	Risk/Opportunity	Recommendation
	The current schedule development depends on mutual agreement and acceptance of quality standards that owners typically demand, creating the risk that contractors will not comply.	<ul style="list-style-type: none"> <li>Clarify and include in commercial contracts OPG's requirements for schedule development by the contractors.</li> </ul>
Risk Management	The current methods for scoring risks are inconsistent and the risk register includes "issues" or "concerns" that needlessly dilute management efforts.	<ul style="list-style-type: none"> <li>Provide consistent characterization and scoring of risks.</li> <li>"Concerns" as currently defined should be eliminated from the Risk Management Program.</li> <li>Ensure that all relevant parties have a seat at the risk table while maintaining a measure of centralized control in the approach to risk identification and tracking.</li> <li>Consider revising probability scoring to increase granularity and ranking of risks.</li> </ul>
	Leadership, training and wide acceptance of the importance of the Risk Management Program is lacking and the Project Controls Risk Group is understaffed.	<ul style="list-style-type: none"> <li>Consider bringing in an experienced risk management lead with a demonstrated track record who is singularly focused on the risk function.</li> <li>Review qualifications within the existing risk team.</li> <li>Elevate Risk Management to a stand-alone functional group with the same level of prominence as the Schedule team.</li> <li>Provide training with a focus on the overall importance of the Risk Management Program</li> </ul>
	The various databases that the Risk Group is populating suffer from a number of IT issues and lack of focus.	<ul style="list-style-type: none"> <li>IT needs to resolve the outstanding issues as quickly as possible.</li> <li>Training should include instruction for populating databases.</li> <li>The AIDA database should be examined and updated if it is to be useful for rate proceedings.</li> </ul>
Cost Management	The DR Team is inconsistently applying AACE guidelines and other processes and procedures central to the BOD's understanding of the underlying quality of project cost estimates.	<ul style="list-style-type: none"> <li>Consistently apply AACE guidelines, and where they are not (as in the RFR project estimates), the DR Team should seek to return to a condition of compliance.</li> </ul>
	Revised planning assumptions for	<ul style="list-style-type: none"> <li>Document and characterize the</li> </ul>



Issue	Risk/Opportunity	Recommendation
	The 2014 Business Plan revised assumptions that are currently being assessed—the business case for these assumptions is centered on the opportunity to reduce risk and increase positive outcome.	<p>information for the BOD and consider meaningful reporting metrics.</p> <ul style="list-style-type: none"> <li>• Should OPG adopt the revised assumptions, review commercial agreements so as to identify potential issues that could be impacted by the revised plan, as well as other issues within contracts that can be improved based on current OPEX.</li> <li>• Review capture and documentation of Unit 2 OPEX information so maximum benefit is derived from this revised plan.</li> </ul>
	The 2015 Business Plan Budget review will likely repeat the process for the 2015 Business Plan in which the budget is refreshed.	<ul style="list-style-type: none"> <li>• Perform a full project reforecast for the 2015 Business Plan in order to progress the project's cost estimates as far as possible before the date of the RQE.</li> <li>• Such a reforecast will provide management with a detailed blueprint for all of the work needed to satisfy the RQE with information related to the budget that should match the DR Project's growing level of maturity.</li> </ul>
	Contingency calculations need closer alignment with the Risk Management Program.	<ul style="list-style-type: none"> <li>• Actions summarized above</li> <li>• Create a clear and repeatable process for calculating contingency at all levels and for all program participants.</li> </ul>
<b>Management Processes</b>	OPG's new processes and procedures are in some cases conflicting and repetitive.	<ul style="list-style-type: none"> <li>• Look at reducing the number and optimizing the process map.</li> </ul>
<b>RFR</b>	SNC/Aecon's Class 4 Estimate (by contractual design) does not monetize contingency nor will it until the date of the 2015 Class 2 Estimate; this fogs the budgeting process and could complicate target price negotiations with SNC/Aecon over risk identification.	<ul style="list-style-type: none"> <li>• Consider asking SNC/Aecon to monetize risks at a much earlier stage.</li> </ul>
	The Class 4 Estimate represents perfect performance; thus, it will form the basis for comparison with actual results.	<ul style="list-style-type: none"> <li>• The DR Team needs to document and explain the nature of the Class 4 Estimate so that there is no such confusion.</li> </ul>
	Project maturation specific to the DR Project was not a factor in SNC/Aecon's estimates to date.	<ul style="list-style-type: none"> <li>• The Class 3 Estimate preparation should be expedited if possible.</li> </ul>



Issue	Risk/Opportunity	Recommendation
		<ul style="list-style-type: none"> <li>OPG should seek SNC/Aecon's monetizing of PMT costs.</li> </ul>
	The potential unlapping of the execution of Unit 2 could result in cost increases from SNC/Aecon due to extended overhead and maintaining the workforce for a longer duration.	<ul style="list-style-type: none"> <li>While SNC/Aecon's costs may increase, there are other elements within the contract that should be negotiated that might serve to reduce the overall project's risk.</li> </ul>
	There are technical improvements that should be reviewed based on OPEX.	<ul style="list-style-type: none"> <li>Study opportunities now that the effort is turning to Darlington.</li> </ul>
BOP	The time engineering needs to create MDP packages is delaying the procurement of the work and the commencement of detailed engineering.	<ul style="list-style-type: none"> <li>Accelerate engineering work as necessary / practicable with the OSS vendors.</li> <li>Reduce and optimize BOP scope as soon as reasonably possible to decrease wasted effort.</li> <li>Change procurement method to a packaged approach (see below).</li> <li>Jumpstart detailed engineering by engaging EPC vendors as early as possible in the design process.</li> <li>Eliminate unnecessary duplication of effort between OSS vendors and EPC designers.</li> <li>Review and eliminate OPG delays in approval of design work.</li> </ul>
	The procurement process for BOP is designed around packaging two large bundles of BOP work and a Secondary Compete process which adds time to the schedule; the outcome of this "competition" is essentially already known.	<ul style="list-style-type: none"> <li>Assign work to ESMSA vendors based on qualifications in smaller bundles.</li> <li>Use the existing ESMSA agreements and eliminate bidding process.</li> </ul>
	The ESMSA contractors have experienced performance problems on the Campus Plan work.	<ul style="list-style-type: none"> <li>Ensure that appropriate performance metrics are in place and aggressively address specific performance trends and problems as they arise.</li> <li>Increase flexibility in the assignment of BOP work to give OPG an opportunity to mitigate ESMSA performance issues.</li> </ul>
	There is a risk that scope defining inspections and discovery work during the Execution Phase will add scope not currently	<ul style="list-style-type: none"> <li>Optimize the BOP work so that an appropriate schedule window exists for performance of scope adders.</li> <li>Increase visibility of this potential risk.</li> </ul>

Issue	Risk/Opportunity	Recommendation
	anticipated to the BOP work.	
Campus Plan	<div></div> <div></div> <div></div>	<ul style="list-style-type: none"> <li>Continue to devote adequate resources to recover the D20 Storage Facility's schedule.</li> <li>OPEX from this project should be used to guide management of the future Execution Phase work.</li> </ul>
	Campus Plan work is multi-faceted and schedule driven; the sheer size and timing of the work adds complexity and risk	<ul style="list-style-type: none"> <li>Additional management attention is needed to ensure planning and execution of the work</li> </ul>
	The Campus Plan's scope is too large	<ul style="list-style-type: none"> <li>Continue to review the Campus Plan Scope and eliminate unnecessary projects.</li> </ul>
OPG Critical Path	OPG-directed work is 25% of the Critical Path of the DR Project.	<ul style="list-style-type: none"> <li>Ensure that this work is given proper focus and resources.</li> </ul>

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Darlington Refurbishment Final Report May 3	Internal Audit	5/12/2013
1 oversight summary	Refurbishment Oversight Report#1	2/22/2013
2 oversight summary	Refurbishment Oversight Report#2	4/2/2013
AssuranceMap_DRP_20130403A_ExecutiveSummary_GeneralApplicability	Part 1 of 2 - General Applicability/Mandate	3/7/2013
Presentation_20130325A_DrpAssuranceMap_Phase-1_Draft_Ip apr3	DRP Risk Assurance Map – Phase-1	3/11/2013
Program Assurance Plan - PMP Sheet 11	Program Assurance Plan For Darlington Nuclear Refurbishment	3/1/2013
N-2013-00303 QA Gap analysis	GAP Assessment	2/11/2013
SCR N-2013-00303 from database	Station Condition Record	1/17/2013
SCR N-2013-00303	Common Cause Analysis	1/17/2013
NK38-CORR-09701-0401046 TG Project Contracting Strategy	Refurb Records; add'l correspondence dated 2/29/12 - Sweetnam & Reiner	3/28/2012
NK38-REP-09701-10020 Contracting Strategy - FH & Defueling	Contracting Strategy For Fuel Handling -Defueling	10/2/2012
NK38-REP-09701-10021 Contracting Strategy - TG	Contracting Strategy for TG; email attached	8/31/2012
NK38-REP-09701-10024 Contracting Strategy - Steam Generator	Contracting Strategy for Steam Generator	8/10/2011
NK38-REP-09701-10030 Contracting Strategy Summary - TG	for Turbine Generators; memo attached dated 3/28/12	8/24/2011
NK38-REP-09701-10034 Contracting Strategy - RFR	Contracting Strategy for Retube & Feeder Replacement	7/31/2011
NK38-REP-09701-10102 Contracting Strategy - BOP	Balance of Plant; email attached	3/19/2013
NK38-REP-09701-10130-R000 Contracting Strategy - FH Refurb	Fuel Handling - Refurbishment	11/16/2012
EDMS BRD Final R1	(BS&IT) Bus. Svcs. & Info. Tech. / (BRD) Bus. Rqmts. Doc. - Nuclear Projects EDMS - Define bus. & key syst. Requirements of target syst.	
Document Management Strategy Review Whitepaper	NK38-REP-08133-0460629-T20 WorleyParsons - Strategy Review Whitepaper	7/27/2012
WP EDM report	NR DOCUMENT MANAGEMENT / STRATEGY REVIEW WHITEPAPER - Worley Parsons	7/27/2012
Engineering Process Major Work Streams (Swim Lanes)	Project Unit 2 Major Work Streams - Org Chart	
EPC Vendor Interface Requirements Rev 2	13 page PowerPoint	
Gated Process Apr 8	Nuclear Projects Gated Process	4/8/2013
Scoping Overview	Organizational Chart	3/5/2013
1-EPC Vendor Engineering Interface Requirements - Intro	scanned PowerPoint	
2-Scope Strategy and Plan - 12-15-11	Refurbishment Scope Strategy & Plan	12/15/2011
3-Engineering Interface Requirements - 2-28-13	Engineering Interface Requirements	2/28/2013
5-Desktop Guide for the Preparation of a Needs Document - 2013	Desk Top Guide for the Prep. Of Needs Doc.	3/13/2013
6-Guide to the Development of a Conceptual Design Report - 12-18-12	Guide to the Development of a Conceptual Design Rpt.	12/18/2012
7-Preparation of Modification Design Requirements - 2013	Prep. Of Modification Design Requirements	
8-Modification Outline and Design Scoping Checklist	Modification Outline Report	
9-Design Completion Assurance - 10-15-12	Darlington Refurb.: Design Completion Assurance	10/15/2012
10-Non-Intent Design Deviation Notice	Non-Intent Design Deviation Notice	10/15/2012
11-Construction Completion Declaration Process - 12-31-12	Nuclear Refurb. Constr. Compl. Declaration Process	
12-Appendix C - Good Practices for Achieving High Product Quality	Good Practices	
13-Nuclear Projects Gated Process	Org chart	
14-Unit 2 Major Work Streams - pg1	Org chart	
15-Unit 2 Major Work Streams - pg2	schedule	
DR Scope Strategy and Plan NK38-INS-09701-10001	Refurb Program-Scope Control	12/12/2012
N-FORM-10958 Modification Outline Form	Modification Outline form	
N-GUID-00700-10002 Preparation of Needs Document	Desk top guide for the Prep of a needs doc (email attached)	
N-GUID-01920-10000 Engineering Oversight	Guideline For Engineering Oversight	
N-INS-00700-10007 Preparation of MDR	PREPARATION OF MODIFICATION DESIGN REQUIREMENTS	
NK38-GUID-01900-10001 Design Completion Assurance	Design Completion Assurance	
NK38-GUID-01900-10002 Non-Intent Design Deviation Notice	Non-Intent Design Deviation Notice	
NK38-GUID-01900-10003 Engineering Interface Requirements	Engineering Interface Requirements	2/28/2013
NK38-GUID-01900-10004 Development of Conceptual Design	Guide to the Development of a Conceptual Design Report	12/18/2012
N-PROC-MP-0090 Modification Process	MODIFICATION PROCESS	
N-STD-MP-0009 Engineering Interface & Oversight	CONTRACTOR/OWNER ENGINEERING INTERFACE AND OVERSIGHT	
Audit Report NO-2013-005 DRAFT_TW (2)	Modification Design Requirements and Design Quality Oversight	
CCA 21 June	Common Cause Analysis associated with Ref. SCR# N-2013-02294	Jun-13
N-NR SCRs from 2012 March 1st to 203 May 31	System Lay-Up Technical Requirements Documentation Compliance	
SCRs from July 1-2012 to 30- April 2013 keyword Contractor Interface	database; tabs - Key Word Contractor & Contractor Interface	5/28/2013

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
1 - Agenda - Eng. Schedule Review - 24 May 2013	Engineering Schedule and Metrics Review Meeting	5/24/2013
2 - Minutes - Eng. Schedule Review - 17 May 2013	Engineering Schedule and Metrics Review Meeting	5/17/2013
6 - Other engineering 24 May2013	VBO Outage Status, MDR Work Streams, Eng. Studies	5/24/2013
2013 06 20 Weekly Meeting Presentation	Meeting Minutes	6/21/2013
20130522_WP_Quad_Chart	MDR Pre-Requisites and Completion Status Report chart	5/22/2013
20130523_AMEC NSS_Quad_Chart	MDR Pre-Requisites and Completion Status Report chart	5/21/2013
April 5 2013 Engineering Schedule and Metrics Review Meeting	Meeting Minutes	
April 12 2013 Engineering Schedule and Metrics Review Meeting	Meeting Minutes	
Copy of B-O Chart and MR Tracking_Eng Leads-PM Updates as of 50113	MR Tracking & P6 Blackout	
Engineering MDR and Studies Summary slides June 14	VBO Outage Status, MDR Work Curves, Eng. Studies (Hos), etc.	
Outstanding Actions MDR Issues-Actions	9 Outstanding actions	5/24/2013
Outstanding Actions MR Holds	Outstanding Actions	5/24/2013
Outstanding Actions Weekly Meeting	Engineering Schedule and Metrics Review Meeting - 5 outstanding actions	5/24/2013
1-NR Engineering Communication Book - cover	Project Values - 1 page	
2-AIP Scorecard and Focus Areas - 2013	Scanned doc - database	
3-Program Status Report - 12-31-12	Meeting Minutes	1/23/2012
4-Nuclear Safety, Engineering Services, Project Engineering - 2-27-13	Scanned doc - nuclear safety	
5-Weekly Tactical Update - 3-15-13	Engineering Key Milestones	
6-Design Engineering Weekly Report - 3-5-13	Weekly Report	
7-Engineering Organizational Chart - 1-14-13	Org chart - photos included	
8-Nuclear Safety Division Organizational Chart - 1-14-13	Org chart - photos included	
9-Engineering WBS - 2-1-13	Org chart	
10-Engineering Cost Breakdown Structure - 2-1-13	Org chart	
12-DSRs for Engineering Studies Work Down Curve - 3-11-13	Chart	
13-Engineering Hours Budget - 2-21-13	scanned doc - database	
14-Darlington Integrated Master Schedule March 18 2013	schedule	2/6/2012
15-Engineering Schedule and Metrics Review Meeting - 3-8-13	Meeting Minutes	3/8/2013
16-MDR Prerequisite Blackout Chart - 3-11-13	database	
17-MDR Workdown Curve, MDR Starts, Acceptance Process - 3-11-13	chart	3/11/2013
18-DSRs for Modifications Blackout Chart - 2-21-13	database/chart	2/21/2013
19-MDR Process - 2-28-13	org chart	2/28/2013
21-EV Engineering Breakdown for MODs	org chart	
22-Earned Value Process for MDRs - Example - 3-1-13	org chart	
23-Project Planning, Engineering Staffing - 1-1-13	database	Jan-13
24-Project Numbers - 7-27-12	org chart	7/27/2012
25-Funding Analysis - 3-7-13	scanned doc - database	3/7/2013
26-EC Modification Tracking Report - 3-19-13	EC Black out chart	3/19/2013
27-Management Plan - 1-30-13	DNGS Refurbishment Mgmt. Plan - Refurb. Eng.	1/30/2013
2013-04-26-WorleyParsons_MDR_Integrated_Schedule_DRAFT_L1	MDRs Integrated Schedule - Level 1	4/25/2013
2013-04-26-WorleyParsons_MDR_Integrated_Schedule_DRAFT_L2	MDRs Integrated Schedule - Level 2	4/25/2013
2013-04-26-WorleyParsons_MDR_Integrated_Schedule_DRAFT_L3_OPG_O	MDRs Integrated Schedule - Level 2 - OPG Activities ONLY	4/25/2013
AMEC 2013-04-26-MDR Program- Level 1	AMEC NSS MDR Program Integrated Schedule	
AMEC 2013-04-26-MDR Program- Level 2	AMEC NSS MDR Program Integrated Schedule - Level 2	
AMEC 2013-04-26-MDR Program- Level 3-OPG activities	AMEC NSS MDR Program Integrated Schedule - Level 3	
AMEC202013-05-27-Level2	MDR Program Integrated Sched. - Level 2	
B-O Chart and MR Tracking_Eng Leads-PM Updates	MR Tracking & P6 Blackout	
D1321 scope for refurb	DSR tracking	
DSR Database	DSR database	
DVBO scope for refurb	DSR for vacuum bldg.	
P6 Blackout Chart	charts included; add'l tabs	
WC Scope Review 13-05-02	DSR Based Estimate - Based on Estimate Details as of August 30, 2012	8/30/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Scope Review Process	NK38-REF-09701-10004-R000 [TBC] Independent Scope Review	5/23/2013
Master_Outage Prep Meeting_Jul_11	Action Log; DSR HOS, etc.	
Memo 20130618160713465 Planning Assumptions	memo; changes in refurb planning assumptions	6/6/2013
NK38-CORR-09701-046500 Non-Core Scope Valve Cost Benefit Analysis	Non-Core Scope Valve Cost Benefit Analysis memo	5/28/2013
Scope Presentation	Darlington Refurbishment Scope	2/1/2013
Scope Review as of 062013	Scope type data (CS02, CS03, etc.)	6/20/2013
Scope_Status_Meeting_June6_2013	Review readiness for refurbish preparation work	6/6/2013
ScopeStatusPackageMay9_2013	Outage Preparation Review Meeting	5/9/2013
Table 1. Non-Core Scope DSR's	database	6/6/2013
Appendix 1 Repair vs. Replace Cost Analysis	DSR Repair vs. Replace	
NK38-CORR-09701-046500 Non-Core Scope Valve Cost Benefit Analysis	Non-core Scope Valve cost benefit analysis	5/28/2013
Table 1. Non-Core Scope DSR's	database	6/6/2013
DR_Engineering WeeklyTactical_Update003 April 19, 2013	Weekly Report	4/19/2013
DR_Engineering WeeklyTactical_Update003	Weekly Report	4/19/2013
Engineering Weekly Tactical Update March 15, 2013	Weekly Report	3/15/2013
D1231 Outage Report	D1231 Planned Outage	5/18/2012
NK38-PLAN-31160-10003_R000(22Jan2013) Detailed Design & Qualification for RFR	Scope of Work - Fuel Channel Zr-Nb-Cu Annulus Spacer - Detailed Design & Qual. For Darlington Retube & Feeder Replmt.	1/22/2013
Bulk MDR Contracting Strategy	Engineering Projects Department to execute Bulk MDR as follows in document	6/27/2013
Contracting Strategy D2O Storage	Memo; Proj. 16-31555 D2O Storage Facility Contracting Strategy; Contracts Rev. Table	3/18/2011
DNGD D2O Storage- Gate 3 Project Execution Plan Form	Heavy Water Storage & Drum Handling Facility; NK38-PEP-38000-0434605	7/10/2012
G1 - 13 - TS Preliminary Contracting Strategy (3) NCD Comments -scf edit oct	CONTRACTING STRATEGY FOR BALANCE OF PLANT – CONVENTIONAL SYSTEMS; <b>no NK38 #, no date</b>	
G1 Preliminary Contracting Strategy	COMMERCIAL STRATEGY; <b>no NK38#</b>	3/15/2011
G1-14 - PR Contracting Strategy	CONTRACTING STRATEGY FOR BALANCE OF PLANT – Pre-Refurbishment Sub-Bundle	1/30/2013
NK38-CORR-09701-0401046 Contracting Strategy Summary TG	Refurb Records; add'l correspondence dated 2/29/12 - Sweetnam & Reiner	3/28/2012
NK38-CORR-38000-0374630 Contracting Strategy D2O Storage	Project D2O Storage Facility; contracts review table attached	3/18/2011
NK38-REF-00150-0379237 2009 Presentation Program Contracting Strategy	Email - fr/ Laura Oakes to Refurb Doc Mgmt.; ppt attached - 'Prelim Procurement & Contracting Strategy'	3/16/2011
NK38-REP-00150-10001 Rev001 Program Commercial Strategy	Commercial Strategy report	10/1/2012
NK38-REP-09701-10020 Contracting Strategy FH Defueling	Contracting Strategy For Fuel Handling -Defueling	10/2/2012
NK38-REP-09701-10021 Contracting Strategy TG	Contracting Strategy for TG; email attached	8/31/2012
NK38-REP-09701-10024 Contracting Strategy SG	Contracting Strategy for Steam Generator	8/10/2011
NK38-REP-09701-10030 Contracting Strategy Summary TG	for Turbine Generators; memo attached dated 3/28/12	8/24/2011
NK38-REP-09701-10034 RFR Contracting Strategy-signed R000	Contracting Strategy for Retube & Feeder Replacement	7/31/2011
NK38-REP-09701-10102 Contracting Strategy BOP	Balance of Plant; email attached	3/19/2013
NK38-REP-09701-10130-R000 Contracting Strategy for FH Refurb	Fuel Handling - Refurbishment	11/16/2012
NK38-REP-09701-0442800 BOP Pre Refurb Contracting Strategy	Pre-Refurbishment Sub-Bundle	1/30/2013
N-MAN-00120-10001-RDM R000 Nuclear Projects Records and Document Management	Nuclear Projects Records And Document Management	3/14/2013
N-MAN-00120-10001-RDM Project Records & Doc Mgmt.	Records And Document Management	3/14/2013
N-MAN-00120-10001-RDM-01-R001 Sharepoint 2007	Nuclear Projects Sharepoint 2007	2/19/2013
N-MAN-00120-10001-RDM-02-R001 Supplier Document Hub	Supplier Document Hub	4/17/2013
N-MAN-00120-10001-RDM-09 Release of OPG Docs to Ext Oversight	Release Of OPG Documents To External Oversight Organizations	4/17/2013
Nuclear Projects Records and Document Management	Nuclear Projects Records And Document Management	3/14/2013
DR Scope Strategy and Plan NK38-INS-09701-10001	Program-Scope Control	12/12/2012
NK38-GUID-01900-10001-R001 Design Completion Assurance	Design Completion Assurance	10/15/2012
NK38-GUID-01900-10002-R001 Non-Intent Design Deviation Notice	Non-Intent Design Deviation Notice	10/15/2012
NK38-GUID-01900-10003-R001 Engineering Interface Requirements	Engineering Interface Requirements	2/28/2013
NK38-GUID-01900-10004 Development of Conceptual Design	Guide to the Development of a Conceptual Design Report	12/18/2012
NK38-GUID-09701-10020 Gen Process for Conceptual Studies	Generic Process for Execution of Darlington Refurbishment Services Conceptual Studies	2/15/2013
NK38-INS-01900-10001-R001 Preparing & Issuing Eng. Directives	Management Expectations On Preparing And Issuing Engineering Directives	8/24/2012
Nk38-INS-01920-10002 Quality Engineering Plan	Quality Engineering Plan	10/18/2012
NK38-INS-09701-10001-R004 Program Scope Control	Program-Scope Control	12/12/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
NK38-INS-09701-10008 Tracking Compliance with Environmental Commitments	Tracking Compliance With Environmental Commitments	11/1/2012
NK38-PLAN-1060-10003 Reference Plan Scope Definition	REFERENCE PLAN - SCOPE DEFINITION	6/25/2008
NK-38-PLAN-09701-10003 Terms of Reference	Scope Review Board – Terms of Reference	2/1/2011
NK38-PLAN-09701-10067 Scope Mgmt. Plan	Program Scope Management Plan	1/31/2013
N-MAN-00120-10001-Scope	Nuclear Projects Scoping Process	12/11/2012
N-MAN-00120-10001-Scope-06 Transfer of Work Process	Transfer Of Work Process	7/26/2012
N-MAN-00120-10001-Scoping Process	Nuclear Projects Scoping Process	12/11/2012
Project Planning, Engineering Staffing - 1-1-13	Release 4: Project 73019, 73020, 73094, 73021 & 73022 Detailed Planning	2/1/2013
GOVERNANCE FRAMEWORK	Index	
Governance Chart	Chart	
N-CHAR-AS-0002 Nuclear Management Systems	NUCLEAR MANAGEMENT SYSTEM	
N-PROG-AS-0001 Managed Systems	MANAGED SYSTEMS	
N-PROC-MP-0090 Mod Process	MODIFICATION PROCESS	
N-PROC-AS-0001 Mgmt. of Administrative Governance	PROGRAM MANAGEMENT OF ADMINISTRATIVE GOVERNANCE	
N-STD-AS-0001 Requirements for Admin Governance Docs	REQUIREMENTS FOR ADMINISTRATIVE GOVERNANCE DOCUMENTS	
E-Manual Template	N-STD-AS-0028 – Project Management Standard	7/17/2013
N-PROG-AS-0007 Project Management	PROJECT MANAGEMENT	
NK38-PLAN-09701-10067-0017-R000 Contract Mgmt. Plan	identifies how the major contracts will be defined, managed and controlled throughout program	1/31/2013
N-PROC-AS-0081 Technical Contractor Management Process	TECHNICAL CONTRACTOR MANAGEMENT PROCESS	
N-STD-AS-0028 Project Management Standard	PROJECT MANAGEMENT STANDARD	
N-STD-AS-0029 Contract Management Standard	CONTRACT MANAGEMENT STANDARD	
N-STD-AS-0030 Project Oversight Standard	PROJECT OVERSIGHT STANDARD	
N-STD-AS-0031 Field Engineering Standard	FIELD ENGINEERING STANDARD	
1 Refurbishment Program Structure And Summary Management Plan	Refurbishment Program Structure And Summary Management Plan	1/31/2013
2 Refurbishment Program Scope Management Plan	Refurbishment Program Scope Management Plan	1/31/2013
3 Program Cost Management Plan	Program Cost Management Plan	1/31/2013
4 Program Schedule Management Plan	Program Schedule Management Plan	1/31/2013
5 Refurbishment Program Reporting Management Plan	Refurbishment Program Reporting Management Plan	1/31/2013
6 Darlington Refurbishment Risk Management Plan	Darlington Refurbishment Risk Management Plan	1/31/2013
8 Refurbishment Program Staffing Management Plan	Refurbishment Program Staffing Management Plan	1/31/2013
9 Program Documentation Management Plan	Program Documentation & Project Closure Management Plan	1/31/2013
12 Program Environmental Management Plan	Program Environmental Management Plan	1/31/2013
13 Program Management System Oversight Management Plan	Program Management System Oversight Management Plan	1/31/2013
16 Nuclear Refurbishment Program Health and Safety Management Plan	Nuclear Refurbishment Program Health & Safety Management Plan	1/31/2013
17 Program Contract Management Plan	Program Contract Management Plan	1/31/2013
18 Program Return to Service Management Plan	Program Return to Services Management Plan	1/31/2013
Project Charter D-PCH-09701-10000-R001	Darlington Refurbishment	6/15/2009
0 Project Charter D-PCH-09701-10000-R001	Darlington Refurbishment	6/15/2009
2 Refurbishment Program Scope Management Plan	Refurbishment Program Scope Management Plan	1/31/2013
3 Program Cost Management Plan	Program Cost Management Plan	1/31/2013
4 Program Schedule Management Plan	Program Schedule Management Plan	1/31/2013
5 Refurbishment Program Reporting Management Plan	Refurbishment Program Reporting Management Plan	1/31/2013
6 Darlington Refurbishment Risk Management Plan	Darlington Refurbishment Risk Management Plan	1/31/2013
8 Refurbishment Program Staffing Management Plan	Refurbishment Program Staffing Management Plan	1/31/2013
9 Program Documentation Management Plan	Program Documentation & Project Closure Management Plan	1/31/2013
12 Program Environmental Management Plan	Program Environmental Management Plan	1/31/2013
13 Program Management System Oversight Management Plan	Program Management System Oversight Management Plan	1/31/2013
16 Nuclear Refurbishment Program Health and Safety Management Plan	Nuclear Refurbishment Program Health & Safety Management Plan	1/31/2013
17 Program Contract Management Plan	Program Contract Management Plan	1/31/2013
18 Program Return to Service Management Plan	Program Return to Services Management Plan	1/31/2013
NK38-PLAN-09701-10067-0001-R002 Refurbishment Program Structure And Summary Management Plan	Prog. Structure & Mgmt. Plan	1/31/2013
Earned Value Guide	N-MAN-00120-10001-SCH-07-R000 - EV Mgmt.	3/15/2013
NK38-PLAN-09701-10067-0004 Sh 0004	Program Schedule Management Plan	3/27/2013
NK38-PLAN-09701-10072 Critical path	Nr Conceptual Level 1 Logic (Pims-C)	9/7/2012



DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
N-MAN-00120-10001-COM	Project Communications	1/1/2013
N-MAN-00120-10001-CST	Cost Management And Project Reporting	7/19/2012
N-MAN-00120-10001-Est-01	NUCLEAR REFURBISHMENT COST ESTIMATE	7/25/2012
N-MAN-00120-10001-Est-R001	Nuclear Projects Cost Estimating	11/30/2012
N-MAN-00120-10001-GRB	Nuclear Projects Gated Process	11/28/2012
N-MAN-00120-10001-PC	Project Controls	1/1/2013
N-MAN-00120-10001-PC-02-R001	Cost And Schedule Change Control Instruction	4/25/2013
N-MAN-00120-10001-Sch	Schedule Management	7/19/2012
N-MAN-00120-10001-Sch-01	Work Breakdown Structure Direction	
N-MAN-00120-10001-Sch-02-R001	Program/Project WBS Manual	4/5/2013
N-MAN-00120-10001-Sch-02-R003	DNG Refurb -Standard Projects Milestone List	
N-MAN-00120-10001-Sch-03-R001	Program & Project missed milestones recovery process	
N-MAN-00120-10001-Sch-05-R001	Program/Project WBS Manual	4/5/2013
N-MAN-00120-10001-Sch-06	Milestone Definition Framework	8/2/2012
N-MAN-00120-10001-Sch-07	Earned Value Management	3/15/2013
Nuclear Contract Management Manual	guidance for the implementation of the five stages in the contracting process	11/28/2012
Program Schedule Mgmt. Plan Rev 1	Program Schedule Management Plan	3/27/2013
Contingency Instructions	bullet points	
Contingency Presentation for RPET (Jan-30-2013)	proposed strategic direction of contingency development and management	1/30/2013
Contingency Worksheets	database template	
N-MAN-00120-10001 Risk	Task Instruction – Closing Risks	
N-MAN-00120-10001 Risk-R001	Nuclear Projects Risk Management Process	11/22/2012
N-MAN-00120-10001-Risk-03	Nuclear Projects Risk Management Process	11/22/2012
N-MAN-00120-10001-Risk-04	Nuclear Refurbishment Risk Management	7/25/2012
N-MAN-00120-10001-RISK-05-R001 Contingency (1)	Contingency Development And Management Guide	6/26/2013
Do not use--Use R001N-MAN-00120-10001-Risk-05 Contingency Development & Mgmt.	Contingency Development And Management	7/19/2012
N-MAN-00120-10001-Risk-06	Darlington Refurbishment Lessons Learned And OPEX Management	7/19/2012
N-MAN-00120-10001-Risk-07	Nuclear Refurbishment Earned Value Management	3/15/2013
Nuclear Projects Risk Management Manual (1)	Risk Management	7/25/2012
Nuclear Projects Risk Management Process	Risk Management Process	11/22/2012
Nuclear Projects Planning & Control Earned Value Management April 2013	Planning & Controls	Apr-13
R3 May 1 Oversight Workshop	for Senior Management	
GRB Schedule 2013	Nuclear Refurbishment Gate Review Board, 2013 Schedule	3/18/2013
Nuclear Projects Gated Process	Nuclear Projects Gated Process	11/28/2012
OPG Proposal Org and Labor Resource revA	Organization & Labour Resource Strategy	5/11/2010
R3 May 1 Workshop on Oversight	Oversight workshop for senior mgmt.	May-13
PR_G1_Presentation	Gate 1 Pre-Refurbishment Sub-Bundle	4/15/2013
Dispositioning Comments scf	Tabs: Comments, Contingency Table	
G1-0 Gate Progression Form	1.0 GATE SUMMARY, 2.0 GATE PROGRESSION STRATEGY, etc.	4/15/2014
G1-0 Gate Progression Form (pdf)	Balance of Plant: Pre-Refurbishment	4/15/2014
G1R BoP S and C GPF	Balance of Plant Safety and Controls	
G1-2 Cost Estimate	DSR Line Estimate _ Scope List - as of Mar 8, 2013 (In \$K)	
G1-3 PR Funding Request Form	Funding Request Form	4/15/2013
BoP_PR_DRAS_Combined	DRAS - Decision Record & Analysis Sum. Form	
G1-4 - PR Decision Records and Analysis Summary	Balance of Plant Pre-Refurbishment Sub-Bundle	4/15/2013
BoP_PR_L1_G1_Waterfall_20130328	Initial Gate Submission - BoP View	2/28/2013
BoP_PR_L1_G1_WBS_20130328	Gate Review Level 1	2/28/2013
BoP_PR_Milestones_20130328	All Pre-Refurbishment Key Milestones	2/28/2013
BoP_PR_WBS_20130328	Primavera org chart	3/28/2013
BoP_PR_L3_G1_Waterfall_20130328	Initial Gate Submission - BoP View	2/28/2013
BoP_PR_L3_G1_WBS_20130328	Gate Review Level 3	2/28/2013
G1-7 - PR Pre-Req. Inspections	Gate 1 Submission Document	4/15/2013

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
G1-9_RiskAssessment	Project Risk Assessment	4/15/2013
G1-10 - PR Alternative Option Decision Making Strategy	Alternative Option Decision Making Strategy	4/15/2013
G1-11 2013-2025 Cash Flows	Sheet 2 -Nuclear Refurbishment Program Staffing (\$) and Contract Cost	
G1-11 2013-2025 Resource Plan	Sheet 1 -Nuclear Refurbishment Program Staffing (FTE) and Contract Cost	
G1-11 Annual Cash Flows	2013 to 20XX CASH FLOWS	
G1-12 Key Assumptions	Key Assumptions & Constraints; Balance of Plant, Pre-Refurbishment	4/15/2013
G1-13 - PR Gate Progression Strategy	Gate Progression Strategy Plan	4/15/2013
G1-14 - PR Contracting Strategy	CONTRACTING STRATEGY FOR BALANCE OF PLANT – Pre-Refurbishment Sub-Bundle	1/30/2013
ESMSA Overview	Extended Svcs. & Master Svc Agreement	2/23/2012
Extended Services MSA - Main	MASTER SERVICES AGREEMENT; redacted version	2/15/2012
Extended Services MSA Appendix 1 - EPC (Owner, Constructor)	Terms & Conditions for Eng., Procurement & Constr.	2/15/2012
Extended Services MSA Appendix 2 - EPC (Owner Only)	Terms & Conditions for Eng., Procurement & Constr.	2/15/2012
Extended Services MSA Appendix 3 - Engineering	Terms & Conditions for Engineering	2/15/2012
Extended Services MSA Appendix 4 - Procurement	Terms & Conditions for Procurement	2/15/2012
Extended Services MSA Appendix 5 - Construction	Terms & Conditions for Construction	2/15/2012
Extended Services MSA Appendix 6 - Engineering and Procurement	Terms & Conditions for Engineering & Procurement	2/15/2012
Extended Services MSA Appendix 8 - Procurement and Construction	Terms & Conditions for Procurement & Construction	2/15/2012
Extended Services MSA Appendix 9 - Augmented Staff	Terms & Conditions for Augmented Staff	2/15/2012
Labour Requirements Acknowledgement	executing acknowledgement of labour requirements	12/6/2010
Labour Requirements Clause - Form 1	Form 1	11/28/2011
Schedule 5 - Cost Allocation Table	table	
Schedule 6 - COIR	Contractor/Owner Eng. Interface Requirements for Nuclear	6/29/2011
Schedule 8 - Business Expense Schedule	STANDARD FORM	7/27/2010
Schedule 10 to Extended Services MSA	table	
Schedule 11 - Definition of First Aid	informative document	
Schedule 11 - List of Items for Human Performance PI	table	
Schedule 11- Annual Performance Indicators and Scoring	table	
Schedule 13 - Free Issue Materials	informative document	
Appendix 1 Repair vs. Replace Cost Analysis	DSR Repair vs. Replace	
NK38-CORR-09701-046500	Non-core Scope Valve cost benefit analysis	5/28/2013
Table 1. Non-Core Scope DSR's	database	6/6/2013
Gate 3 Presentation 73821	Gate 3 GRB Meeting	6/11/2013
Campus Plan	arial view of campus	
13MAY2013 - DNGS WHITEBOARD	CAMPUS PLAN WHITEBOARD	5/13/2013
16-31555 Full Execution Release April 19 GRB Distribution	Type 3 Business Case Summary	
Business Case - DN Refurb - 2011	N-REP-00120.3-10000-R001, Economic Feasibility Assessment	11/15/2011
CSIS (05-Mar-2013)	Campus Plan Integration Plan - Master Plan - Layout B	3/5/2013
Extended Services MSA - Main	MASTER SERVICES AGREEMENT	2/15/2012
NK38-REF-09701-0439454 T10 Integrated Work Flow Analysis	Personnel Flow; R&FR Workers, BoP Workers, etc.	Jun-12
Project Charter D-PCH-09701-10000-R001	Darlington Refurbishment	6/15/2009
Projects and Modifications information	Email - fr/ Dragan Popovic to E. Gould	5/13/2013
Remaining Work Status 19Apr2013.pdf	DNGS-Heavy Water Management Building West Annex	4/19/2013
Risk Register Template C - Gate 3b R1	Instructions & Notes for Risk Register (RR) Template C; add'l tabs	
Site Layout Yearly Option-Model May 7 2013.pdf	Campus Plan Proposed Refurb Gen Arrangement	
Visio-27FEB2013 DNGS OUTAGE CAMPUS PLAN - Lookahead 2013 Level 1.pdf	2013 LEVEL 1 PROJECT REVIEW	2/27/2013
Visio-Copy (1) of 08APRIL2013 - DNGS - 20 Week Project Look Ahead (3).pdf	20 WEEK PROJECT LOOK AHEAD	4/8/2013
Components requiring Unit overlap Memo	Memo to summarize review performed FH refurb	6/17/2013
Darlington Defueling Study	Darlington NGS Defueling Study	4/1/2011
Email response from FH Proj. Mgr. re documents	Email - Doc for External Oversight Team	4/29/2013
FH and Refurbishment Integration Readiness May 8 2013	chart	5/8/2013
NK38-PLAN-35000-10005- Basis of Flow Defueling Critical Path Evaluation Feb 21 2013	Refurbishment Defueling Basis For Critical Path Estimation	2/21/2013
REVISED Terms of Reference	FH Equipment Reliability and Refurbishment Integration Steering Committee	
2013_Defuel Presentation-Gate 2-June 14-final	Project Status	6/14/2013
Defueling Project Management Plan Rev 0	Defueling Project Management Plan	6/5/2013
Gate Progression Form-Gate 2-final	Fuel Handling Defueling	



DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
NK38-REP-09701-10005 R001 White Paper Islanding Strategy	White Paper - Refurbishment Island Strategy	4/20/2012
BH Gate 2 Scope Summary Statement	Islanding Bulkhead and Containment Isolation Sub bundle	
Dispositioning Comments scf	templates/tables - blank	
Islanding BH G2 GPF	Islanding - Bulkhead	
NK38-PLAN-09701-10159	Islanding Project Management Plan	4/16/2013
Risk Management Plan R00 Signed	NR Islanding Project - Risk Mgmt. Plan	2/19/2013
Gate 2 DRAS Cover Sheet	Islanding – Bulkhead and Containment Isolation	4/30/2013
BH Milestones Gate 2	Bulkhead Milestones	4/4/2013
BHLevel 1 Gate 2	Bulkhead Level 1	4/4/2013
BH G2-7 Analysis of alternative options	Evaluation of preferred alternative; Islanding – Bulkhead and Containment Isolation	4/30/2013
BH G2-8 Review of Engineering Analysis	Review of scope and engineering analysis to determine/anticipate scope additions; Islanding – Bulkhead and Containment Isolation	4/30/2013
AIDA_Islanding	Current Islanding Assumptions; add'l tabs	
Bulkhead Assumptions	Darlington Refurbishment - Planning & Cntls. (3 pgs. of 150)	4/17/2013
Gate 2 Assumptions Cover Sheet	G2-9 Key Project Assumptions & Constraints	4/30/2013
BH G2-10 2 Percent Design Complete	G2-10 ~2% Design Complete	4/30/2013
PDRI-2 Nuclear bulkhead Letter	Nuclear Bulkhead Containment Project, PDRI-2 Results	4/18/2013
PDRI-Nuclear Bulkhead	Nuclear Islanding (Bulkhead & Containment); instructions & database	
BH G2-12 Identification of major long lead items	G2-12 Identification of major long lead items	4/30/2013
Gate 2 Risks Cover Sheet	G2-13 Project Risk Assessment Subject Project Bundle: Islanding	4/30/2013
Gate 2A Risk Contingency	Islanding Bulkhead & Containment Isolations and Project Management Gate 2A Risk Contingency	
Islanding BH and PM Risks	Residual Risk Description	
BH G2-14 PIR Criteria	G2-14 PIR Criteria	4/30/2013
DRAFT Islanding Oversight Plan Rev 00 (2) 8April2013	Island Project Oversight Plan	4/23/2013
BH G2-16 Review of G0 Scope	G2-16 Review of G0 Scope	4/30/2013
BH G2-17 Level 2 and 3 Schedule	G2-17 Level 2 and Level 3 Schedule	4/30/2013
BH OPG Level 2 3 Gate 2	Bulkhead OPG Level 2/3	4/4/2013
BH Vendor Gate 2	RFR Team; DRAFT Containment Isolations Remaining Work Status: 23Apr2013	4/24/2013
BHLevel 2 Gate 2	Bulkhead Level 2	4/4/2013
Volume Reduction Strategy CP0420-1 Combined	scanned doc - RFR Volume Reduction Location	
QA_RFR_Contract_Confidential	Questions & Answers	4/9/2013
RFR Contract Summary of Key Terms	Eng., Procurement, & Constr. Agreement for Refurb Retube & Feeder Replmt. Proj.	3/12/2012
Contract Strategy for RFR NK38-REP-09701-10034	Retube & Feeder Replacement	7/31/2011
NK38-DAI-0901-10008 RFR Contractor Interface Requirements	RFR Contractor/Owner Interface Requirements	8/15/2012
RFR Eval Summary NK38-REP-09701-10084	R&FR RFP Evaluation & Negotiation Process Sum.	6/25/2012
Dispositioning Comments scf RFR -Gate 2 A	P&C Cost Review; add'l tabs included	
Gate 2 A Summary	Mar 2013 - May 2014	
NK38-REP-09701-10034 RFR Contracting Strategy-signed R000	Retube & Feeder Replacement	7/31/2011
Projects - Retube and Feeder Replacement	Current Gate 2A; Fiscal Mo End 03-July-2013	7/3/2013
RFR G2A GPF	Retube and Feeder Replacement Project	
RFR Gate 2A Level I Schedule 28Feb13	Review Level 1	2/28/2013
RFR Gate 2A Progression Signed off	Retube & Feeder Replacement Proj.	
RFR Risks - by RBS - Feb 21 2013	Risks Level 1 and Level 2; RFR - Retube & Feeder Replacement	2/21/2013
Dec 2012 Estimate Report	ESTIMATE, LEVEL 2 SCHEDULE & RISK REPORT	12/21/2012
RFR Resource Plan - Revised March 6 -Gate 2A	March, 6	
RFR Resource Plan 15 Feb 2013-Gate 2A	Feb 15 2013	
RFR Resource Plan 20 Feb 2013-Execution	Feb 20 2013	
34-120019 Annulus spacer Qual-9Jan2013	Annulus Spacer Qualification Test for Darlington Retube	
34-120019 Inconel 9Jan2013	Inconel Spacer Qualification Test for Darlington Retube	
2013-02-08- R0031- Basic	R0031 : Retube and Feeder Replacement Resources	
2013-02-08- R0031- Cash flows- Basic with actuals-Oct12-May14.pdf	CT-01 Monthly Project Cash Flow -with actuals	2/8/2013
2013-02-08- R0031- Cash flows- detailed by WBS with actuals.pdf	CT-02 Monthly Project Cash Flow by WBS	2/8/2013
2013-02-08- R0031- detailed	R0031 : Retube and Feeder Replacement Resources	2/2/2013
AECL Op 3 Pricing Submission Form Annulus Spacer	Option 3: Combined Inconel X-750 & Zr-Nb-Cu Tight Fitting Spacers	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
AECL Zr - R1	Zr-Nb-Cu Irradiation Program High Level Schedule and Budgetary Estimate	
AMEC NSS OSS Services- Gate 1 and 2A Deliverable List (verified - Updated)	Appendix B: Deliverable Budgetary Cost and Schedule; add'l tabs	
Appendix 01 - 509407-0000-00000-33RA-0035 OSM (Rev PB)	MATERIAL ALLOWANCE CALCULATIONS - BASED ON A SINGLE UNIT ONLY (2013)	4/12/2013
Assistance for RFR - Hours Estimate	Document list, engineering reviewers, hrs, etc	
Contractor Owner Interface Requirements RFR	NK38-PLAN-28200-10006-R000 Engineering Quality Oversight Plan for RFR Islanding Svc Annex	3/15/2013
NK38-PLAN-31160-10002_R000(22Jan2013)	Scope of Work Fuel Channel Modified Inconel X-750 Annulus Spacer	1/22/2013
NK38-PLAN-31160-10003_R000(22Jan2013)	Scope of Work Fuel Channel Zr-Nb-Cu Annulus Spacer	1/22/2013
RFR Cash Flow 2013 -R2 Current	Progress Curves - Calculations	
RPET Presentation Gate 2A Meeting 1	Execution Phase Estimate	1/23/2013
RPET Presentation Gate 2A Meeting 2	Gate 2a Project Plans	2/6/2013
RPET Presentation Gate 2A Meeting 3	Gate 2a Look Ahead	2/13/2013
Contractor Owner Interface Requirements RFR	NK38-PLAN-28200-10006-R000 Engineering Quality Oversight Plan for RFR Islanding Svc Annex	3/15/2013
NK38-DP-09701-10001 RFR Design Plan Rev. 000	Retube & Feeder Replacement Design Plan	
NK38-DP-09701-10001 RFR Design Plan	RFR Design Plan (Proj. #73100)	3/11/2013
NK38-PLAN-09701-10126 Retube and Feeder Replacement Oversight Plan Rev 01 (3)	Retube And Feeder Replacement (RFR) Project Oversight Plan	2/1/2013
NK38-PLAN-09701-10074 R002 RFR Project Mgmt. Plan	RFR Project Mgmt. Plan	2/4/2013
NK38-PLAN-09701-10126 Oversight Plan Rev 000	RFR Project Oversight Plan	2/27/2013
NK38-PLAN-09701-10148-RFR Project Controls Plan	RFR Project Controls Plan	3/1/2018
NK38-PLAN-09701-10148-RFR Project Controls Plan-3	RETUBE & FEEDER REPLACEMENT (RFR) Project Controls Plan	1/18/2013
NK38-PLAN-09701-10150-RFR Contract Management Plan	(RFR) Contract Management Plan	2/28/2013
NK38-PLAN-09701-10152 RFR Engineering Plan Rev. 000	RFR Engineering Plan	2/4/2013
NK38-PLAN-09701-10152 RFR Engineering Plan	RFR Engineering Plan	2/4/2013
PMP Rev 2	(RFR) Project Management Plan	2/4/2013
509407-0000-00000-30RM-0006 R00 Monthly Progress Report September 2012	Retube & Feeder Replmt. Proj.	Sep-12
509407-0000-00000-30RM-0008_R00 Monthly Progress Report October 2012	Retube & Feeder Replmt. Proj.	Oct-12
509407-0000-00000-30RM-0011_R01 Monthly Report January 2013 Complete	Retube & Feeder Replmt. Proj.	Jan-13
509407-0000-00000-30RM-0012_R00 Monthly Report February 2013 Complete	Retube & Feeder Replmt. Proj.	Feb-13
509407-0000-00000-30RM-0013_R00 Monthly Report March 2013	Retube & Feeder Replmt. Proj.	Mar-13
509407-0000-00000-30RM-0014_R00_Monthly Report April 2013	Retube & Feeder Replmt. Proj.	Apr-13
509407-0000-00000-30IM-0001_RPB_Project_Controls_Plan	identifies the required Project Controls systems, processes and procedures	6/15/2012
509407-0000-00000-30IM-0002 RPA - Resources Management Plan 20120515	identifies the required resource management processes utilized for the purposes of this DNGS RFR Project	5/10/2012
509407-0000-00000-30IM-0003 RPA - Scope Management 20120515	includes a change control process so it has been abbreviated as SCP – a short form for Scope and Change control Plan	5/15/2012
509407-0000-00000-30IM-0003_R02 Scope and Change Management Plan	to ensure there is a controlled work process that will document, track and manage all project changes	5/6/2013
509407-0000-00000-30IM-0005 - R00 JV Risk Management Plan	to describe risk management processes that will be implemented; shall describe the application of SLN-Aecon's corporate risk management program	8/28/2012
509407-0000-00000-30IM-0005_RPB_Risk_Management_Plan	shall describe the application of SLN-Aecon's corporate risk mgmt. program as well as OPG's risk management program(s).	6/13/2012
509407-0000-00000-30IM-0008 Proj Admin Plan RPB - 20120601	to describe SLN-Aecon's project admin practices and policies to provide systematic and practical approach for the project admin function	6/4/2012
509407-0000-00000-30IM-0012_R00 Interface Coordination Plan	will focus solely on the technical interfaces of the Project where differing scopes interface with each other during the Definition Phase	4/10/2013
509407-0000-00000-30IM-0013_R00 JV Human Performance Program	shall aim to recognize and address error-likely situations and potential challenges in task performance by establishing, promoting and reinforcing positive behaviours throughout project	3/1/2013
509407-0000-00000-32IM-0001 Schedule Management Plan -	identifies the required management systems, processes and procedures to be utilized by	4/13/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Apr 13 2012	the DNGS RFR Team	
509407-0000-00000-32IM-0001_R02 Schedule Management Plan	describes the requirements and work processes to be used as they relate to the various schedules	5/6/2013
509407-0000-00000-33IM-0001 RFR - Estimate Plan - Apr 13 2012	to prescribe the processes and the basis of Estimate and requirements for production of the Execution Phase Estimate	4/13/2012
509407-0000-00000-33RA-0035 Apr-23-13_Rev PB JV RFR CL 4 Cost Estimate OSM	TMOD material, supports, hardware, feeder vision system, and miscellaneous items.	5/15/2013
509407-0000-00000-33RA-0035 Apr-23-13_Rev PB	CL-4 Cost Estimate - Owner Specified Materials (OSM)	5/15/2013
509407-0000-00000-34IM-0001_R00_JV Cst_Mgmt_Pln	This Cost Management Plan (CMP) is a component of the Project Controls Plan (PCP). It identifies the required management systems, processes and procedures to be utilized	6/12/2012
509407-0000-00000-40EP-0001 R00 - Engineering Plan	Provide a description of eng. work; how work will be organized; applicable procedures & processes to be used	8/23/2012
509407-0004-00000-60IM-0001_R00 - D1341 Walkdown Plan - 08FEB13 – MASTER	RFR team will perform a series of walkdowns to perform inspections, take measurements and photos to support plant modifications engineering and tooling design	2/7/2013
509407-30CC-I-0224-Letter-Submission of Schedule Management Plan R02	correspondence referring to SMP, Retube & Feeder Replacement	5/27/2013
Appendix 02 - 509407-30CC-I-0109-Intermediate Level Waste Assessment	revised estimate: intermediate level waste components and key assumptions	10/12/2012
JV Project Controls Plan	509407-0000-00000-30IM-0001; Rev 01	5/6/2013
JV Project Management Plan	509407-0000-00000-30IM-0006; Rev 01	8/10/2012
OPG Org Strategy Study Plan _Rev 2a	Faithful & Gould report	Sep-10
Transmittal Milestone and Submittal Schedule 10Agu2012	Milestone schedules/database attached	8/10/2012
OverallRemainingWork2013-05-30 Part1	RFR Team - Retube & Feeder Replacement	5/30/2013
OverallRemainingWork2013-05-30Part2	RFR Team - Retube & Feeder Replacement	5/30/2013
OverallRemainingWork2013-05-30Part3	RFR Team - Retube & Feeder Replacement	5/30/2013
ALSTOM AGREEMENT	ENGINEERING SERVICES AND EQUIPMENT SUPPLY AGREEMENT	3/27/2013
RFR Agreement		3/2012
TG Project - Integration Update - July 4, 2013 v1	TG Project Update (pdf of ppt)	7/4/2013
Turbine Risk Register	Scanned doc - Nuclear Refurb - Turbine Generator	4/3/2013
1 -Table of Contents		3/19/2013
2-Title Page		3/19/2013
3 -Memo - Darlington Refurbishment Turbine Generator Project - Single Source Justification Approval Request	Memo	3/19/2013
4 -Darlington Generator Equipment Single Source Justification	Report, March 18, 2013	3/19/2013
Exhibit 1	Description of Item and/or Service: Darlington Refurbishment Turbine Generator Project Engineering Services and Equipment Supply	3/19/2013
Exhibit 2	Major Contract Memorandum	3/19/2013
Exhibit 3	Contracting Strategy Summary For Turbine Generators (8/24/11)	3/19/2013
Exhibit 4	Turbine Generator Refurbishment Project Alternate Contracting Plan (11/9/12)	3/19/2013
Exhibit 5 - Worley Parsons Burns and Rowe Technical Evaluation Report	Turbine Generator ("TG") Project Independent 3rd Party Technical Scope Evaluation and Validation	3/19/2013
Exhibit 6 - Design Basis Documentation Gap Analysis	Design Basis Documentation Gap Analysis	3/19/2013
Exhibit 7 - Design Basis Documentation Estimate	Design Basis Documentation Estimate	3/19/2013
Exhibit 8 - D.C. Cook OPEX	D.C. Cook OPEX	3/19/2013
Exhibit 9 - Faithful and Gould Class 5 Estimate	Independent Estimate for Fixed Priced Contract	3/19/2013
Exhibit 10 - Pricing Team Evaluation	Pricing Team Evaluation	3/19/2013
Exhibit 11 - Alstom Benchmarking Presentation		3/19/2013
Exhibit 12 - OPG Benchmarking		3/19/2013
Exhibit 13 - Technical Team Evaluation		3/19/2013
Faithful and Gould Proponent Information Form revB	PROONENT INFORMATION FORM REQUEST FOR PROPOSALS	7/21/2010
Faithful and Gould Risk Program Gap Analysis	Risk Mgmt. Best Practice	Jul-11
Memo to CPO March 2013 rev 3	Single Source Justification approval request (3/10/13)	3/19/2013
NGD Refurbishment Contracting Report_Final	Plant Life Extension Project (PLEP) - Phase II & III Contracting Strategy Analysis	10/6/2006
Summary Memo rev 2	Single Source Justification Summary (3/10/13)	3/19/2013
Gate 2a Presentation to GRB April 2013 [19-Apr-13 revision]	Presenter: Todd Josifovski	Apr-13
TG G2 GPF 19-Apr-13	Turbine Generators	
Gate 2a Presentation to GRB April 2013	Presenter: Todd Josifovski	Apr-13

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
TG G2 GPF	Turbine Generators	
TG Project Staffing Plan Rev 6	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan, etc.	3/11/2013
TG Project Staffing Plan Rev 6b	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan, etc.	3/11/2013
TG Project Staffing Plan Rev 2	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan, etc.	3/11/2013
TG Project Staffing Plan Rev 3 (with Gate Plan and Interest)	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan, etc.	3/11/2013
TG Project Staffing Plan Rev 4	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan	3/11/2013
TG Project Staffing Plan Rev 5 Elisabeth's Version r	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan	3/11/2013
TG Project Staffing Plan Rev 5	TURBINE GENERATORS FUNDING; 2013-2025 Resource Plan	3/11/2013
NK38-PLAN-41000-10001-R000	Turbine Generator (T-G) Project Management Plan	3/12/2013
Attachment to TG11	Technical Evaluation Report	9/21/2012
Condenser Reconfiguration AIDA109 or TG07	Decision Record & Analysis Sum. Form; Condenser Tube Reconfiguration for MW Output Increase	
DRAS TG09 TS0760-43 Remove from scope	Turbine Generator Project - Steam Turbines and Turbine Auxiliaries: Gas Cooling DSR to be removed from scope	
DRAS TG10 SI0300-16 19 remove from scope	Turbine Generator Project Strategic Outage Improvements DSRs to be removed from scope	
DRAS TG11 Final	Turbine Generator Sustaining DSRs	
Generator Aux Improvement AIDA216 or TG04	Turbine Gen. Proj. #73255	
Generator Core Replacement and Rewind AIDA218 or TG06	Gen. Core Replacement & Rewind	
Moisture Separator Reheater Improvement AIDA214 or TG02	DSR TS0680-13; Moisture Separator Reheater Improvement Initiative	
Stator Cooling Water Skid Replacement AIDA217 or TG05	Stator Cooling Water skid Replacement DSR #TS0760-25	
Stop Valve Seating AIDA213	Stop Valve Revised Seating Angle	
TCV, PRV FRF DRAS AIDA215 TG03	DSR Ts0750-28, SI10270-1, TS0750-34; elimination of the lube Oil TCV, etc	
TG List of DRASs		
2012 01 04 TG Estimate (1.01) 300113	Turbine Generator Independent Estimate	1/30/2013
BOEfxed	TG Independent Estimate for Fixed Cost Contract	1/30/2013
Estimate for Fxed	Confirmation of Faithful-Gould completed estimate	1/30/2013
NOC Data 8th Draft	DSR Database; includes Alstom data	
NOC Data TJ IW March 6th 2013	TG Scope elements	
20130402_TG_Level0 and Level1	Refurbishment Program Coordination & Control Schedule	
Contractors proposed schedule	Gate Review Level 1	2/28/2013
P6 milestones	Classic schedule layout	1/29/2013
TGContractScheduleandDefinitions_Feb 20 2013	Turbine Generator Gate 2A milestones	2/28/2013
Level 3 april22013	TG Equipment Supplier Vendor (ESV) Contract Milestones & Definitions	
TG_Level 1_OPG	Gate Review Level 3	2/28/2013
TG_Level 3_OPG	Gate Review Level 1	2/28/2013
	Gate Review Level 3	2/28/2013
G2-1 Gate 2A Option Decision Making Strategy	Alternative Option Decision Making Strategy	
Assumption gaps	DNGS Turbine Generator Refurbishment	3/10/2013
Assumption layup	Turbine Generator #73255	
Assumption prereqs	Key Assumptions Identification Form	2/27/2013
Assumption RFP	Turbine Generator #73255	
Key Assumption 229	Key Assumptions Identification Form	
Output 5 - 2 percent design completion	Initiation Phase Output #5: ~2% of Design Complete	
PDRI-2 TG Letter	Turbine-Generator Project, PDRI-2 Results	2/27/2013
PDRI-2 TG Mar-14-2013 R1	Turbine Generator Project	3/19/2013
Long lead items	Turbine Generator Gate 2A (one page)	3/14/2013
73802 Water and Sewer FULL BCS 3Apr2013	Executive Summary & Recommendations	
Execution Full Release GRB Presentation 73802 Water and Sewer[1]	Darlington Water & Sewer Project	
W and S G3 GPF[1]	Gate 3 Presentation	4/8/2013
Processes and Procedures re Cost and Schedule	Darlington Water and Sewer	
RFR Project Controls Requirements	Project Controls	5/9/2013
AACE Rec Prac 37R-06 Schedule Levels of Detail	Exhibit 2.9(j) - Project Controls	
	applied to eng., procurement & constr.	3/20/2010

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
AACE Rec Prac 38R-06 Documenting the Schedule Basis	7.2 Sched Planning & Development	6/18/2009
AACE Rec Prac 40R-08 Contingency Estimating -- General Principles	7.6 Risk Mgmt.	6/25/2008
AACE Rec Prac 41R-08 Risk Analysis and Contingency Determination	7.6 Risk Mgmt.	10/27/2008
5 DN Refurb_Release 4b Cost Summary	Program & Annual Cash Flow Sum. > Proj. Bundles/Work Pkgs.	
Appendix 1 Repair vs. Replace Cost Analysis	DSR Repair vs. Replace	
Determining P50 Contingency for a Target Price Contract	a proposal of the methodology to determine a 50% confidence level contingency for a Target Price Contract	11/30/2012
Engineering Cost Breakdown Structure - 2-1-13	Scanned Organizational chart	
Engineering WBS - 2-1-13	Scanned Organizational chart > Nuclear Refurb. Eng. WBS	
Funding Analysis - 3-7-13	Eng. Proj. Director - RC 1066, 2077, 2073	3/7/2013
NK38-CORR-09701-046500 Non-Core Scope Valve Cost Benefit Analysis	Non-core Scope Valve cost benefit analysis	3/28/2013
N-MAN-00120-10001 Cost and Schedule Change Control Instruction		7/31/2012
N-MAN-00120-10001 Nuclear Projects Cost Estimating		11/30/2012
N-MAN-00120-10001 Nuclear Refurbishment Cost Estimate		7/25/2012
N-MAN-00120-10001 Risk-05 Contingency Development and Management Guide	hand written notes on doc	6/30/2013
NR Program Cost and Cashflow 2011 E2 R13 (GHR) Sep 28 2011	R&FR Data Summary	9/28/2011
NR Program Cost and Cashflow Estimate File for 4b	2013-2015 Business Plan Listing - Project Life Cycle Costs (K\$)	9/14/2012
Proposal for Determining P50 Contingency for Target Cost Contract	proposal of the methodology to determine a 50% confidence level contingency for a Target Price Contract at Nuclear Refurbishment	11/30/2012
RFR Roadmap	Cost Variance Roadmap; RFR used as an example	6/27/2013
Strategic Direction for Nuclear Refurbishment Contingency Development and Management	Basis of Strategy, Classification, Accountability, Development & Monitoring	12/5/2012
Summary of Cost Estimate - Feasibility Asmt - Board Nov 2009_R03	Initiatives, Cost Estimate and Cash Flow	
Summary of Cost Estimate - Feasibility Asmt - Board Nov 2009_R04	DN Refurbishment Feasibility Cost Assessment	Nov-09
Target Cost Contracts Presentation 31 Mar 11	PDF ppt - Target Cost Contracts presentation	3/31/2011
4b Estimate p2	Tabs = Rev. Status, ISR Analysis, Syst. Layout, EPW & Passport Issues	7/22/2013
4b Estimate P3	<b>NOTE:</b> Password Protected; Tabs = ISR, 4b, Campus Plan, ISR Mods, ISR Programmatic & ISR TRF	7/22/2013
Estimate Analysis 4b vs. 3 April 2013	DNGS Refurbishment Estimate Analysis	4/25/2013
NR Program Cost and Cashflow 2011 E2 R13 (GHR) Sep 28 2011	R&FR Data Summary	9/28/2011
NR Program Cost and Cashflow Estimate File for 4b	Program and Annual Cash Flow Summary - Release 4b	10/9/2012
Summary of Cost Estimate - Feasibility Asmt - Board Nov 2009_R03	Cost Estimate High Level Summary, Rev 1.1.03 Cost Estimate High Level Summary, Rev 10 (Including Contingency)	
Summary of Cost Estimate - Feasibility Asmt - Board Nov 2009_R04	DN Refurbishment Feasibility Cost Assessment - Board - November 2009 (Rev 1.1.04)	11/1/2009
4b Dataset	Revised DSR Based Estimate > multiple entries for DSR TS0010-4	
DSR Estimates by BoE	Tabs: Passport Issues, Summary, RFR G1, FHG1, ETC. (Jacob Mills)	3/26/2013
Estimating Baseline Schedule 2013		Jan-13
Status Report	Tabs: Status, DSR Database 03282013, Passport Issues, BoE DSRs, ETC. (Jacob Mills)	3/28/2013
Example BoE	example only	
Example Estimate	example only	
Example Factored Rate + Indirect Costs	example only	
Campus Plan Status Report	Tabs: Status, DSR Summary, 4b Data, ETC.	4/2/2013
Campus Plan Estimate validation Report (1)	Parking Constr. Estimate Validation	3/1/2011
Campus Plan Estimate	Tabs: DSR Summary, 4b Data, 2013BP Life Cycle Costs, DSR Database	
N-REP-00120-0373568	Memo fr/ Gary Rose (Campus Plan Est. Validation Rpt. attached)	3/3/2011
RFR BoE	Execution Conceptual Independent Class 5 Summary Basis of Estimate	1/27/2012
RFR DSR Cost Estimate	R&FR Bundle	
4B Data Summary	Tabs: Summary, 4b Data Summary, ETC.	3/7/2013
LISS Nozzle replacement assessment R-01	Retube & Feeder Replacement Study	



DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
RE DEC CCO Matrix Listing costing and overview drawing		
NK38 SOW 31100 10016 RFR SOW	Retube & Feeder Replacement Scope of Work	1/4/2012
TS0010-3	Est. Sum: LISS Nozzle Replacement Unit 1, 2, 3 & 4	7/8/2011
TS0010-5	Est. Sum: Contingency: Headers Replacement for Unit 1, 2, 3 & 4	7/7/2011
TS0100-6	Est. Sum: Extend Inspection of Pressurizers	8/21/2011
TS0100-7	Est. Sum: Clean Sludge Deposits from Pressurizer	8/21/2011
TS0100-8	Est. Sum: Repair/replace bleed cooler	8/21/2011
TS0100-9	Est. Sum: Replacement of Pipe Sections for 33310-L62, L37 and 33320	8/21/2011
TS0220-4	Est. Sum: Review the Phase 1 Outputs of COG Project on Calandria Vessels	8/5/2011
TS0240-1	Est. Sum: Replace all sections of the high instruments lines	8/8/2011
TS0260-2	Est. Sum: Replace SDS2 Orifice Flow Element	8/9/2011
TS0260-5	Est. Sum: Recommended Actions of SDS2 Instrument tubing	8/10/2011
TS0770-1	Est. Sum: ECI Pressure Breakdown Flow Elements	8/12/2011
TS1310-1	Est. Sum: Investigate the Benefit and Risks of Chromium Plating	8/21/2011
TS1310-2	Est. Sum: Modification of Plate end fittings	8/21/2011
TS1310-5	Est. Sum: Modification of Garter Springs	8/21/2011
RFR Tooling BOE FPage	Tooling Project Chosen Lead Proponent Tooling Fixed Price Cost	1/19/2012
RFR Mock-up BOE FPage	Darlington Energy Complex Chosen Lead Proponent Mock-up Fixed Price Cost	1/24/2012
RFR OSM BOE FPage	OSM Conceptual Cost Summary	1/24/2012
RFR Independent Class 5 Estimate BOE FPage	Execution Conceptual Independent Class 5 Estimate w/ Lead Proponent Fee	1/25/2012
RFR Class 5 Summary BOE FPage	Execution Conceptual Independent Class 5 Summary Basis of Estimate	1/27/2012
Visio-RFR_March20 WBS	WBS Rev 0 - Organizational Chart	3/21/2013
RFR Class4 Estimating Kick-off	Email - From: James Laudanski; material for Kick-off mtg.	1/22/2013
OPG RFR 7March2013-Est	Mtg. Minutes: RFR CL-4 Estimate Meeting #2	3/19/2013
OPG RFR 14March2013-Est	Mtg. Minutes: RFR CL-4 Estimate Meeting #3	3/14/2013
OPG RFR 28March2013-Est	Mtg. Minutes: RFR CL-4 Estimate Meeting #4	3/28/2013
Send RFR DSR with comments Dec. 19, 2011 cost Rev. 1		12/19/2011
UI Prereq Mods BOE Review	Email w/ NR Islanding Project Basis of Est. Prerequisite Modifications doc. attached	2/14/2012
Plot Plan Unit 2 Elev. 100	Dwg: RB, RAB, Turbine AB Turbine Hall	
NK38-SOW-09701-10005 R000 FINAL	Outage Unit Containment Isolations	10/18/2011
Seal Plate	Reactor Bldg. Structure; Calandria Seal; Installation Details; Misc. Steel	
TS0810 1 Install remove Shielding for the Bulkhead	Est. Sum: Install & Remove Shielding for the Bulkhead	2/6/2012
TS0810 1 Install Remove Temp Hor. Bulkheads	Est. Sum: Install & Remove Horizontal bulkheads	2/3/2012
TS0810 1 Install Remove Temp Supports for Hor. Bulkheads	Est. Sum: Install & Remove temporary Supports for hor. Bulkheads	2/2/2012
TS0810 1 Install Seal Plate	Est. Sum: Install Seal Plates	2/3/2012
TS0810 1 Remove install Catenary Deflector	Est. Sum: Remove & install Catenary Deflector	2/2/2012
TS0810 1 Remove Reinstall Plugs for the Bulkhead drain holes	Est. Sum: Install & Remove Plugs for the Bulkhead drain holes	2/6/2012
TS0810 1 Repair Vertical Bulkheads	Est. Sum: Repair Vertical Bulkheads	2/2/2012
TS0810 1 Turnover Closeout	Est. Sum: Turnover/Closeout	2/15/2012
Lessons Learned from D2O Storage 2-13	MODIFICATION PLANNING LESSONS LEARNED REPORT	2/27/2013
NK38-REF-03810-0405549 Need Stmt.-Heavy Water Mgmt.	Need Stmt.: Heavy Water Mgmt.	10/3/2011
NK38-REF-34200-0405550 Need Stmt-Neg Pressure Containmt	Need Stmt.: Neg. Pressure Containment	10/3/2011
NPC Cost Estimating Approximations_R01.docx	Email - NPC Cost Estimating Approximations -attachment	2/13/2012
UI D2O NPC cost estimating approximations	Email - 2 attachments: D2O Cost Estimating Approximations; NPC Cost Estimating Approx.	1/30/2012
Air Lock Seal Drawings	Drawings	
Airlock Seals CATID Price	Screen prints of Master Materials Catalog	
NK38-REF-34200-0405550 Need Stmt-Neg Pressure Containmt	Need Stmt.: Neg. Pressure Containment	10/3/2011
Signed BOE for Barriers FPage	NR Islanding Proj - Basis of Est. Barriers	2/29/2012
Pre-req. DSR Estimates	Est. Sum: U2-Containment Safety Monitoring - Common Containment Pressure	1/27/2012
Signed BOE for Bulkheads FPage	NR Islanding Proj - Basis of Est. Containment Bulkhead	3/8/2012
Signed UI BOE - Summary Front Page	NR Islanding Proj - Gate 1 Summary Basis of Est	4/3/2012
SHD 4b Comparison	Tabs: DSR Database, 4b Data Sum, Shutdown Est, ETC.	3/7/2013
Moderator-PHT BOE	NR RFR - Moderator Auxiliary, PHT & Auxiliary Layup Project - Gate 2 Basis of Estimate	3/1/2013
Moderator-PHT Estimate	Tabs: Ts0890-2; Ts0890-1; Summary	
RE Planning Basis	Email - Fr: Audrey Razo; To: Nicole Zhang	2/22/2013
Re Request for Your Feedback - Roles and Responsibilities	Email - Fr: Lonnie Schofield; To: Ron Chatterton	3/21/2013
PM Signed SG Estimate Summary	SG Bundle - DSR Line Estimate_Scope List as of 8/31/11	9/1/2011
SG BOE-signed with type of doc. changed	Steam Generator Basis of Estimate	11/11/2011

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Signed SG BOE	Steam Generator Basis of Estimate	11/11/2011
FH-Defueling BOE	Darlington – Fuel Handling Refurbishment – Defueling Basis Of Estimate	1/17/2013
FH-Defueling Estimate	FH-DEFUELING DSR COST	
Final Draft Defueling SOW Oct232012	Scope Of Work: Reactor Defueling	10/23/2012
Signed BOE for FH - Defueling FPage	Darlington-Fuel Handling-Refurb-Defueling Basis of Estimate	1/17/2013
FH Refurbishment BOE	Fuel Handling (FH) Basis Of Estimate	12/28/2012
FH Refurbishment Estimate	FH-REFURBISHMENT BUNDLE	
FH Refurbishment Factors Rates and Costs	Hourly Rate Calculation: 10 Hrs / Shift, 2 Shifts (Appendix B, 7 day Coverage); add'l tabs	
Updated DSR fr Sunil May 24, 2012	TSO Approved Scope	
Cable Estimates	Email - attachment, Trolley Cable estimate Rev 00; Fr: Raihan Khondker/ To: Juan Natividad	6/28/2012
Fuel Handling Mtce Jan 292007	Chart	1/29/2007
List of all cables in the trolley	Email - attachments, List of all Trolley Cables & Trolley Cable estimate Rev 00; Fr: R.Khondker/ To: J.Natividad	6/26/2012
Trolley Cable Estimate	Email - attachments, Trolley Cable Qty estimate & Trolley Cable Manhours Est; Fr: R.Khondker/ To: J.Natividad	6/27/2012
DRAS Comparison	Fuel Handling; add'l tabs	
Work Breakdown Structure	breakdown	
Signed BOE FH-Refurbishment FPage	Basis of Estimate	12/28/2012
FH Defueling Work Packages WBS Layout		
FH - Defueling WBS and Work Package Details	Email - attachment, FH Defueling Work Packages; Fr: Sunil Ingle/ To: J.Natividad	4/3/2013
BoE BOP Common	“Common ” Sub Project Basis Of Estimate	11/28/2012
BOP Common Estimate	Tabs: DSR Sum., Overall Sum., ETC.	
01-NK38-FEX-20100-2501-01	Reactor Bldg.	
02-NK38-FEX-20100-2502-04	T.H.R.A.B. & Turbine	
03-NK38-FEX-20100-2502-04	T.H.R.A.B. & Turbine	
04-NK38-FEX-20100-2503-06	R.B., R.A.B., Turbine	
05-NK38-FEX-20100-2503-06	R.B., R.A.B., Turbine	
06-NK38-FEX-20100-2504-01	Reactor Bldg	
07-NK38-FEX-20100-2505-02	R.B., R.A.B., Turbine	
08-NK38-FEX-20100-2505-02	R.B., R.A.B., Turbine	
09-NK38-FEX-20100-2506-02	Reactor Bldg & R.A.B.	
10-NK38-FEX-20100-2507-04	R.B., R.A.B., Turbine	
11-NK38-FEX-20100-2507-04	R.B., R.A.B., Turbine	
12-NK38-FEX-20100-2508-00	R.B., R.A.B., Turbine Aux. Bay	
13-NK38-FEX-20100-2509-00	R.B., R.A.B., Turbine Aux. Bay	
14-NK38-FEX-20100-2510-02	Reactor Bldg & R.A.B.	
16-NK38-FEX-20102-0503-00	Equipment Layout	
18-NK38-FEX-20102-0505-00	Equipment Layout	
19-NK38-FEX-20102-0506-00	Equipment Layout	
20-NK38-FEX-20102-0507-00	Equipment Layout	
22-NK38-FEX-20102-0509-00	Equipment Layout	
23-NK38-FEX-20102-0510-00	Equipment Layout	
24-NK38-FEX-20102-0501-02	Site Building Layout	
25-NK38-FEX-20102-0501-02	Site Building Layout	
27-NK38-FEX-20102-2507-01	Equipment Layout	
28-NK38-FEX-20102-2513-00	Equipment Layout Unit Pumphouse	
29-NK38-FEX-20102-0512-00	Equipment Layout Standby Generator	
30-NK38-FEX-20102-0513-00	Equipment Layout Standby Generator	
CBA ASW Pressure Regulating Valve	DSR Number SI0270-3, ASW Pressure Regulating Valve	9/13/2012
DSR_SI0270-3	Gate Review Form	5/5/2011
Email Recom_11.01.2012	Email - OPG Acceptance of Balance of Plant Scope Feasibility Studies Report; Fr: G.Mills/ To: L.Crisologo	11/1/2012
NK38-F0H-72500-0002_FLOWD_DWG	Ctrl. Svc. Area Aux. Svc. Water Syst. Flow Diagram	
Pipe Price_passport	Screen prints of Master Materials Catalog	
DSR_TS0150-2	Inspect civil structure of Emergency Coolant Injection Storage Tank	1/26/2011
DSR_TS0150-8	CCA 001441 Contingency - ECI Water Storage Tank	1/26/2011
IWST Construction 1	photograph	
IWST Construction 2	photograph	
IWST Construction 3	photograph	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
IWST Construction 4	photograph	
TS0150-2	ECI Water Storage Tank	
CCA001600	Aging Management Program Component Condition Assessment (CCA) Equipment Room Sump(SUO-RIS)	
NK38-REP-0368-10078	Ageing And Actual Condition Of Systems, Structures And Components Safety Factor Report	10/14/2011
CCA000366	Aging Management Program Component Condition Assessment (CCA) MVC Recirculation pump	
DSR_TS0210-15	Negative Pressure Containment: Rebuild or Replace All 3 Pumps (Contingency)	3/2/2011
NK38-D2H-34222-9026_Vacuum Pumps GA Drwg	vacuum pumps	
NK38-DM-34220	Service Manual - Main Vacuum Pumps	
NK38-DM-34220_Vac System Manual	Vacuum Syst. Manual	
NK38-RH-34222_Main Vac Pumps Manual	Vacuum Syst. Manual	
34220 - P 1-3 vacuum pmp	photograph	
DSR_TS0210-17	Negative Pressure Containment: Replace NPC Vacuum System TK 1-4 (Contingency)	3/2/2011
NK38-D2H-34222-9024_TK4 Drwg	Vertical Tank	
NK38-D2H-34222-9025_TK1-3 Drwg	Horizontal Separator Tanks	
NK38-D2H-34222-9026_Vacuum Pumps GA Drwg		
NK38-F5H-34220-0001_Vacuum Flow Diag		
NK38-FXX-34220-0501_NPC Vacuum Sys		
NK38-WAH-34222-9041_NPC Drwg		
CCA000076	Aging Management Program Component Condition Assessment (CCA) Reactor Building Structure	
NK38-PIP-21100-10001	Reactor Building Non-Containment Components Periodic Inspection Program	4/16/2012
NK38-SR-03500-10001	Darlington Safety Report, Part 1 & 2	12/19/2010
CCA000077	Reactor Building Internal Structure	
NK38-PIP-21200-10001	Reactor Building Internal Structure Periodic Inspection Program	3/29/2012
CCA000083	Central Service Area - Nuclear	
NK38-PIP-22600-10001	Central Control Area Periodic Inspection Program	4/29/2012
NK38-PIP-24100-10001	Turbine Support Structure Periodic Inspection Program	6/8/2012
NK38-FEX-27103-1501-00	C.W. & S.W. Pumphouse 1	
NK38-PIP-27110-10001	Circulating Water Pump House Periodic Inspection Program	5/7/2012
Book3	2009 conversion USD - CAD; Equip. - Carried to Summary	
2004 Underwater Inspection Report	Final Report - Underwater Inspection of Circulating Water Intake Tunnel, Intake Structure & Intake shaft	
DSR_TS0510-7_CCA000092	Component Condition Assessment - Pipes, Ducts & Encasements	
DSR_TS0510-17	DNGS Structures: Perform Inspections on Pipes, Ducts Encasements Structures	4/13/2011
NK38-FEX-20102-0516-00	Equipment Layout - EPS Electr. Bldg.	
NK38-FEX-20102-0517-00	Equipment Layout - EPS Electr. Bldg.	
NK38-FEX-20102-0518-00	ESW Pumphouse	
NK38-FEX-20102-0519-01	ESW Pumphouse	
NK38-FEX-78400-0502-03	EPS Fuel Mgmt. Bldg.	
NK38-PIP-28300-10001	Emergency Power Supply And Emergency Service Water Complex Periodic Inspection Program	
NK38-PIP-22200-10001	Turbine Hall and Turbine Auxiliary Bay Periodic Inspection Program	3/29/2012
CCA000085	Component Condition Assessment (CCA) Central Service Area - Conventional Part	
NK38-PIP-22400-10001	Central Service Area -Conventional Periodic Inspection Program	4/17/2012
CCA000085	Aging Management Program Component Condition Assessment (CCA) Central Service Area - Conventional Part	
NK38-PIP-22400-10001	Central Service Area -Conventional Periodic Inspection Program	4/17/2012
CCA000078	Component Condition Assessment (CCA) Reactor Auxiliary Bay including structural and architectural elements	
NK38-PIP-21300-10001	Reactor Auxiliary Bay Periodic Inspection Program	3/20/2012
CCA000079	Component Condition Assessment (CCA) FFAA - West & East	
NK38-FEX-21400-0501-02	Fueling Facilities Aux. Area West	
NK38-FEX-21400-0502-01	Fueling Facilities Aux. Area West	
NK38-FEX-21400-0503-02	Fueling Facilities Aux. Area West	



DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
NK38-FEX-21400-0504-05	Fueling Facilities Aux. Area West	
NK38-FEX-21400-0505-02	Fueling Facilities Aux. Area West	
NK38-FEX-21400-0506-01	Fueling Facilities Aux. Area	
NK38-FEX-21400-0507-01	Fueling Facilities Aux. Area West	
NK38-PIP-21400-10001	Fuelling Facilities Auxiliary Area Periodic Inspection Program	
NK38-PIP-21500-10001	Irradiated Fuel Area (West and East) Periodic Inspection Program	
CCA000081	Component Condition Assessment (CCA) Fuel Handling & Service Area	
NK38-PIP-21600-10001	Fuel Handling and Service Area (West and East)Reception Bay Periodic Inspection Program	
CCA000077	Component Condition Assessment (CCA) Reactor Building Internal Structure	
CCA000083	Component Condition Assessment (CCA) Central Service Area - Nuclear	
NK38-PIP-24100-10001	Turbine Support Structure Periodic Inspection Program	
CCA000090	Component Condition Assessment (CCA) Pumphouse	
DSR_TS0510-23	DNGS Structures: Repair/Replacement of Pipes, Ducts, and Encasements (Contingency)	4/13/2011
nk38_bom_27117	Removal of Submerged Injection Piping in UI Pumphouse	
nk38_d5h_27121_1001_intake tunnel	CW Syst. Structures Intake Tunnel	
nk38_d5h_27141_2003_intake pipe	Pumphouse to Powerhouse Intake Pipes	
nk38_d5h_27141_5001-u2_intake pipe misc	Pumphouse to Powerhouse Intake Pipes & Manifold	
nk38_d5h_27141_pipe earth excav	Pumphouse to Powerhouse Concrete Press Pipe	
nk38_draw_27113_pipe sleeve	CW Pumphouse No. 2 Pipe Sleeve	
nk38_draw_27117_10001_injection piping	CW Syst. Structures, CW Pumphouse, Chlorine Injection Piping Support	
nk38_draw_27117_injection piping	CW Syst. Structures, CW Pumphouse, Chlorine Injection Piping Support	
nk38-rep-27124-10001_Underwater_inspection	Final Report - Underwater Inspection of Circulating Water Intake Tunnel, Intake Structure & Intake shaft	
CCA000084	Component Condition Assessment (CCA) Turbine Hall & Turbine Auxiliary Bay civil/structural elements	
CCA000469	Component Condition Assessment (CCA) Fire Protection Panel (Conventional)	
CP—35	Siemens CP-35 System 3 <sup>TM</sup> Control Panel	
NK38-FEX-67861-0501-04	Inactive Chem. Waste Transfer Facility Fire Panel	
NK38-FEX-67870-0501-11	Fire & Smoke Detection Syst. Panels	
NK38-FEX-67870-0505-05	Domestic Waste Water Pumphouse	
NK38-FEX-67870-0507-02	Fire & Smoke Detection Syst. Panels	
NK38-FEX-78400-0501-01	CO2 Fire Protection	
NK38-FEX--78400-0502-03	CO2 Fire Protection	
NK38-FEX-78400-0503-02	CO2 Fire Protection	
NK38-FEX-78400-0504-02	CO2 Fire Protection	
NK38-FEX-78610-0501-02	Inactive Chem. Waste Transfer Facility Fixed	
Ansul_Bladder Tank Sight Gauge	Bladder Tank Sight Gauge; Hydraulic Concentrate Control Valve	
Ansul_Bladder_Specs	Vertical & Horizontal Bladder Tanks	
Ansul_Drawings_Specs	Typical Bladder Tank Syst. Piping Requirements	
ANSUL_Email_Prices	Email - OPG CID 187668; Fr: Robert Whiting/ To: Liza Crisologo	11/19/2012
Bladder tank drawing	Drawing	
CCA 000707	Component Condition Assessment (CCA) Foam Concentrate Tank	
DSR_TS0660-2	Fire Protection System: Replace Diaphragm of the Foam Concentrate Tanks	4/13/2011
Email_Ansul Quote	Email - OPG CID 187668; Fr: Yatin Nayak/ To: G. Mills	10/3/2012
Existing Diaphragm drawing	drawing	
Flow Diagram	Standby Generators, Oil Tanks Foam Fire Protection System	
Flowsheet	Air Form Fire Protection	
Foam Fire Protection Piping	Standby Generator Fuel Mgmt. Bldgs. #1 & #2	
FW bladder tanks	Email - attachments, Vertical Bladder Tank, Bladder Replacement vertical, picture	
FW OPG CID 187668	Email - attachments, Vertical & Horizontal Bladder Tanks svc. Manual/specs & drawing	
RE BOP-CS DSR TS0660-2 - Replace Diaphragm of the Foam Concentrate Tanks	Email - attachment, CHUBB Fire Security Installation, Operation & Maint. Manual	
NK38-D1H-24900-9021	Ground Floor Plans	
Appendix C_Productivity Factors (1)	Tabs: Rubber Day/Night 10, Zone 1/2	
Appendix D_Height factor	Appendix D: Height Factors	
Appendix E_Crew Rates_Factors	Tabs: shifts for Pipefitters, Boilers, and Electr.	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Appendix F_ Indirect cost	Tabs: Auditing, Site ofc., Summary, BOE	
Appendix A_ CS Summary	CS System DSR Line Estimate _ Scope List - as of Nov 6, 2012 (In \$K) / Provided from database; several tabs included	
Appendix A_ Estimate Summary_ 11 28 2012	CS System DSR Line Estimate _ Scope List - as of Nov 6, 2012 (In \$K) / Provided from database	
Appendix A_ System_ Summary	Tabs: FIRE PROTECTION-SUMMARY, NPC REPAIRS-SUMMARY, MCR HVAC UPGRADES - SUMMARY, STRUCTURES -SUMMARY	
Appendix B_ Project Breakdown of DSR	The 38 Darlington Scope Review (DSRs) items approved by the SRB (and pending approval as noted) for the CS Systems Sub-Bundle	
Appendix C_ Productivity Factors	Appendix- C: Productivity Factors	
Appendix D_ Height factor	Appendix D: Height Factors	
Appendix E_ Crew Rates_ Factors	Appendix-E: Crew Rates	
Appendix F_ Eng Assessment and Mods	APPENDIX F- Assessment Engineering and Modification Works; add'l tabs	
Appendix F_ Indirect cost	Appendix -F: Indirect Cost; add'l tabs	
Appendix G_ RFI -List-Common Systems.docx	Appendix G: RFIs, Emails & references; emails, status reports, etc. included in file	
Appendix H_ Detailed Estimates	CS System DSR Line Estimate _ Scope List - as of Nov 6, 2012 (In \$K) / Provided from database; add'l tabs	
BOP CS BOE R000_ 11 28 2012	Darlington Refurbishment Balance of Plant (BOP) "Common " Sub Project Basis Of Estimate	
BOP_ CS_ Index	BOP Common Systems Sub-bundle	
BOP Conventional BoE	Darlington Refurbishment Balance of Plant (BOP) "Conventional " Sub Project Basis Of Estimate	
BOP Conventional Estimate	Tabs: DSRs List, BOP_ TS (Summary), individual DSR tabs	
Answer for RFI 019	Request for Info: BOP - Conventional Sub-Bundle	9/11/2012
Conventional system_ RFI 009_ 08 29 2012	Clarify the cost arrangement	8/29/2012
Conventional system_ RFI 010_ 08 29 2012_	Clarify the scope, DSR - TS 0530 -1, DSR - TS 0530-3 ( CCA-000144 related to the DSR)	8/29/2012
Conventional system_ RFI 011_ 08 30 2012	Clarify the scope, DSR - TS 0840 -3 ( CCA- related to the DSR ; Not applicable).	8/30/2012
Conventional system_ RFI 013_ 09 04 2012	Clarify the scope, TS-0560-9, related with CCA 001732	9/4/2012
Conventional system_ RFI 014_ 09 04 2012	Clarify the scope, TS-0170-1, related with CCA 000337	9/4/2012
Conventional system_ RFI 016_ 09 06 2012	TS-0570-21, related with CCA 001296	9/6/2012
Conventional system_ RFI 018_ 09 010 2012	TS-0570-25, related with CCA 001313	9/10/2012
Conventional_ RFI012_ 30.08.2012	TS0630-7/TS0630-11	8/30/2012
Conventional_ RFI015_ 05.09.2012	SI0280-2, SI0280-3, SI0390-1, TS0590-22	9/5/2012
Conventional_ RFI017_ 07.09.2012	TS0590-22, TS0590-18, TS0610-17	9/7/2012
Conventional_ RFI019_ 11.09.2012	TS0610-17, TS0610-3, TS0610-18, TS0610-22, TS0610-3/18/22	9/11/2012
F+G RFIs_ client answer	RFI Master List; add'l tabs per RFI included	
RFI -List-Conventional	Appendix G : RFI/Reference- List	
Design Basis	documents sourced from OPG systems in support of information provided from the DSR database	
CCA 000337	Component Condition Assessment (CCA) MCCs, contactor, motor starter	
NK38-F3S-53397-0018	600V Distr., EPS Reactor Aux Bay, EPS MCC 821	
NK38-FXX-53390-1501-04	Unit, 600V EPS Distr. Syst.	
NK38-F0S-55490-0002	129V CC Distr. Syst.	
NK38-F0S-55590-0002	4 BV DC Distr. Syst.	
NK38-F0S-55590-0003	4 BV DC Distr. Syst.	
NK38-FEX-55410-0501	Common 125V DC Class 1 Pwr. Supplies	
NK38-FEX-55410-1501	Unit 1 125V DC Class 1 Pwr. Supplies	
NK38-FEX-55510-0501	Common 48V Class 1 Pwr. Supplies	
NK38-FEX-55510-0502	Common 48V Class 1 Pwr. Supplies	
NK38-FEX-55510-1501	Common 48V Class 1 Pwr. Supplies	
NK38-FEX-55510-1502	Common 48V Class 1 Pwr. Supplies	
NK38-F0S-55490-0002	128V DC Distr. Syst.	
NK38-F0S-55590-0002	48V DC Distr. Syst.; EPS Powerhouse	
NK38-F0S-55590-0003	48V DC Distr. Syst.; EPS Powerhouse	
NK38-FEX-55410-0501	Common 125V DC Class 1 Pwr. Supplies	
NK38-FEX-55410-1501	Unit 1 125V DC Class 1 Pwr. Supplies	
NK38-FEX-55510-0501	Common 48V DC Class 1 Pwr. Supplies	
NK38-FEX-55510-0502	Common 48V DC Class 1 Pwr. Supplies	
NK38-FEX-55510-1501	Common 48V Class 1 Pwr. Supplies	
NK38-FEX-55510-1502	Common 48V DC Class 1 Pwr. Supplies	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
CCA 000049	Component Condition Assessment (CCA) Distribution Bus	
NK38-CMP-53307-03-R012	KLOCKNER MOELLER SERIES 200 MOTOR CONTROL CENTRE INSPECTION AND MAINTENANCE	
NK38-D1S-53320-9012	Automatic Transfer Switch	
NK38-D1S-53320-9014	Ctrl. Panel Parallel Syst.	
NK38-D1S-53320-9016	Channels A&B 347/600V Class II	
NK38-E3S-53320-9018-SHT0004	D2O/TRF Bldg.	
WMS-Equipments list	List	8/31/2012
ABB product list	list	
CCA 000048	Component Condition Assessment (CCA) Transformers	
NK38-D1S-53320-9016	Channels A&B 347/600V Class II	
NK38-D1S-53320-9017	Channels A&B 347/600V Class II	
NK38-F0S-53520-0001-U2	120V/208V AC Class II Distr. Syst.	
NK38-F0S-53520-0002-R011	120V/208V AC Class II Distr. Syst.	
NK38-F1S-53520-0005-R007	Unit 1 Ctrl. Computer	
ABB-TX price list	Transformers	
CCA 000048	Component Condition Assessment (CCA) Transformers	
NK38-F1S-53520-0005-U2-R007	Unit 1 Ctrl. Computer	
CCA 001732	Component Condition Assessment (CCA) Transformers, 4 kV (10MVA) (oil)	
NK38-D1S-53202-9001	drawing	
NK38-D2S-53202-9005-U2	wiring diagram distr. Syst. Transformer	
NK38-FEX-53240-1501-01	Electr. Pwr. Distr. Unit 4	
CCA 001292 (1)	Component Condition Assessment (CCA) Isolated Phase Bus	
NK38-D0S-51100-0001-U2	Generator Voltage Output Syst.	
NK38-D3S-51100-0002-U2	Generator Voltage Output Syst. Isolated Phase Bus Electr. Arrng. - Isometric	
NK38-D4S-51100-9031-U2	Deionizing Grid Syst.	
NK38-F1S-51100-9012-REV 007	Isolated Phase Bus Cooling Syst. Flow Diagram	
NK38-M4S-51100-9017-SHT002	Isolated Phase Bus	5/26/1986
CCA 001301	Component Condition Assessment (CCA) Main Switch	
NK38-D1S-52120-9008-REV9	Unit Service Transformer	
NK38-D1S-52520-9014-REV13	Syst. Svc. Transformer	
NK38-D3S-51521-9006-U2	Main Output Transformer	
NK38-D3S-51521-9007-REV005	Main Output Transformer	
NK38-D5S-51521-9008-B	Main Output Transformer	
NK38-D5S-51521-9009-A	Main Output Transformer	
Passport finding- equipment location	Screen Prints of TIMD030-Equipment/Component Header	
CCA 001323	Component Condition Assessment (CCA) Switchyard Voltage Transformer	
NK38-DM-51500-R001	500 KV OUTPUT SYSTEM Design Manual	
NK38-DXS-15400-0031-R1	Proposal, Land Use & Planting Programme	
NK38-QM-51000-R055	MAIN POWER OUTPUT	11/14/2011
CCA 001292	Component Condition Assessment (CCA) Isolated Phase Bus	
NK38-CMP-51150-01-REV011	Ctrl. Maint. Procedure, Isolated Phase Bus Link Removal, Install. & Meggering, IPB Inspection & Cubicle Checks	
CCA 001296	Component Condition Assessment (CCA) Main Output Transformer	
NK38-CMP-51520-01-REV 001	Ctrl. Maint. Procedure, MAIN OUTPUT TRANSFORMER ROUTINE MAINTENANCE	
NK38-FEX-51520-2501-01	Main Output Transformer, One Phase	
CCA 001296 (1)	Component Condition Assessment (CCA) Main Output Transformer	
NK38-CMP-51520-01-REV 001	Control Maintenance Procedure MAIN OUTPUT TRANSFORMER ROUTINE MAINTENANCE	
NK38-FEX-51520-2501-01	Main Output Transformer, One Phase	
CCA 001305	Component Condition Assessment (CCA) Unit Service Transformer	
NK38-D0S-52120-0002-U2	Gen. Voltage Sta. Serv. Sup. Sys. Unit Serv. Transformer T2	
NK38-D1S-52120-9003-U2	Unit Service Transformer	
NK38-WAS-52120-9021-REV05	Westinghouse Instruction Book No. CT-289, Four 80 MVA Type OFAF Three-Phase	
CCA 001296	Component Condition Assessment (CCA) Main Output Transformer	
NK38-CMP-51520-01-REV 001	Control Maintenance Procedure MAIN OUTPUT TRANSFORMER ROUTINE	

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
	MAINTENANCE	
NK38-FEX-51520-2501-01	Main Output Transformer One Phase	
CCA 001305	Component Condition Assessment (CCA) Unit Service Transformer	
NK38-D0S-52120-0002-U2	Gen. Voltage Sta. Serv. Sup. Sys. Unit Serv. Transformer T2	
NK38-D1S-52120-9003-U2	Unit Service Transformer	
NK38-WAS-52120-9021-REV05	Westinghouse Instruction Book No. CT-289, Four 80 MVA Type OFAF Three-Phase	
NK38-D0S-52520-0002-U2	500KV Station Serv. Supply Sys. Transformer T3	
NK38-D0S-52520-0002-U2	500KV Station Serv. Supply Sys. Transformer T3	
NK38-CMP-53130-01	Control Maintenance Procedure STANDBY GENERATOR BUS MAINTENANCE	
NK38-CMP-65300-28	Control Maintenance Procedure CALIBRATION GUIDE FOR PROTECTIVE RELAYING ASSOCIATED WITH 13.8 KV SWITCHGEAR ASSEMBLIES	
NK38-D1S-53103-9020	13.8 KV Distribution System	
NK38-F0S-53130-0001	13.8 KV Distribution System	
NK38-FXX-53130-0501	Electr. Pwr. Distr. 13.8 KV Class III/IV	
Conventional system_RFI 009_08 29 2012	BoP -Conventional Sys Sub-Bundle	
Conventional system_RFI 010_08 29 2012	DSR - TS 0530 -1, DSR - TS 0530-3 ( CCA-000144 related to the DSR);	
Conventional system_RFI 011_08 30 2012	DSR - TS 0840 -3 ( CCA- related to the DSR ; Not applicable)	
Conventional system_RFI 013_09 04 2012	TS-0560-9, related with CCA 001732	
Conventional system_RFI 016_09 06 2012	TS-0570-21, related with CCA 001296	
Conventional system_RFI 018_09 010 2012	TS-0570-25, related with CCA 001313	
Conventional_RFI012_30.08.2012	TS0630-7/TS0630-11	
Conventional_RFI015_05.09.2012	SI0280-2, SI0280-3, SI0390-1, TS0590-22	
Conventional_RFI017_07.09.2012	TS0590-22, TS0590-18, TS0610-17	
Conventional_RFI019_11.09.2012	TS0610-17, TS0610-3, TS0610-18, TS0610-22, TS0610-3/18/22	
F+G RFIs_client answer	RFI Master List; add'l tabs per RFI included	
RFI -List-Conventional	Appendix G : RFI/Reference- List	
NK38-CMP-53140-01-REV007	Control Maintenance Procedure 13.8KV BUS INSPECTION AND MAINTENANCE	
NK38-CMP-53200-01-REV003	Control Maintenance Procedure 4.16 KV BUS INSPECTION AND MAINTENANCE	
NK38-F0S-53230-0001-U2	4.16KV Distr. Syst. Class III (Unit)	
RFI -List-Conventional	Appendix G : RFI/Reference- List	
BOP Pre-Refurb Estimate	PRE-REFURBISHMENT- DSR Line Estimate _ Scope List - as of Mar 8, 2013 (In \$K) / Provided BY PM; add'l tabs included	
BOE BOP Pre-Refurb	Darlington Refurbishment Balance of Plant (BOP) "Pre-Refurbishment " Sub Project Basis Of Estimate	
Appendix A_ PR System_Summary	Tabs: ESW, ALW, VALVES, CONTROLLERS	
Appendix B_Project Breakdown of DSR	The 8 Darlington Scope Review (DSRs) items included in the BOP Pre-refurbishment Sub-Bundle.	
Appendix C_Productivity Factors	Appendix- C: Productivity Factors	
Appendix D_Height factor	Appendix D: Height Factors	
Appendix E_Crew Rates_Factors	ES MSA Hourly Rate Calculation: 10 Hrs / Shift, 2 Shifts (EPSCA : Appendix B, 7 day Coverage); Add'l Tabs included	
Appendix F_Mods 021513	OPG- MODIFICATION PROCESS - COST ESTIMATING	
Appendix G_Correspondence	RFIs, Emails & references	
BOP Reactor Estimate	BOP Reactor Systems - Overall Estimate Summary	
BOP Reactor Factors Rates+Costs	Appendix- C: Productivity Factors; add'l tabs	
BOP Reactor BoE	Darlington Refurbishment Balance of Plant (BOP) "Reactor Systems" Sub Project Basis Of Estimate	8/28/2012
BOP_RS_Appendix G_Emails	Emails	
BOP_RS_Appendix G_RFI List	RFI List	
BOP_RS_Appendix G_RFI006_RFI007	Emails	
1_Supporting Docs_Design Basis	List of reference docs	
SI0300-30	Strategic Outage Improvements: Dedicated Vault Vapour Relocated Flowpaths for Ice Plus	5/5/2011
SI0300-31	Strategic Outage Improvements: Dual Pwr. Supple for Vault Vapour Recovery Purge Dryer	5/5/2011
SI0300-36	Strategic Outage Improvements: Provide On-Line De-Tritiation Capability for Heat Transport	5/5/2011
TS0070-1	Inspect End Shield Cooling Expansion Tanks	1/26/2011
TS0070-2	Inspect Piping of End Shield Cooling System	1/26/2011
TS0070-3	Contingency - End Shield Cooling Expansion Tanks	1/26/2011

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
TS0070-4	Contingency - Piping Associated with End Shield Cooling	1/26/2011
TS0080-10	Contingency - Moderator Pumps	1/26/2011
TS0090-1	Overhaul & Inspect the Two Main HT Pumps w/ Cover Gasket Leaks	1/26/2011
TS0090-3	Inspect One Representative PHT Purification Strainer	1/26/2011
TS0090-4	Inspect Collection Tank, Vent Condenser Tank, & Collection Tank Coolers on U2	1/26/2011
TS0090-7	Replace the Switch Modules & Connecting Cable Associated w/ PHT Trip Press. Switches	1/26/2011
TS0090-12	Contingency - Refurbish All PHT pumps	1/26/2011
TS0090-14	Contingency - Extend Collection Tank Inspection to the Rest of the Units	1/26/2011
TS0100-3	DNGS Primary Heat Transport Pressure & Inventory Ctrl: One-Time Inspection of Piping	3/11/2011
TS0110-1	Video Inspection of Shell Side	1/26/2011
TS0110-4	Inspect Flow Orifices (x28)	1/26/2011
TS0120-2	Darlington Arilocks & Transfer Chambers: Replacement of non EQ Pressure Switches	4/13/2011
TS0200-3	Liquid Zone Ctrl. Syst.: Replace the Recombination Units	3/2/2011
TS0200-5	Liquid Zone Ctrl. Syst.: Replace the Recombination Units (Contingency)	3/2/2011
TS0210-12	Neg. Pressure Containment: Replacement of all Reactivity Mechanism (RMD) Seals	3/2/2011
TS0320-1	Refurbish all PHT Pump Motors	12/6/2010
TS1370-1	Vapour Recovery - Part 3: Replace all the Dryers	5/5/2011
TS1370-2	Vapour Recovery - Part 3: Replace all the Dryers (Contingency)	5/5/2011
TSO110-16	Contingency for HX	1/26/2011
0_BOE Signed	Darlington Refurbishment BOP 'Reactor Systems' Sub Project Basis of Estimate	8/28/2012
1_BOP RS BOE R000_08.28.2012	Darlington Refurbishment Balance of Plant (BOP) "Reactor Systems" Sub Project Basis Of Estimate	8/28/2012
2_Overall Summary signed	Scanned, BOP Reactor Systems - Overall Estimate Summary	
3_Funding Stream Signed	Scanned documents	
5_Appendix A_Overall and Per System Summaries	Scanned docs, BOP Reactor Systems Overall Estimate Summary	
6_Appendix B_WBS from PM	Scanned doc, Applicable DSR	
7_Appendix C_Productivity Factors	Scanned docs	
8_Appendix D_Height Factor	Scanned docs, Appendix D: Height Factors	
9_Appendix E_Crew Rates	Scanned docs, ES MSA Hourly Rate Calculation: 10 Hrs / Shift, 2 Shifts (EPSCA : Appendix B, 7 day Coverage)	
Appendix G	Scanned doc, RFI List	
Appendix G_Emails	Emails	
Appendix G_RFI006_RFI007	Emails	
0_BOE Signed	Darlington Refurbishment BOP 'Reactor Systems' Sub Project Basis of Estimate	8/28/2012
1_BOP RS BOE R000_08.28.2012	Darlington Refurbishment Balance of Plant (BOP) "Reactor Systems" Sub Project Basis Of Estimate	8/28/2012
2_Overall Summary signed	Scanned, BOP Reactor Systems - Overall Estimate Summary	
3_Funding Stream Signed	Scanned documents	
5_Appendix A_Overall and Per System Summaries	Scanned docs, BOP Reactor Systems Overall Estimate Summary	
6_Appendix B_WBS from PM	Scanned doc, Applicable DSR	
7_Appendix C_Productivity Factors	Scanned docs	
8_Appendix D_Height Factor	Scanned docs, Appendix D: Height Factors	
9_Appendix E_Crew Rates	Scanned docs, ES MSA Hourly Rate Calculation: 10 Hrs / Shift, 2 Shifts (EPSCA : Appendix B, 7 day Coverage)	
Appendix G	Scanned doc, RFI List	
Appendix G_Emails	Emails	
Appendix G_RFI006_RFI007	Emails	
BOP DSR	DSR List	
BOP_Gate1_WP1	DSR List	
Accepted BOP Estimating	Outlook Mtg. Response	2/3/2012
Accepted BOP Summary BOE	Outlook Mtg. Response	3/21/2012
Below is the UPDATED DRAFT Timeline based on Garry Rutledge input	BOP SAFETY AND CONTROLS SYSTEM GATE 1 (based on Gary Rutledge input)	
BOE Comments	Email - attachments, BOE_Sbagshaw Comments_2012-03-03 / BOE_Summary_SBagshawComments_2012-03-03	3/3/2012
BOE	Email - Fr: Jennifer Nodwell / To: Ian Wright; request for BOE, Summary Table & Estimate Sheets on gate submission	3/13/2012
BoEs	Email - Fr: Ian Wright / To: Jennifer Nodwell; Ian hasn't recvd. Updated BoEs	3/5/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
BOP - Safety and Control Sub-Bundle	Includes links to Sharepoint	1/10/2012
BOP - SCS Estimates	Email - Fr: Sean Bagshaw / To: Ian Wright	2/10/2012
BOP Fee	Total hrs & rates	
BOP Overview Package	Email - Outlook mtg. request	4/2/2012
BOP Summary Report	Email - Fr: Gary Rutledge / To: Lonnie Schofield; request for Summary Rpt. updated	5/8/2012
BOP_WP1.4_Prereq Mods BOE R0_Feb 27	NR Islanding Project – Basis of Estimate – Pre-requisite Modifications	
CANDU Reactivity Devices		1/1/2008
DSR_IP0510-7	ISR Acceptable Deviations - Contingency: Shut Down Systems	4/27/2011
DSR_SI0270-2	SPV - Potential Redesign for Refurbishment: Logic and Control Modules	5/5/2011
DSR_TS0220-1	Darlington Reactor Regulating: Inspection of the Spiroid Gear Set	3/2/2011
DSR_TS0220-2	Darlington Reactor Regulating: Replace Gear Boxes Based on Results of D1111 (Contingency)	3/2/2011
DSR_TS0220-3	Darlington Reactor Regulating: Replace Control Absorber Rods and Adjusters (Contingency)	3/2/2011
DSR_TS0220-5	Darlington Reactor Regulating: Replace All RRS Flux Detectors	3/2/2011
DSR_TS0220-13	Darlington Reactor Regulating: Replace Spiroid Gear Set (Contingency)	3/2/2011
DSR_TS0220-14	Darlington Reactor Regulating: Review the Phase I Outputs of COG Project	3/2/2011
DSR_TS0220-15	Darlington Reactor Regulating: Reactivity Worth Check	3/2/2011
DSR_TS0220-16	Darlington Reactor Regulating: Inspection of Worm Gear Boxes	3/2/2011
DSR_TS0240-10	Shutdown System 1 Process: Replace All 228 Vertical Flux Detectors	3/2/2011
DSR_TS0260-1	Shutdown System 2 Process: Perform Video/Visual Inspection on 1-34710-TK4	3/2/2011
DSR_TS0260-8	Shutdown System 2 Process: Replace all SDS2 In-Core Flux Detectors	3/2/2011
DSR_TS0260-9	Shutdown System 2 Process: Replace 34710-TK4 (Contingency)	3/2/2011
DSR_TS0350-1	Replacement of the SDS1 Trip Computers	12/22/2010
DSR_TS0350-2	Replacement of the SDS1 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-3	Replacement of the SDS1 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-4	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-5	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-10	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-11	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-12	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-13	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-14	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-15	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-16	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-17	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
DSR_TS0350-18	Replacement of the SDS2 Trip Computers (Item #1)	12/22/2010
Darlington SDS Refurb	Darlington SDS Computers Refurbishment Level 1 Logic/Schedule	
BOP Safety and Controls BOER000	Balance of Plant "Safety and Control Systems" Sub Projects (BOP) Basis Of Estimate	1/3/2012
Signed Copy	Darlington Refurbishment BOP "Safety & Control Systems" Sub Project Basis of Estimate	1/3/2012
BOP Safety and Controls Summary BOER000 030412 _2_05 25 2012 _3_	Darlington Refurbishment Balance of Plant (BOP) "Safety and Control Systems" Sub Project For BOP & SIO Summary Basis Of Estimate	5/25/2012
BOP Safety and Controls BOER000	Balance of Plant "Safety and Control Systems" Sub Projects (BOP) Basis Of Estimate	1/3/2012
BOP Safety and Controls Summary BOER000 030412 (2)	Darlington Refurbishment Balance of Plant (BOP) "Safety and Control Systems" Sub Project For BOP & SIO Summary Basis Of Estimate	4/12/2012
BOP Safety and Controls Summary BOER000 030412 (2)_rev105.25.2012	Darlington Refurbishment Balance of Plant (BOP) "Safety and Control Systems" Sub Project For BOP & SIO Summary Basis Of Estimate	4/13/2012
BOP Safety and Controls Summary BOER000 030412 (3)	Darlington Refurbishment Balance of Plant (BOP) "Safety and Control Systems" Sub Project For BOP & SIO Summary Basis Of Estimate	4/18/2012
BOP Safety and Controls Summary BOER000 030412	Balance of Plant "Safety and Control Systems" Sub Projects (BOP) Summary Basis Of Estimate	2/3/2012
BOP Summary Errata	DARLINGTON REFURBISHMENT BALANCE OF PLANT (BOP) "SAFETY AND CONTROL SYSTEMS" SUB PROJECTS SUMMARY BASIS OF ESTIMATE	4/18/2012
BOP S+C BoE	Darlington Refurbishment Balance of Plant (BOP) "Safety and Control Systems" Sub Project For BOP & SIO Summary Basis Of Estimate	5/25/2012
bop summary R001 (2) (Final032712)	Scope List - as of March 09, 2012	3/9/2012
bop summary R001	Scope List - as of Feb. 28, 2012	2/28/2012
BOP	Tabs: DCMS, DSR Calc	



DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
bopDSR List (4)	dbo_MASTER_SYS_LINEITEM	
Copy of BOP_GRB_04 03 2012 (8)	DSRs; add'l tabs	
Copy of BOP_GRB_04 03 2012 (8)_REV1_05.23.2012	DSRs; add'l tabs	
Copy of BOP_GRB_04 03 2012 (9)	DSRs; add'l tabs	
BOP S+C Estimate	BOP Summary DSR, PROJECT - SUMMARY ESTIMATE +/- 00%; add'l tabs	2/27/2011
BOP007_TS03500-1-18_Estimate	TS0200-3 - BOP007 - Replacement of SDS2 Trip Computers; add'l tabs	
Estimate SDS Computer Replacement	TS0200-3 - BOP007 - Replacement of SDS2 Trip Computers; add'l tabs	8/23/2011
Estimate SDS Computer Replacement_rev1	TS0200-3 - BOP007 - Replacement of SDS2 Trip Computers; add'l tabs	8/23/2011
BOP S+C 1A BOE	Balance of Plant "Safety and Control Systems" Sub Projects (BOP) Basis Of Estimate	3/13/2013
BOP S+C 1A Estimate	Appendix A_DSR Summary by DSR; add'l tabs	4/29/2012
Preparatory Work	Tabs: Excitation, Turbine Ctls, Pwr. Cables, etc.	
TG BOEN	Turbine Generator (TG) Basis Of Estimate	9/13/2011
TG Signed BOE Sheet	Turbine Generator (TG) Basis Of Estimate	9/13/2011
Approved Scope by Project-2.xlsb	Scope List - as of August 18, 2011 (In \$K)	8/18/2011
Approved TG DSR List Page 1	PAGE 1, Scanned Doc: ...System DSR Line Estimate_Scope List	8/18/2011
Approved TG DSR List Page 2	PAGE 2, Scanned Doc: ...System DSR Line Estimate_Scope List	8/18/2011
Approved TG DSR List Page 3	PAGE 3, Scanned Doc: ...System DSR Line Estimate_Scope List	8/18/2011
Scope Summary August 31 2011 (Revised 030911 IMW)	Scope List - as of August 18, 2011 (In \$K)	8/18/2011
Canceled Turbine Generator - F G Class 5 Estimate Update and Review	Email: Mtg. Cancellation	8/2/2011
Dale	Digital Plant Control Systems and Plant Simulators	
Bearings 1 (thrust 2)	Organizational Chart	4/1/2010
Bearings 3+4	Organizational Chart	
Bearings 5,6+7	Organizational Chart	
HI POT Testing	D1021 HI POT Testing Org Chart	
HP Turbine Overhaul	D1021 HP Turbine Overhaul, Org Chart	
LP 2 Overhaul	D1021 LP 2 Overhaul (with BCH in Place), Org Chart	
LP1 Overhaul	D1021 LP1 Overhaul Org Chart	
LP2 Cleaning Logic	D1041 LP2 Cleaning Logic Org Chart	
MSR Inspection	D1021 MSR Inspection Org chart	
NR TURBINE GENERATOR WORK ORDER MATRIX	NR TURBINE GENERATOR WORK ORDER MATRIX	
Slip Ring Grind	1021 Slip Ring Grind WO #1762744	
Stage 5 Liner Repair	LP1, LP2 & LP3 Stage 5 Liner Repair	
Standardization of network technologies	Alstom	
Steam turbines	Article	8/1/2007
STOP GOV Valves MV1 MV2 MV3 MV\$	D1021 - STOP/GOV Valves MV1, MV2, MV3 & MV4	
The Alstom control system ALSPA Controplant is designed for energy applications	Alstom Control System ALSPA Controplant	
Unit 2 HP Large Scale	Turbine Overhaul	
Unit 2 HP Spindle Removal	Spindle Removal	
Apendiix F PWU 10HR Burdened Pipefitters	Shifts	
Appendix B TG Work Breakdown Structure	WBS Code & Name	
Appendix D Productivity Factors 10 Hr Shift Z2	Basic Shift	
Appendix E Height Factors	Height	
Appendix F -1 Crew Rate 10Hr	2011 Overnight Burdened Rate	
Appendix F CSU+PWU 10Hr Burdened Electrician	10 hr day shift	
Appendix F PWU 10Hr Burdened Boilermakers	10 hr day shift	
Appendix F PWU 10Hr Burdened Machinist	10 hr day shift	
Appendix F PWU 10Hr Burdened Millwright	10 hr day shift	
Appendix F PWU 10Hr Burdened MTE	10 hr day shift	
Appendix G Estimators Assumptions and Instructions	Release 4 AACE 5 Estimating Assumptions/Instructions	
Appendix H Control Systems Draft_Estimate_TGSI_25.08.11	TG summary DSR Line No. SI0010-1	
Appendix H Excitor Draft_Estimate_TGSI_25.08.11	TG summary DSR Line No.	
Appendix I Revised Estimate Range 03 September 2011	TG System DSR Line Estimate Scope List	
SI0010-1	TG ELECTRONIC CONTROL SYSTEM	8/29/2011
SI0020-1	OBSOLETE GENERATOR EXITATION SYSTEM	7/21/2011
SI0020-2	INSPECT, TORQUE CHECK AND CLEAN 830 VOLT AC	8/2/2011
SI0020-3	REPAIR 830 VOLT AC BUS SECTIONS	8/2/2011

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
SI0270-1	INSTALLATION OF NEW SPV FOR INCREASED REDUNDANCY	8/2/2011
SI0280-1	FIELD WORK RECONFIGURE CONDENSOR TUBE \$	8/2/2011
SI0300-16	INSTALL 15 TONNE CAPACITY CRANE	8/2/2011
SI0300-18	LP CASING DOWELS	8/2/2011
SI0300-19	COMPONENT SWAPPING AND OFFLINE OVERHAUL CREW	8/2/2011
TS0680-1 (1 OF 6)	UNIT 1- 1st Stage GV 1 to 4-41870-MV1, MV-2	7/28/2011
TS0680-1 (2 OF 6)	UNIT 1- 2nd Stage GV 1 to 4-41880-MV1, MV-2 \$	8/2/2011
TS0680-1 (3 OF 6)	UNIT 1- Separator GV 1 to 4-48100-MV16, MV17, MV18 & MV19	8/2/2011
TS0680-1 (4 OF 6)	UNIT 1- HP Drain GV 1 to 4-48500-MV30 & MV192	8/2/2011
TS0680-1 (5 OF 6)	UNIT 1 -HP Turbine Extraction GV 1 to 4-48100-MV22 & MV23	8/2/2011
TS0680-1 (6 OF 6)	UNIT 1- HP DRAIN GV 1 to 4-48500- MV36, MV48, MV115, MV121, MV145, MV151, MV1	8/5/2011
TS0680-4 (1 OF 3)	X-48100-NV1/2/3 LP TURBINE 1,2 & 3	8/2/2011
TS0680-4 (2 OF 3)	X-48100-NV10/11/12/13 HEADER 4	8/2/2011
TS0680-4 (3 OF 3)	X-48100-NV14 DEAERATOR	8/2/2011
TS0680-6 (3 OF 6)	UNIT 1 Separator GV 1 to 4-48100-MV16, MV-17, MV18 & MV19	8/4/2011
TS0680-6 (4 OF 6)	UNIT 1 HP Drain GV 1 to 4-48500-MV30 & MV192	8/4/2011
TS0680-10 (1 OF 2)	INCREMENTAL WORK TO MOISTURE PRE-SEPARATOR (MOPS)	8/2/2011
TS0680-11	MSR MOP REPAIR	8/2/2011
TS0680-13 (2 OF 2)	REPLACE HEATING SYSTEM IN THE PIPES TO THE FIRST STAGE BUNDLE	8/2/2011
TS0680-15	RE-TUBE MSR	8/2/2011
TS0680-17	REPLACE CROSSOVER LINES	8/2/2011
TS0680-19	REPLACE MSR INLET LINE	8/3/2011
Crew Rate 10Hr	10 hr day shift	
DR Estimating Assumptions and Instructions		
EPSCA_Elec 2011-2012	Burdened Labour Rate Calculation - Plain Time - Electrical Worker	1/20/2012
Height	OPG Height Factors	
Overhead	Definition Phase - RFR & Assumed TG Estimate	
TGP BoE	Turbine Generator (TG) Independent Estimate Basis Of Estimate For Fixed Cost Contract	
TGP FC Estimate		
Estimate	Tabs: DSR Summary, 4b Data, DSR Database, etc	
FC Signed Estimate	Turbine Generator (TG) Independent Estimate Basis Of Estimate For Fixed Cost Contract	
Independence Confirmation Signed	Turbine Generation	
SGP 4b Comparison	Steam Generator Status 8th March 2013	
SGP 1 Estimate	Current DSR Estimates as of March. of 2013; Tabs - SG, Summary (Rel4), Rel4B (DSR estimate)	
SGP BOE	Steam Generator (SG) Basis Of Estimate	2/3/2011
SGP Factors Rates Costs	Steam Generator Project Crew 12 Hrs Shift Hourly Rate Calculation	
SG DSR list as August, 2011	Screen Print, TS0050-1, etc., approved/not approved	
SG Validate Info	Project: Steam Generator	
PM Signed SG Estimate Summary	Scanned Doc - SG Bundle - DSR Line Estimate_Scope List as of 8/31/11	9/1/2011
SG BOE-signed with type of doc. Changed	Steam Generator (SG) Basis of Estimate	11/11/2011
Signed SG BOE	Steam Generator (SG) Basis of Estimate	11/11/2011
2013-2015%20CEO%20CFO%20BP%20Presentation_Sept%2013%20r1	2013-2015 Bus Plan	9/18/2012
DN 2012-2014 BP Presentation Sept 8 Final	2012-2014 Bus Plan	9/12/2011
2013-2015 CEO CFO BP Presentation_Sept 13 r1	2013-2015 Business Plan	9/18/2012
N-GUID-00400-10000 Nuclear Refurbishment Cost Estimate Review Guide	Nuclear Refurbishment Cost Estimate Review	5/6/2011
ON Outlook Highlights - Draft for Committee Review	Construction Looking Forward - Draft	2/1/2012
Ontario LMI -- Preliminary Trade Rankings (Dec 2011)	GTA: December 2011 Forecast	12/1/2011
Productivity Factors 10 Hr Shift Z2	Rubber Day & Night 10 Zone 2	
Productivity Factors 10 Hr Shift Z3	Rubber Day & Night 10 Zone 3	
Productivity Factors 12 Hr Shift Z2	Rubber Day & Night	
Productivity Factors 12 Hr Shift Z3	Rubber Day & Night	
Productivity Factors	hourly rate	
509407-0000-00000-33RA-0035 Apr-23-13_Rev PB	TMOD material, supports, hardware, feeder vision system, and miscellaneous items.	5/15/2013
Appendix 01 - 509407-0000-00000-33RA-0035 OSM (Rev PB)	Material Allowance Calcs based on Single Unit	4/12/2013
Appendix 02 - 509407-30CC-I-0109-Intermediate Level Waste	revised estimate: intermediate level waste components and key assumptions	10/12/2012



DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Assessment		
Dec 2012 Estimate Report	Docs & Correspondence from Aecon Joint Venture - ESTIMATE, LEVEL 2 SCHEDULE & RISK REPORT (373 pgs)	12/21/2012
RFR May_Data	Planned, Actual, Forecasted & Earned budget breakdowns by period. WP breakdown.	11/6/2012
RFR Resource Plan - Revised March 6 -Gate 2A	Retube & Feeder Replacement Project- Cash Flows by Year- Gate 2A ( March 2013- May 2014 ); add'l tabs	
RFR Resource Plan 15 Feb 2013-Gate 2A	Retube & Feeder Replacement Project- Cash Flows by Year- Gate 2A ( March 2013- May 2014 ); add'l tabs	
RFR Resource Plan 20 Feb 2013-Execution	Retube & Feeder Replacement Project - Resource and Contract Cost Estimate Sheet- Gate 2A to Project Completion (2014-2025)	
34-120019 Annulus spacer Qual-9jan2013	Annulus Spacer Qualification Test for Darlington Retube; schedule portion	
34-120019 Inconel 9jan2013	Inconel Spacer Qualification Test for Darlington Retube; schedule portion	
2013-02-08- R0031- Basic	All Active Project - Master Schedule (10 pgs)	
2013-02-08- R0031- Cash flows- Basic with actuals-Oct12-May14.pdf	CT-01 Monthly Project Cash Flow -with actuals	2/8/2013
2013-02-08- R0031- Cash flows- detailed by WBS with actuals.pdf	CT-02 Monthly Project Cash Flow by WBS	2/8/2013
2013-02-08- R0031- detailed	All Active Project - Master Project Schedule; NSS-OPG-001-Ganttchart-with SPI-Final	2/8/2013
AECL Op 3 Pricing Submission Form Annulus Spacer	Pricing Submission Form - Fuel Channel Annulus Spacer Design Concept for Darlington NGS Refurb. Program	
AECL Zr - R1	AECL Zr-Nb-Cu Irradiation Program High Level Schedule and Budgetary Estimate	
AMEC NSS OSS Services- Gate 1 and 2A Deliverable List (verified - Updated)	Appendix B: Deliverable Budgetary Cost and Schedule; add'l tabs - Deliverable List, Summary by Area, PO Named Individuals	
Assistance for RFR - Hours Estimate		
NK38-PLAN-31160-10002_R000(22Jan2013)_RFR-Fuel Channel Modified Inconel X-750	Scope of Work - Fuel Channel Modified Inconel X-750 Annulus Spacer	
NK38-PLAN-31160-10003_R000(22Jan2013)_RFR - Fuel Channel Zr-Nb-Cu Annulus Spacer	Scope of Work - Fuel Channel Zr-Nb-Cu Annulus Spacer	
RFR Cash Flow 2013 -R2 Current	Tabs: Curve Data, Summary 2013-2014, Issued Curves, CPI-SPI Ctgy Curves, Mock Up Milestones, etc.	
RFR Cashflow 20121116	Mark RL-03 Cost Loading RFR by Groups (Late Dates)	11/16/2012
summary of cost estimate - feasibility asmt - board nov 2009_r04	Darlington Site Master Plan; Cost Estimate and Cash Flow	
DVBO scope for refurb	DSR tracking	
information for Jim... with MDRs	database	
D1321 Level 1 REV H - May 7th draft	D1321 Unit 2 Outage Logic Level 1October	5/8/2013
D1501Level 1 - Rev A April 19, 2013	Vacuum Building Outage ** Rev A ** Level 1 Overview	4/19/2013
Darlington Critical Path Schedule January 31 2013	Critical Paths before Oct 15 2016	1/31/2013
Darlington Integrated Master Schedule March 18 2013	Integrated Master Sched	2/6/2012
Darlington Integrated Master Schedule	Critical Paths before Oct 15 2016	1/31/2013
Darlington Unit 2 Conceptual Level 1	schedule	7/20/2012
Engineering Major Work Streams	schedule (draft)	2/14/2013
June 17 Latest Eng Schedule_ALL	Integrated Master Sched	5/30/2013
Key Milestone Report and Contract Status Nov 2012	Key Milestone & Contractor Status	11/15/2012
Nuclear Projects Planning & Control Earned Value Management April 2013	EV Mgmt.	Apr-13
Program Integration Summary Master Schedule Revision 1 Visio Overview	Org Chart - Revision 1 (Visio Overview)	
Program Master Schedule Dec 19 2012	Critical Paths before Oct 15 2016	12/19/2012
Revised Project Controls Chart 1	Org Chart	5/17/2013
Program Schedule Mgt Plan Rev 1	Program Schedule Management Plan	3/27/2013
RFR Contract Schedule	Exhibit 3.1(c )(A) Definition Phase Target Schedule (scanned doc)	
Appendix A - Health of CandC Score_Card	Health of the C&C Schedule as of April 04 ,2013	4/4/2013
Appendix_07_Fuel Handling Defueling	Program C&C Schedule	4/4/2013
Appendix_08_Turbine Generator Bundle	Turbine Generator Project Bundle	4/4/2013
Appendix_09_Campus Plan Bundle	Campus Plan Project Bundle	4/4/2013
Appendix_C_PMSS_Completed	Program Milestones & Key Dates -- Achieved	4/4/2013
Appendix_D_PMSS_3M Lookahead	Program Milestones and Key Dates -- 3 Months Look Ahead	4/4/2013
Appendix_E_PMSS_All_Remaining	Program Milestones & Key Dates -- All Remaining	4/4/2013
Appendix_F_PMSS_All_in_2013	Program Milestones and Key Dates -- 2013 Milestones	4/4/2013
Appendix_G_Outage_Prep_Milestones	Program Milestones and Key Dates -- Refurb Outage Prep Milestones	4/4/2013

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
APPENDIX_H_Update-Critical_Path-2013-04-04	RFR Bundle Schedules - Critical Activities	4/4/2013
AppendixBCandC-Schedule-Development Plan	C&C Schedule Development Plan	4/7/2013
Copy of Appendix A - Health of CC Score_Card	May 2013 Status	May-13
Planned Outages Inspections - BOP	Major Works for All Planned Outages Prior U2 Breaker Open	Apr-13
Planned Outages Inspections - FH	Fuel Handling and Defueling Bundle - Major Works for All Planned Outages Prior U2	4/4/2013
Planned Outages Inspections - Islanding	Major Works for All Planned Outages Prior U2 Breaker Open	4/4/2013
Planned Outages Inspections - RFR	Major Work for All Planned Outages Prior U2 Breaker Open	4/4/2013
Planned Outages Inspections - SG	Steam Generator Bundle - Major Works for All Planned Outages Prior U2 Breaker Open	4/4/2013
Preamble 032013	Preamble – March 2013 Status Submission – Unit 2	4/7/2013
Scope Development - BOP	Scope Development Schedule	4/4/2013
Scope Development - ISL	ISL Bundle - Scope Development Schedule	4/4/2013
Scope Development - Shutdown and Layup Serv	Shutdown and Layup Services - Scope Development Schedule	4/4/2013
Update-MU-3M-2013-04-04-APPENDIX Q	RFR Bundle - Mock Up Schedule - 3 Months Lookahead	4/4/2013
Update-MU-CM-2013-04-04-APPENDIX O	RFR Bundle - Mock Up Schedule - Completed Activities	4/4/2013
Update-MU-RM-2013-04-04-APPENDIX P	RFR Bundle - Mock Up Schedule - Remaining Activities	4/4/2013
Update-PM-3M-2013-04-04-APPENDIX T	RFR Bundle - PMOD's Schedule - 3 Months Lookahead	4/4/2013
Update-PM-CM-2013-04-04-APPENDIX R	RFR Bundle - PMOD's Schedule - Completed Activities	4/4/2013
Update-PM-RM-2013-04-04-APPENDIX S	RFR Bundle - PMOD's Schedule - Remaining Activities	4/4/2013
Update-TL-3M-2013-04-04-APPENDIX N	RFR Bundle - Tooling Schedule - 3 Months Lookahead	4/4/2013
Update-TL-CM-2013-04-04-APPENDIX L	RFR Bundle - Tooling Schedule - Completed Activities	4/4/2013
Update-TL-RM-2013-04-04-APPENDIX M	RFR Bundle - Tooling Schedule - Remaining Activities	4/4/2013
Update-TM-3M-2013-04-04-APPENDIX W	RFR Bundle - TMOD's Schedule - 3 Months Lookahead	4/4/2013
Update-TM-CM-2013-04-04-APPENDIX U	RFR Bundle - TMOD's Schedule - Completed Activities	4/4/2013
Update-TM-RM-2013-04-04-APPENDIX V	RFR Bundle - TMOD's Schedule - Remaining Activities	4/4/2013
2013-04-26- WorleyParsons_MDR_Integrated_Schedule_DRAFT_L1	MDRs Integrated Schedule - Level 1	4/25/2013
2013-04-26- WorleyParsons_MDR_Integrated_Schedule_DRAFT_L2	MDRs Integrated Schedule - Level 2	4/25/2013
2013-04-26- WorleyParsons_MDR_Integrated_Schedule_DRAFT_L3_OPG_O	MDRs Integrated Schedule - Level 2 - OPG Activities ONLY	4/25/2013
AMEC 2013-04-26-MDR Program- Level 1	AMEC NSS MDR Program Integrated Schedule	
AMEC 2013-04-26-MDR Program- Level 2	AMEC NSS MDR Program Integrated Schedule - Level 2	
AMEC 2013-04-26-MDR Program- Level 3-OPG activities	AMEC NSS MDR Program Integrated Schedule - Level 3	
AMEC202013-05-27-Level2	MDR Program - Integrated Schedule Level 2	
OverallRemainingWork2013-05-30 Part1	RFR TEAM - Part 1	5/30/2013
OverallRemainingWork2013-05-30Part2	RFR TEAM - Part 2	5/30/2013
OverallRemainingWork2013-05-30Part3	RFR TEAM - Part 3	5/30/2013
WorleyParsons_2013-05-27_MDR_Integrated_Schedule_L2	Level II Schedule	5/9/2012
OPG Darlington Schedule Quality	ribbon & phase analysis; details 2007-2025	5/9/2013
NK38-PLAN-09701-10067-0004 Sh 0004	Program Schedule Management Plan	3/27/2013
NK38-PLAN-09701-10072 Critical path (1)	Nr Conceptual Level 1 Logic (Pims-C)	9/7/2012
NK38-PLAN-09701-10072 Critical path	Nr Conceptual Level 1 Logic (Pims-C)	9/7/2012
CC_Apr_ME	schedule	
5_BOP_L2	schedule	
5_FUNCTIONAL_L3 1b	schedule	
5_FUNCTIONAL_L3 b	schedule	
5_FUNCTIONAL_L3	schedule	
6_BOP_L2	schedule	
9_FUNCTIONAL_L3 1b	schedule	
9_FUNCTIONAL_L3 b	schedule	
9_FUNCTIONAL_L3	schedule	
CC_Apr_ME	schedule	
CMP_L2 b	schedule	
CMP_L2	schedule	
D1321 Level 1 REV H - May 7th draft	D1321 Unit 2 Outage Logic Level 1October	5/8/2013
D1501Level 1 - Rev A April 19, 2013	Vacuum Building Outage ** Rev A ** Level 1 Overview	4/19/2013
FH_DF_OPG_Uc_L2	schedule	
FH_DF_OPG_Uc_L3	schedule	
IS_OPG_Uc_L3	schedule	
Program Master Schedule Dec 19 2012	Critical Paths before Oct 15 2016	12/19/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Revised Project Controls Chart 1	Org Chart	5/17/2013
RFR_L2 b	schedule	
RFR_L2	schedule	
SD_OPG_Uc_L3	schedule	
TG_SG_OPG_Uc_L3	schedule	
2010 a year in review_final (3)	PowerPoint - Dietmar Reiner	Jan-11
Program Update - External Advisors - Feb 27 2013	Program Update ppt (145 pgs)	2/27/2013
SC_NCD_Prj_Execution_Workshop_FINAL_March_18_2013	PDF ppt - Excellence in Executing Accountabilities & Interacting in a Mega-Proj. Environment	3/18/2013
NP Information Management SC Mtg.		
Refurb SC 26 April 13	Adobe PowerPoint - Refurb Program Contract Steering Committee	4/26/2013
EAC April 29 013	Adobe PowerPoint - Refurb Executive Advisory Comm.	4/29/2013
May 22 2013 NPMSRB Decisions docx	File: N-REF-09701-0465832	5/22/2013
N-PLAN-09701-10002-DN Refurb Executive Advisory Committee DRAFT	Darlington Refurbishment Executive Advisory Committee Terms Of Reference	2/15/2012
Oversight and Control - EAC	Adobe PowerPoint - Oversight & Ctrl. Function of Major Projects	4/29/2013
May 22 2013 NPMSRB Decisions docx	Decisions and Records of Key Points	5/22/2013
Outstanding Actions for NPMSRB Latest	Outstanding Actions	11/22/2012
April Program Status Report	DN Refurb Program Status Report Meeting	5/22/2013
Darlington Refurbishment Program Update Outline Feb 2013	Program Update outline	2/1/2013
June Program Status Report	Agenda, Mtg. Minutes, Outstanding Actions	7/24/2013
March Program Status Report REV02	Meeting Minutes: Outstanding Actions & Status Rpt.	3/1/2013
May Program Status Report	agenda, Mtg. Minutes, Outstanding Actions (5)	6/19/2013
Program Status Meeting June 12(2)	Agenda; Attached docs: Listing of Outstanding Actions, Program Status May ppt, Functional Update	6/12/2013
Program Status Report Mtg for Period Ending December 2012	Outstanding Actions & Sect. 5.0, B - Project Quad Charts included	1/23/2012
Program Status Report Mtg for Period Ending February 2013	Outstanding Actions & Darlington Refurb Overview	3/20/2013
Darlington Refurbishment D2O Board Memo - May 2013	Heavy Water Storage and Drum Handling Facility - submitted to BOD	5/16/2013
Darlington Refurbishment Economic Update - NOC May 2013	Darlington Refurbishment Program Economic Update - submitted to NOC	5/14/2013
Darlington Refurbishment Refurb Project Office Memo - May 2013	Refurbishment Project Office - submitted to BOD	5/16/2013
Darlington Refurbishment Water and Sewer May 2013 (2)	Darlington Water and Sewer Project - submitted to BOD	5/16/2013
NOC Q1 2013	Darlington Refurbishment Program Status Report - submitted to NOC	May-13
Outstanding Actions for NPMSRB Latest	NPMSRB - Outstanding actions, total of 2	11/22/2012
13-04-17 20U2 20Readiness	Scope Status Meeting (revised format – 3/fiscal month)	
April 17-13 Integrated Proj. Functional Coordination Mtg	INTEGRATED PROJECT/FUNCTIONAL COMMUNICATION MEETING; attachments included	4/17/2013
Functional Update March	Update	Mar-13
Functions - Quad Charts March 2013	Management System Oversight	4/3/2013
Projects - Quad Charts March 2013	Fuel Handling Refurbishment	3-Apr
Outstanding Actions	scanned doc - NR Execution RPET/Proj. Mgr.	4/16/2013
Program Status March	PowerPoint	Mar-13
Action Items 051513 Project Meeting	NR Execution RPET/Project Mgr. - Outstanding Actions	5/14/2013
Functional Update April 2013	April 2013 Month End	Apr-13
Functions - April 2013	Management System Oversight	5/1/2013
Pre reqs	Unit Ready for Refurb	
Program Status April 2013	April 2013 Month End	Apr-13
Projects - April 2013	Fuel Handling Refurbishment	5/1/2013
Functional Update May 2013	Update (ppt)	May-13
Functions - 05 13	Management System Oversight	5/29/2013
Program Status May 2013	Report card, cost perf., program milestones	May-13
Projects - 05 13	Fuel Handling Refurbishment	5/29/2013
Projects - Retube and Feeder Replacement	Current Gate 2A; Fiscal Mo End 03-July-2013	7/3/2013
Arnone Email unlapping of units 070713	Email, Attachments: Impact of Changing Units, Considerations, copy of Outage Duration Impact & Components documents	7/4/2013
Components requiring Unit overlap Memo	Attachment to Arnone Email; review conducted on the FH refurbishment and defueling approved scope	6/17/2013
Considerations for Refurbishment Outage Logistics Ver2_U2Finish_toStartU1	Attachment to Arnone Email; U2 Finish to Start U1	6/26/2013
Copy of Outage Duration Impact	Impact of Planned Darlington Refurbishment Unit Outage Overlap Dates	6/28/2013

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Impact of Changing Units 2 and 1 from Parallel to Series	Re: Contracts, 4C, Staffing, Procurement, Changed/New Risks, Help Required, & Actions	7/4/2013
Monthly Integrated Projects and Functional Comm Meeting (July 17)	Agenda, Action Items, Qtrly rpt. info, Program Status	7/17/2013
TG Turbine and Excitation Controls removal from Unit 2 Refurb scope - draft June 28, 2013	TG Turbine and Excitation Controls removal from Unit 2 Refurbishment scope with installation during 1st planned outage after Unit 2 Refurbishment	6/27/2013
Refurb Work Program Action Decision Log	Action, Decision, Completed Actions	7/22/2013
Refurb Work Program Integration Meeting COMBINED Agenda - June 3 2013	Meeting Agenda	6/3/2013
Project Quality Assurance Plan (CD-0022) 509407-0000-00000-38QP-0001 R0 1	Assurance report	5/31/2012
12-H13.1-Written submission from OPG on EA for Darlington Nuclear Generating Station	Proposed Environmental Assessment Screening Report	9/13/2012
12-H13.80A-Presentation from CNWC	Environmental Assessment of OPG's proposed Refurbishment and Continued Operation of the DNGS	11/26/2012
12-H13.80-CNWC and DDLC	Environmental Assessment; renew Waste Mgmt. Facility license; renew Nuclear Pwr. Reactor Operating license	10/15/2012
12-H13.A Supplementary Submission from CNSC Staff on the Proposed EA Screening for DNGS	Proposed Environmental Assessment Screening Report	11/15/2012
12-H15.1-Written submission from OPG on Licence Renewal for Darlington Nuclear Generating Station	Renewal of the licence for the Darlington Nuclear Generating Station	9/14/2012
12-H13.1A-Presentation from OPG	Environmental Assessment; renew Waste Mgmt. Facility license; renew Nuclear Pwr. Reactor Operating license	11/23/2012
12-H13.1-Written submission from OPG on EA for Darlington Nuclear Generating Station	Proposed Environmental Assessment Screening Report	Nov-12
12-H13.2-Sierra Club Canada	HOW NOT TO EXTEND THE LIFE OF AGING REACTORS IN ONTARIO	7/18/2012
12-H13.59-Bruce Power	Bruce Pwr. - in support of license renewal for Darlington Waste Mgmt. Facility	10/15/2012
12-H13.79A-Presentation from Power Workers Union	presentation	11/26/2012
12-H13.79-Power Workers Union	REQUEST TO INTERVENE and WRITTEN SUBMISSIONS	10/15/2012
12-H13.83A- Presentation from the Organization of CANDU Industries	supplementary info & presentation	11/26/2012
12-H13.83-Organization of CANDU Industries	Request to Intervene at CNSC Public Hearing on November 13 and 14, 2012	10/15/2012
12-H13.86-Candu Energy Inc	Environmental Assessment of OPG's proposed Refurbishment	10/15/2012
12-H13.A Supplementary Submission from CNSC Staff on the Proposed EA Screening for DNGS	Proposed Environmental Assessment Screening Report	11/15/2012
12-H13-Written submission from CNSC Staff on EA Screening-DarlingtonNGS	Proposed Environmental Assessment Screening Report	9/12/2012
12-H15.1-Written submission from OPG on Licence Renewal for Darlington Nuclear Generating Station	Licence Renewal for Darlington Nuclear Generation Station	9/14/2012
12-H15-Written submission from CNSC Staff on Darlington Nuclear Generating Station Licence	Request for License Renewal	9/14/2012
April Meeting Schedule	Agenda	Apr-13
OPG_IRM_Report_of_the_Board_20130328	Incentive Rate-making for Ontario Power Generation's Prescribed Generation Assets	3/28/2013
Power_Advisory Presentation OEB 82812 Incentive Regulation Options	Incentive Regulation Options for Ontario Power Generation's Prescribed Generation Assets	8/28/2012
Power_advisory_report_OPG_20120511	Incentive Regulation Options for Ontario Power Generation's Prescribed Generation Assets	4/20/2012
5142_First_Amendment_BPRIA_20070829	First Amending Agreement to the Bruce Pwr. Refurb. Implementation Agreement	8/28/2007
Assumptions - Detailed Report	Planning and Controls - Key Assumptions	5/9/2013
Assumptions - Summary Report	Planning & Ctrls - Assumptions Summary	5/9/2013
Decisions - Detailed Report	Planning & Ctrls - Decisions Identification	5/9/2013
Decisions - Summary Report	Planning & Ctrls - Decisions Summary	5/9/2013
AECON Lessons Learned	Nuclear Restart Early Lessons Learned	7/27/2007
Bruce Lessons Learned	Self-Assessment D11-000190	6/2/2011
Lesson Learned Bruce Self Assessment	Nuclear Refurb Islanding	5/18/2011
Lessons-Learned_Wolsong	List; Fuel Channel Installation NIR	
NK38-REP-09701-10164R00 Lessons Learned Report	Quarterly Lessons Learned Rpt. - Q3 2012	4/29/2013
OPEX Process Chart	org chart	
Report from OPEX	Lessons Learned database	
Tooling OPEX Database 03 18 2013	database - Type, Evidencing, etc.	5/2/2013
Wolsong OPEX list	OPEX-1 thru OPEX-VI	
Concerns	RFR Construction Management	12/20/2012

DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
PLN OPEX - Constable	database	12/20/2012
Copy of Outage Duration Impact	Impact of Planned Darlington Refurbishment Unit Outage Overlap Dates	6/28/2013
Contingency Presentation for RPET (Jan-30-2013)	proposed strategic direction of contingency development and management	1/30/2013
ROC-June 2013	Risk Oversight Committee	6/5/2013
Components requiring Unit overlap Memo	Attachment to Arnone Email; review conducted on the FH refurbishment and defueling approved scope	6/17/2013
Considerations for Refurbishment Outage Logistics Ver2_U2Finish_toStartU1	Attachment to Arnone Email; U2 Finish to Start U1	6/26/2013
F&G RISK MANAGEMENT REVIEW	Faithful+Gould Assessment	3/4/2012
Impact of Changing Units 2 and 1 from Parallel to Series	Re: Contracts, 4C, Staffing, Procurement, Changed/New Risks, Help Required, & Actions	7/4/2013
N-FORM-11306	Program Risk Identification Form	
N-FORM-11390	Decision Record & analysis Sum.	
N-FORM-11394	Key Assumption Identification Form	
OPG Risk Management Review - rev 1	Assessment of Program & Project Risk Management	3/4/2012
RISK MANAGEMENT SUMMARY TABLE	Risk Self-Assessment Summary Table	
ROC June Meeting Agenda	Agenda	6/5/2013
TG Turbine and Excitation Controls removal from Unit 2 Refurb scope - draft June 28, 2013	TG Turbine and Excitation Controls removal from Unit 2 Refurbishment scope with installation during 1st planned outage after Unit 2 Refurbishment	6/27/2013
1 oversight summary	Oversight Report#1	2/22/2013
2 oversight summary	Oversight Report#2	4/2/2013
3 oversight summary	Oversight Report#3	5/7/2013
Darlington Refurbishment Risk Management Plan	Risk Mgmt.	1/31/2013
DARLINGTON REFURBISHMENT RISK REPORT	Risk Reporting for the Darlington Refurb Progress	4/5/2013
ENTERPRISE RISK MANAGEMENT PROCESS AUDIT	Internal Audit report	Feb-13
Enterprise Risk Org Chart	Org chart	
Meeting Minutes March 2013 Risk Oversight Committee	Meeting minutes	3/12/2013
N-MAN-00120-10001 Sh RISK-03	Task Instruction – Closing Risks	
N-MAN-00120-10001 Sh RISK-05	Contingency Development And Management	7/19/2012
N-MAN-00120-10001 Sh RISK-06	Lessons Learned And OPEX Management	7/19/2012
N-MAN-00120-10001 Sh RISK-07	Assumptions And Decisions Management	7/19/2012
Nuclear Projects Risk Management Manual	Nuclear Refurbishment Risk Management	7/25/2012
Nuclear Projects Risk Management Process (1)	Nuclear Projects Risk Management Process	11/22/2012
OPG-MAN-08708-0001 Guide to Proj Risk Mgmt	Guide To The Project Risk Management Standard	12/23/2011
OPG-STD-0062 Proj Risk Mgmt Standard	PROJECT RISK MANAGEMENT STANDARD; correspondence attached to file	2/27/2012
Program Risk Register RADAR	Risks Mitigation - Summary (114 pgs)	4/4/2013
Program-RiskList	Risks Mitigation - Summary (118 pgs)	3/11/2013
RFR Overall risk list	Risk Mitigation summary by Category	4/4/2013
RFR-Level 1 and Level 2 Risks	Risks Level 1 and Level 2	4/4/2013
Risk Management Self Assessment	Self-Assessment rpt. details	4/14/2013
Risk Work Flow Diagrams	org chart/diagram	
ROC June 2013 Minutes	Meeting minutes	6/5/2013
ROC-June 2013	PPT presentation	6/5/2013
SNC Lavalin 2225_Corporate_Project_Risk_Mgt_Procedure	Risk Mgmt Procedure 2225	Sep-10
Visio-Sharepoint DB Relationship Map	Organizational Chart	3/11/2013
Wolsong OPEX re Estimating RFR	Feeder program breakdown	
Campus Plan Risks	Campus Plan Program	6/18/2013
Contract Management Risks May	Refurbishment Contract Management	6/18/2013
EA Risks May	Licensing & Environment	6/18/2013
ENG NS Risks May	Refurbishment Nuclear Safety	6/18/2013
ENG Proj Risks May	Refurbishment Engineering Projects	6/18/2013
ENG Risks May	Refurbishment Engineering	6/18/2013
Ops_Mtc Risks May	Operations and Maintenance	6/18/2013
Oversight Risks May	Management System Oversight	6/18/2013
PA Risks May	Public Affairs	6/18/2013
P-C Risks May	Planning and Controls	6/18/2013
Program Risk Register - Review of Risk Descriptions	Review of the Darlington Refurbishment Program Risk Register	Apr-13
RFR Contract Language - Target Cost and Risk	Definitions	7/3/2013
RFR Exhibit 3.5 Target Cost and Schedule	Exhibit 3.5- Development of the Execution Phase Target Schedule, Execution Phase Target Cost and Execution Phase Fixed Fee	
Risk List Program	Risks Mitigation - Summary	7/2/2013



DOCUMENT NAME	DOCUMENT DESCRIPTION	DOC. DATE
Risk List Projects run July 3	Risk Mitigation summary by Category	7/3/2013
Sample Program Risk Register Format	Risks Mitigation - Summary	4/4/2013
Section 3.5 RFR Contract-Risk Register	Section 3.5 for Definition Phase Work	
Supply Chain Risks	Supply Chain	6/18/2013
2011-CNSC-NPP-Safety-Report-INFO-0823_e	CNSC Staff Integrated Safety Assessment	Sep-12
03-21-13 -Chem and Environ	Transfer Ownership Plan – NR, Chemistry and Environment	3/21/2013
03-21-13 -ERT and SATM	Transfer Ownership Plan - Fire and Emergency Response	2/22/2013
04-11-13 Conv Safety	Department Transfer Ownership Plan – Conventional Safety	4/11/2013
02-04-13- Design Eng	Design Engineering	4/4/2013
02-04-13-WMa Transition plan	Transfer Plans Update	2/4/2013
02-22-13 Systems Transition Plan	Perf/Syst. Engineering	2/22/2013
02-25-13 Presentation Frank	Site Transition Oversight Committee	2/22/2013
03-07-13 - EP Presentation	Transfer Ownership Plan: NK38-PLAN-09701-10113 EP-01 R000	3/7/2013
03-07-13 -Licensing Presentation	Department Ownership Transfer Plan – LICENSING	3/7/2013
03-07-13 Operations	Transfer Ownership Plan: NK38-PLAN-09701-10113 OPS-01 R000	3/7/2013
03-21-13 Radiation Protection	Department Transfer Ownership Plan – Radiation Protection	3/21/2013
04-11-2013 CAP STOC pres	Corrective Action Control Group/MSO	4/11/2013
2013-04-25 - Nuclear Safety	Department Transfer Ownership Plan – Nuclear Safety Analysis	4/25/2013
FH Dept Transfer Plan	Department Integration/Transition Ownership Plan – Fuel Handling	
Training Transition STOC Apr 11_13	PROJECT TRAINING WORK PLAN	4/11/2013
Chemistry and Environment - Ownership Transfer Plan D2	Chemistry & Environment - Ownership Transfer Plan	11/26/2012
EP Ownership Transition Plan	Refurbishment Emergency Preparedness Ownership Transfer Plan	2/28/2013
FH Tansition Plan_LN (3)	FUEL HANDLING - INTEGRATION / TRANSITION PLAN	4/19/2013
Fire Protection - Ownership Transfer Plan	Fire Protection - Ownership Transfer Plan	11/15/2012
Licensing Ownership Transfer Plan	Licensing - Ownership Transfer Plan	11/23/2012
Maintenance Ownership Transfer Plan	Maintenance Ownership Transfer Plan	10/15/2012
MSO Department Ownership Transfer Plan	Corrective Action Control Group/Oversight - Ownership Transfer Plan	11/21/2012
Nuclear Safety Analysis Ownership Transfer Plan	Nuclear Safety Analysis - Ownership Transfer Plan	4/23/2013
OPS - Ownership TP	Operations - Ownership Transfer Plan	2/27/2013
Radiation Protection - Ownership Transfer Plan	Radiation Protection - Ownership Transfer Plan	11/1/2012
Work Managment Ownership Transfer Plan	Work Management Ownership Transfer Plan	11/23/2012
02-22-13- Mtce Presentation	Maintenance	2/22/2013
2012- Prj Execution Update_ Oct 19 2012 Final	TG, SG, RFR Constr. Update information	10/19/2012
COMBINED Agenda - July 19 2013	Refurbishment Work Program Integration Meeting	7/19/2013
COMBINED Agenda - June 13 2013	Refurb Work Prog. Integration Mtg agenda; top 5 milestones	6/13/2013
Conventional Safety - Ownership Transfer Plan	Conventional Safety - Ownership Transfer Plan	10/22/2012
Design Engineering - Ownership Transfer Plan	REFURB DESIGN ENGINEERING OWNERSHIP TRANSFER PLAN	8/19/2011
Licensing Ownership Transfer Plan (pdf)	Licensing - Ownership Transfer Plan	11/23/2012
Project Training Work Plan	scanned doc - Training Work Plan	6/10/2011
Refurb Work Program Integration Meeting COMBINED Agenda - June 3 2013	Refurb Work Prog. Integration Mtg agenda; top 5 milestones (docs attached to agenda)	6/3/2013
Systems-Components Eng. Ownership Transfer Plan	SYSTEMS/COMPONENTS ENGINEERING OWNERSHIP TRANSFER PLAN	11/15/2011



## **Report to Nuclear Oversight Committee**

**4<sup>th</sup> Quarter 2013**

**Darlington Nuclear Refurbishment Project**

**ONTARIO POWER  
GENERATION**

Burns & McDonnell  
Modus Strategic Solutions

November 12, 2013

## I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMCD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of October 31, 2013. The DR Project continues to advance toward its major goal of producing a Release Quality Estimate ("RQE") for final Board of Directors and Shareholder approval by October 15, 2015.

The following is a brief summary of the Project's most significant developments over the last quarter:

- **Retube & Feeder Replacement Project Risk:** The RFR project remains the DR Project's most notable risk, and the schedule for SNC/Aecon's Tooling and Definition work of the Mock-up has degraded significantly over the last quarter. From July 1 to September 30, 2013, SNC planned to earn \$61.0M. However, during this period, SNC/Aecon earned only \$43.2M (70% of plan). Additionally, SNC/Aecon first claimed that it was entitled to meet its late-finish payment milestones in its contract, a sure way to eat up schedule float and significantly increase the risk that it will not meet its dates to support the planned start of execution in 2016. OPG's RFR Management has rejected that approach and has required SNC/Aecon to develop a recovery plan to restore progress to the plan by May 2014 based on its target schedule. In addition, SNC/Aecon's Class 3 Estimate, which is also due in May 2014, is off to a slow start. The DR Team is committed to holding SNC/Aecon accountable for both a timely and a robust Class 3 Estimate. SNC/Aecon's progress will require close monitoring.
- **4c Cost Estimate Release:** The DR Team completed the Project's request for release of funding as part of the 2014 Business Plan ("4c Cost Estimate"). The DR Team used the 4c Cost Estimate to evaluate the status of the Project and all of its component parts, and address potential risks to the Project's success. In this Report, we provide our comments regarding the 4c Cost Estimate effort and recommendations for the development of the 4d Cost Estimate and related contingency model, which will be an important predecessor to the Release Quality Estimate ("RQE") in 2015.
- **DR Project Scope and Schedule Review:** Project scope and schedule assumptions were vetted and management issued its recommendations for reducing the DR Project's scope and "unlapping" the performance of Unit 2. The 4c Cost Estimate reflects these changes. BMCD/Modus found the process the DR Team used for revising its plan to be robust and in keeping with the Project's core mission and processes. The results achieved – reducing the Project's scope and focusing on a single unit refurbishment – are reasonably calculated to mitigate the Project's overall performance risks.
- **Balance of Plant ("BOP") Contracting Model Change:** BOP planning and related Engineering product are advancing well. Management has moved forward with suggested modifications to the BOP contracting model that should streamline the work and reduce performance risks, as well as advance the work to the detailed engineering phase that underpins a robust and reliable RQE. Engineering has geared up to support the BOP work and has met interim milestones. In addition, the scope reduction should positively impact both BOP and Engineering.
- **Campus Plan Project Risk:** The Campus Plan also remains a significant risk. The work on the D20 Storage Facility excavation has been impacted by unforeseen conditions and ongoing engineering challenges and is projecting to complete four weeks late. Management is taking appropriate action to bring needed focus to this work and the remainder of the Campus Plan scope.

Overall, the DR Team's senior leadership has positively responded to the recommendations in our Initial Project Assessment that we presented to the NOC last quarter as well as ongoing challenges. Attachment A to this Report summarizes the Project's current risks and generally tracks the Team's progress in implementing improvements to the Project's plan.



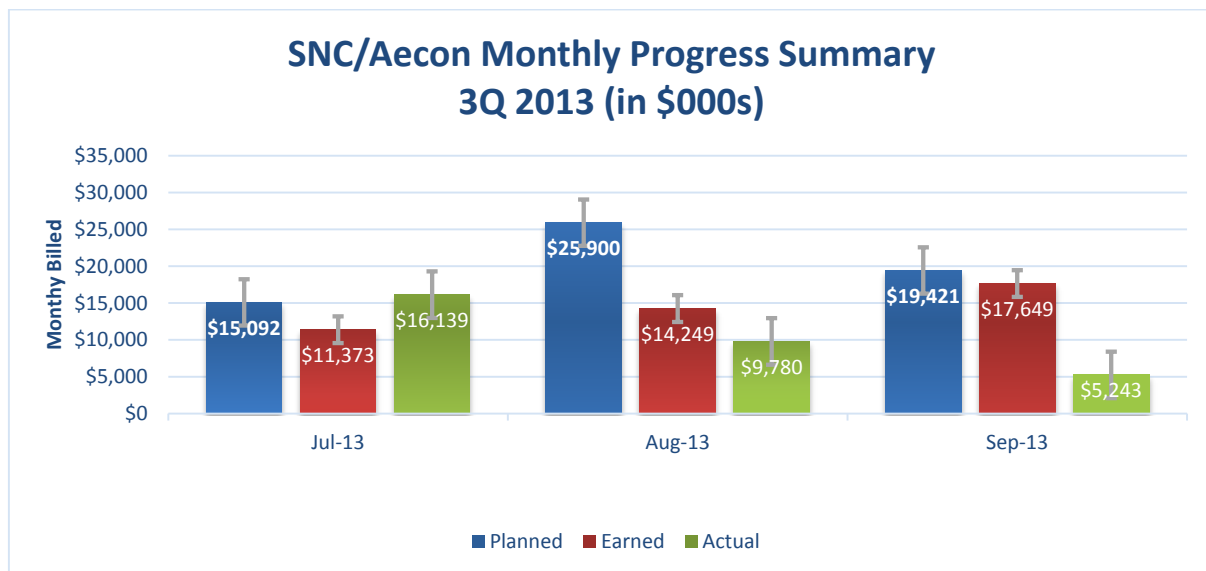
BMCD/Modus has worked with Internal Audit to identify areas within the Project's Assurance Plan that BMCD/Modus is covering in our Independent Oversight role. It is important to note that BMCD/Modus is not performing audits and that this assurance coverage will be performed under our existing reporting and lines of authority. As such, it should provide the DR Team some relief from "audit fatigue." We will continue to work at the NOC's direction in support of OPG's Assurance Plan.

## II. Major Projects – Summary of Key Risks

### A. Retube & Feeder Replacement

#### 1. Work Status – Tooling, Definition and Mock-up

SNC/Aecon is behind schedule in the Definition, Tooling and Mock-Up phases of its work and is continuing to trend downward for these scopes of work. When the DR Team baselined the C&C Schedule in June 2013, SNC/Aecon was essentially on or slightly ahead of plan. OPG's monthly report for July 2013 reflected that SNC/Aecon had planned to earn a total of \$168.6M, earned \$169.4M and expended \$165.7M, yielding a cumulative CPI of 1.02 and an SPI of 1.0. However, in the three months since the baseline, SNC/Aecon's progress has taken a significant turn for the worse. From July 1 to September 30, 2013, SNC planned to earn \$61.0M. During this period, however, SNC/Aecon earned only \$43.2M (70% of plan); notably, they only expended \$31.1M, or 51% of plan, which indicates they are not spending enough to keep pace. The chart below depicts SNC/Aecon's monthly earned and actual billings in comparison to its plan for each month of the 3<sup>rd</sup> Quarter 2013:



Overall, these figures when translated to schedule progress show SNC/Aecon was approximately 30% behind its planned schedule for 3Q 2013. SNC/Aecon's most significant delays appear to be:

- **RT Platform:** Originally planned to complete June 13, 2013; now that the schedule performance is visible, it is now apparent that this work is one year late and slipping; this is the critical path for the mock-up;
- **Procurements of Feeder Tube and Retube Waste Containers:** Originally planned for 2Q 2013, these procurements have slipped to 4Q 2013, and OPG is concerned with locking up key suppliers;
- **Multiple Planning Deliverables:** SNC/Aecon is late in preparing and providing to OPG its suite of processes and procedures for developing the Class 3 Estimate, Tool Quantification, Project Controls and Project Execution.

With respect to Tooling, SNC/Aecon reported on October 7, 2013 that its procurement and engineering were significantly behind schedule, such that SNC/Aecon's cumulative SPI was 0.80. Moreover, SNC/Aecon was projecting that its SPI will bottom out at 0.70 for several months and rise slowly well into next year. SNC/Aecon is projecting to be approximately 11% behind schedule as of May 2014 even with some substantial improvements over its current performance.

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OPG's RFR Management Team, now led by Roy Brown, has demanded a recovery plan from SNC/Aecon that will close this significant gap and return to the plan by May 2014 (the due date for the Class 3 Estimate and the next major project gate for RFR). In addition, in a Senior Project Management meeting with SNC/Aecon on October 25, 2013, OPG's team required and SNC/Aecon agreed to provide its target schedule as the baseline for the C&C Schedule going-forward. This will substantially increase SNC/Aecon's transparency. The Team has requested SNC/Aecon to support its recovery plan with meaningful data showing how it will obtain and utilize the necessary resources. The RFR team is also increasing its presence in Oakville and is probing SNC/Aecon's progress to ensure greater accountability.

BMcD/Modus draws the following conclusions from the review of project data:

- Management's recent actions with SNC/Aecon have set the proper tone of accountability. This is a very positive step, as OPG's senior project leadership recognizes the importance of working with the contractors to overcome challenges. It was also timely, in that catching these trends now at this early stage allows for course corrections at an opportune time before the teams become entrenched. We will now measure SNC/Aecon's performance against its recovery plan to see whether it has properly received the message.
- The current SNC/Aecon situation shows the importance of tracking contractors based on earning rules that have interim steps based on tracking ongoing physical progress and key commodities. Placing too much importance only on deliverables and completion milestones will result in tremendous peaks and valleys, making forecasting and accurate progress reporting very problematic. BMcD/Modus recommends earning rules to be structured based on a combination of physical progress and milestones, utilizing earned work hours and commodities bought/installed as the basis for earned value.
- The DR Project's reports should have more emphasis on period-over-period performance so that negative trends are more easily discernible from the project's data. The monthly Project Status and Program reports show monthly variances but the metrics focus on cumulative results which can easily mask the velocity of performance changes. Correcting these trends requires their visibility.
- OPG should not hesitate to request the contractors to provide the information it needs to properly manage the work. As an example, OPG will be hampered in gauging SNC/Aecon's recovery plan if it does not receive actual work hours and costs for every activity, regardless of whether the work is part of a fixed-price component. SNC/Aecon will likely have to commit significant resources for recovery and the only way OPG can be assured of SNC/Aecon's commitment will be if SNC/Aecon is transparent in all aspects of the plan and execution.
- Since the RFR Project consists of approximately 45% of the DR Project's overall measured earned value, these poor indices have, and will continue to, drag down the entire Project's earned value until or unless this performance trend is corrected by SNC/Aecon.

BMcD/Modus is closely monitoring this situation, and has been invited to attend progress meetings with SNC/Aecon's management.

## 2. SNC/Aecon Class 3 Estimate Plan

SNC/Aecon is required under the contract to submit its next phase of estimate on May 15, 2014. This estimate has been termed a “Class 3 Estimate” though, as with the earlier SNC/Aecon Class 5/4 estimates, the AACE-based definition for this estimate is imperfect at best. While this Class 3 Estimate will turn the focus from OPEX gathered at other stations to DNGS, it will still not account for risks, nor will it strictly adhere to other AACE requirements. The DR Team recognizes the need to monetize risks in concert with the Class 3 Estimate and will seek visibility to these risk items. The SNC/Aecon and OPG Teams are meeting weekly to reach an agreeable Class 3 Estimate Plan which should put the concerns over the basis of the estimate to rest.

SNC/Aecon’s team announced at the October 28, 2013 project meeting that the Class 3 Estimate development has no float through May 15, 2014. BMcD/Modus identified that SNC/Aecon’s Monthly Report for September 2013 showed SNC/Aecon had earned extremely little time (only 335 hours) in preparing the Class 3 Estimate to date. SNC/Aecon believes that there is an anomaly or error in this report, though the amount of work apparent to date on the Class 3 Estimate suggests that SNC/Aecon needs to significantly ramp-up this effort. This also bears close monitoring over the next quarter.

### B. Scope Rationalization Process / Unlapping of Unit 2

In 2Q 2013, the DR Team’s Senior VPs initiated a process to review, scrutinize, and rationalize the DR Project’s scope. This process was performed by a “Tripartite Review Team” drawn from the Project Team, the station and a team of independent reviewers including VPs external to the DR Project who have knowledge of the plant. The Tripartite Review Team evaluated the DR Project’s scope with a view of the Project’s objectives as well as requirements/commitments that have been made to the CNSC. The Tripartite Review Team’s results were aggregated and presented to the DR Project and DNGS station representatives for future review and disposition by the Project Scope Review Board (“PSRB”).

In all, the Tripartite Review Team reviewed 579 DSRs with an estimated value of \$4.865 B and determined that 210 DSRs with an estimated value of \$212M should be removed from the DR Project’s scope. In addition, 22 DSRs totaling \$125M are slated for further review and potential future action. The chart below summarizes the results of the Tripartite Review Team’s evaluation:

**Tripartite Review Team Recommendations**

Funding Stream	Total DSR Database	Confirmed To Perform in Refurb.	Not Reviewed <sup>1</sup>	Further Review Needed/Potential Further Reduction	Recommended to Cancel
<b>Nuclear Refurbishment</b>	\$4,827	\$4,468 M	\$32 M	\$125 M	\$202 M
<b>Other</b>	\$70 M	\$60 M	\$0	-	\$10 M
<b>Total</b>	<b>\$4,897 M</b>	<b>\$4,528 M</b>	<b>\$32 M</b>	<b>\$125 M</b>	<b>\$212 M</b>

BMcD/Modus has followed this process from its conception and found it to be robust. In fact, the DR Team should review OPEX from this process to improve the gate process. We have the following observations:

<sup>1</sup> These DSRs were not considered by the Tripartite Review Team and thus remain the DR Project’s scope.

- The Tripartite Review Team's findings indicate that significant scope reductions can be achieved in order to reduce risk in certain aspects of the DR Project. In addition, the process has reduced the Project's budget, though not necessarily as much as was initially anticipated.
- The process also challenged the value and overall scope of items that remain in the DR Project, and provided additional guidance for contingent scope items and future potential reductions.

BMCD/Modus has reviewed the documentation and related analyses supporting the scope recommendations and decisions made by Tripartite Review Team and found them to be acceptable and generally complete. There will be considerably more documentation needed for PSRB presentation and disposition, though the preparation of this documentation should not be a cause of delay for the PSRB to render its decisions.

Simultaneous to the Scope Rationalization, the DR Team was instructed by Management to change the planning assumptions for the Project's refurbishment schedule, resulting in the unlapping of Unit 2 from Unit 1. As noted in our Initial Project Assessment, BMCD/Modus sees this change as a positive for the Project so long as there is a strong technical basis for life extension of the remaining units. The revised schedule should substantially reduce the overall risk of the Project and result in valuable lessons learned for the performance of the remaining units.

### C. Campus Plan

The Facilities and Infrastructure Projects that are part of the Campus Plan remain a significant risk to the DR Project. The projected 4 week delay to the D20 Storage Facility's excavation and another one month delay to the building's engineering are just the latest in a series of events. In addition, current estimates have put this sub-project's cost at \$20M above the \$130M budget. While the D20 Storage Facility differs from much of the Campus Plan work in that it is inside the security fence, the risk of this portfolio is its sheer volume and the multitude of tasks that must get done prior to opening breaker on the Unit 2 Outage.

The DR Team's senior leadership is taking action to turn the performance around, including:

- Additional focus on helping the ESMSA vendors' design partners' efforts by co-locating with OPG resources;
- Developing a plan to integrate all of the pre-requisite work into a large project with an integrated schedule so that the ESMSA's can properly plan and resource load the work and OPG can manage the contractors' work load and performance.
- Completion of work allocation to each of the vendors so that the ESMSA can properly plan their work.

The Campus Plan work will require close monitoring over the next several months.

### D. Balance of Plant

In the Initial Project Assessment, BMCD/Modus expressed concerns over the plan for the BOP work, which we believed could have impacted the quality of the RQE. Specifically, we believed the BOP plan had unnecessary steps for procurement and assignment of work that would deprive the ESMSA vendors with requisite time to perform the detailed design, which in turn would increase the risk and variability around the BOP work at RQE.

In our last report to the NOC, we noted that the DR Team's Senior Leadership was fully aligned with our observations and was in the process of moving forward with streamlining the BOP work. The DR Team is planning to direct-assign work to the ESMSA contractors on an equitable basis in keeping with the principles in the ESMSA contracting strategy. In parallel, the BOP Team has been preparing plans for this split of work and Engineering is preparing to support the ESMSA in the engineering phase. Now that this work is moving forward and in the right direction, it will be critical for the DR Team to learn from the OPEX from the D20 Storage Facility and work hand-in-hand with the vendors to produce a quality design product. In addition, many of the changes initiated with the Campus Plan should benefit the BOP work, as this work can

be used as a beta test for many of the processes put in place. The DR Team's actions are encouraging and should lead to a better result.

### **III. Vetting of 4c Cost Estimate**

#### **A. Summary of 4c Cost Estimate**

As noted, the DR Team finalized its 4c Cost Estimate and 2014 Business Plan input and presented the results to the Board for its approval. The 4c Cost Estimate was not a full reforecast of the DR Project's costs; instead, it was developed to show variances from the predecessor 2013 Business Plan ("4b Cost Estimate") which the Board approved. A summary of the 4c Cost Estimate and the results of the variances from the 4b Cost Estimate are summarized in Attachment B. The DR Project's cost estimate currently stands at \$10.8 B including contingency and management reserve.

As the Project progresses toward RQE, the DR Team is working to reduce the Project's cost estimate to \$10 B. This goal appears to be reasonable and can be achieved through: (1) continued maturation of the Project's planning; (2) corresponding reductions of both the Project's overall point cost estimate and related contingency, and; (3) locking down or further reducing scope and determining that results from the remaining scope defining inspections are favorable. The DR Team has currently identified approximately \$158 M of cost reductions that will be specifically scrutinized over the next year. In addition, there are other opportunities for cost reduction and re-allocation that OPG may consider, in particular, the characterization of Operations & Maintenance ("O&M") support costs, which currently total \$871 M. The DR Team is studying the projected "value add" cost that O&M will be providing directly to the Project. OPG should investigate whether it can characterize the remaining O&M cost as a regulatory asset and not burden the Project with that cost.

In reviewing the 4c Cost Estimate, BMcD/Modus focused more on the processes that the DR Team used in developing this estimate than the actual results. In our Initial Project Assessment, we recommended that OPG consider the 4d Cost Estimate that the DR Team will be presenting for next year's Business Plan a "dry run" for RQE, and that recommendation has been embraced by Senior Management. With that understanding, we have looked at the development of the estimate as a way of testing certain key assumptions that OPG has put forth and we will provide recommendations for improving those processes, as necessary.

BMcD/Modus's vetting exercise has focused on the following with respect to the 4c Cost Estimate:

- Reasonable sampling of the 4c Cost Estimate to validate the underlying basis of the estimate;
- Assessing the efficacy of the processes that the DR Team has put in place for scope control, most notably the Gate Process;
- Review of methods used for contingency and management reserve derivations; and,
- Review of systems that the DR Team is developing to report on cost development.

The results of our review and related recommendations for the next phases of cost estimating are summarized below.

#### **B. Sampling and Validating of 4c Cost Estimate**

In our August 12, 2013 report to the NOC, we emphasized the importance of the Project Team properly characterizing the basis of the cost estimates it was putting forward for Board approval. In the case of the 4c Cost Estimate, the DR Team has characterized the estimate as one that generally meets the AACE's definition of a Class 5 or Class 4 estimate. Typical expected accuracy ranges for Class 5 estimates are (-20% to -50%) on the low side, and (+30% to +100%) on the high side, and Class 4 estimates range (-15% to -30%) on the low side, and (+20% to +50%) on the high side.

BMcD/Modus performed some reasonable sampling of the 4c Cost Estimate including:

- Detailed vetting of the current SNC/Aecon cost estimate for the RFR work;
- Review of six DSRs in the BOP scope that total \$67 M, or 14% of the BOP Basis of Estimate cost;
- Review of one DSR in the Turbine Generator sub-project scope that totals \$119 M, or 17% of the projected turbine Basis of Estimate costs.

In all, we considered approximately 64% of the project bundle costs. In this review, we vetted the nature of the driving aspects of these cost estimates, including: work hour derivations, labor and productivity modification factors, allowances, and the like. Our purpose in doing so was to confirm the basis of the estimates' components and the level of maturity underlying the information. In addition, we reviewed the development of the OPG costs for project management and support, which are essentially drawn from head counts of staff and flowed-out over time. This analysis essentially confirmed that the DR Team has prepared and presented an estimate that generally conforms to the AACE Class 5/4 definitions. This characterization is generally confirmed by the DR Project's current overall status at this time.

As noted in our Initial Project Assessment, the 2015 Business Plan ("4d Cost Estimate") will need to reflect an expected leap in Project maturity that will occur over the next 8 to 10 months; thus, we would expect that the quality of OPG's estimate would parallel that increase. BMcD/Modus has the following additional observations and recommendations for development of the 4d Cost Estimate and 2014 Business Plan:

- With the expected ramp-up of the amount of information needed to support estimates, the DR Team should focus on improving traceability, sourcing, vetting and suitability of database information underlying the estimate as this will be even more essential for vetting the Class 3 Estimates.
- Quality control will be critical as the estimates move from ranges to point numbers. The DR Team may consider migrating to a standard estimating platform such as SNC/Aecon is now utilizing for its Class 3 cost estimate.
- Many of the tools Finance and Project Controls developed for reviewing of the 4c Cost Estimate should find their way into the metrics the DR Team uses in an attempt to increase cost consciousness.
- Vetting of OPG costs was impacted by the timing of the 4c Cost Estimate effort, which began in the middle of the summer months. The next phases of estimating should have a schedule of activities and begin earlier in the year, particularly considering the increased complexity expected for the 4d Cost Estimate.

Attachment C provides more details regarding our review of the 4c Cost Estimate. Our comments and recommendations are geared toward helping OPG to strengthen its review of costs for this next critical phase of estimating.

In summary, BMcD/Modus found that the processes the DR Team used to develop the 4c Cost Estimate were robust and generally conformed to customary practices for an AACE Class 4/5 estimate. The DR Team has also properly characterized the nature of the estimate that it has advanced for approval. The DR Team has also conceptually accepted our recommendations regarding its going-forward activities, though implementation of those recommendations will require focus and attention over the next 10-12 months, as development of the 4d Cost Estimate will be an ongoing effort.

### **C. Evaluation of Gate Process**

The DR Team is utilizing the Gate Process for evaluation of cost, scope and schedule [Nuclear Projects Gated Process, N-MAN-00120-10001-GRB-R001]. Each portion of the work as it matures is subject to a "gate" review in order to obtain full funding for the successive phase of the work. To date, majority of the gate reviews have been for projects in early planning stages, though over the next 12 months, passing through gates will require considerably more rigor. Thus, the Gate Process represents an interim step between the cost forecast efforts to evaluate and vet key elements of the Project's cost and maturity level.

BMcD/Modus has evaluated the Gate Process in concept and in practice, as well as participated in a number of Gate Review Board ("GRB") meetings. We have also sampled multiple "gate packages" that the Project Team has prepared.

The process itself is well-formulated and should serve the intended purpose. However, the DR Team's execution within the process should be addressed. From our sampling of the process, we have found the DR Team is not consistently developing the materials needed for the GRB's evaluation. Some comments and recommendations are as follows:

Observation from Gate Review Process	Recommendations
Quality and consistency of the materials in Gate packages should be addressed. Gate review packages are often hastily assembled by the project teams and provided to the GRB only shortly before the gate review meetings.	<ul style="list-style-type: none"> <li>➤ Gate package development should follow the existing schedule and key documents should be delivered well in advance of the GRB.</li> <li>➤ The quality of the gate packages presented to the GRB would be improved by timely delivery of materials prior to pre-vetting sessions within the Project Team.</li> </ul>
Within gate packages, there are requirements for explaining variances in cost estimates, there is no formal controlled process for presenting these changes. We have generally found little consistency between the various files kept on the bundles, and in some cases, the estimates used for gate reviews were not preserved.	<ul style="list-style-type: none"> <li>➤ Improve record keeping and chain of document retention.</li> <li>➤ Provide a reconciliation of the estimates presented with the gate package to prior estimates (i.e., 4b, 4c) and the basis of estimates so that changes can be traced and sources are identifiable.</li> <li>➤ Provide an estimate reconciliation within the standard gate package template.</li> <li>➤ The estimates developed for evaluation at the gates should follow the same general vetting methodology and adhere to the same quality and consistency standards described in <b>Attachment C</b>.</li> </ul>
Although designed to provide a forum for challenging scope and cost estimates, the gate review process has thus far had mixed results for that purpose.	<ul style="list-style-type: none"> <li>➤ In addition to Project Controls, the DR Team should consider utilizing a 3<sup>rd</sup> Party (e.g., Finance and the Controllershship) to provide an independent analysis and examination of the sufficiency of the gate packages. The 3<sup>rd</sup> party can report to the GRB its findings and concerns.</li> </ul>

Now that the Project's scope has essentially been determined, the Team's focus should turn to fully supporting the work that will be done in the Gate Process. We have recommended to Management the need to drive down to the lowest levels of the DR Team the importance of schedule and cost consciousness. Senior Leadership has accepted these recommendations and is implementing changes to the process that should address these concerns.

#### **D. Assessment of Contingency and Management Reserve**

BMCD/Modus undertook a review of contingency to determine how discrete risk elements are accounted for in the 4c Cost Estimate. Our review found that while risks are being identified and analyzed in a reasonable manner, the value of individual risks are not directly traceable or otherwise transparent all the way through the estimate to the bottom line. Instead, management has made a decision to carry Monte Carlo Output risk amounts at a more global level, namely, at the project bundle level only. As a result, discrete risks and associated amounts are merely subsumed into a single contingency number with no tractability back to the individual risk elements.

BMCD/Modus has the following observations regarding the methods the DR Team is using for establishing and managing contingency and management reserve:



- As noted in our Initial Project Assessment, the DR Team needs wider and increased appreciation of the importance of accurately identifying risks and related parameters. Furthermore, as evidenced by a review of the risk register, more than a few DR Team members do not understand the distinction between management performance issues and true project risks. Senior management needs to continue to focus the DR Team on weeding-out unnecessary risk items that take up management time and attention.
- The risk group needs to be more involved and empowered as part of the initial risk identification efforts. Challenge meetings would help to identify true project risks and proactively eliminate false risks and duplicate inputs.
- OPG's choice to aggregate risk at the bundle level is not without precedent in the industry. However, given this choice, OPG will lose transparency as well as the ability to focus on and manage individual post-Monte Carlo risk amounts, which is particularly important for addressing the Project's most significant risks. Without having a discrete risk basis for formulating contingency, project managers will need to request individual Monte Carlo analyses on selected risk items and expend extra effort to track those risks. In addition, such retrospective calculations will not be consistent with the results of bundled-level analyses.
- The distinction between Management Reserve and Contingency needs further definition as do the rules for allocation of funds.
- Future cost estimates should include a composite roll-up of contingent scope so that the extent of the "unknowns" in the estimate are transparent.

At this time, BMcD/Modus have not undertaken an analysis of the specific amounts of contingency and management reserve being held or the adequacy of this reserve. However, as the estimate progresses toward RQE, the derivation of contingency will become increasingly important. Going forward, BMcD/Modus would expect to see contingency dollars for the Project's most significant known risks developed on a deterministic basis with stochastic modeling limited to chances of occurrence. Future reports will focus on how well contingency and management reserve is defined, calculated, managed, and released to the Project.

## **IV. Functional Group Update**

### **A. Schedule**

In our Initial Project Assessment, BMcD/Modus identified several concerns with the DR Team's plan for the development of the Project's Execution Phase schedule. The DR Team is currently populating the schedule utilizing the Coordination & Control ("C&C") Schedule. We questioned the application and efficacy of this approach, particularly for the Execution Phase. Our chief concern with the C&C Schedule was the point of integration between the contractors and other work groups. Per the Team's original Schedule Management Plan, this integration would occur at Level 2 and not at the detailed Level 3, which we saw as problematic, as the determination of a Project's critical path relies on linkage of detailed activities. We also saw that developing the C&C Schedule was diverting the Team's attention from the integration, assessment and reporting of the Level 3 pieces of the schedule. We articulated additional concerns in our Initial Project Assessment regarding earned value tracking and schedule performance.

Subsequent to our Initial Project Assessment, in further examination of the schedule, we noted some additional issues in the DR Team's plans for integration of the DR Project's Execution Phase—including the fact that the Project Managers' expressed preference to integrate and otherwise use the Level 3 schedule as the tool for day-to-day management during the Execution Phase. Additionally, the DR Team's ability to resource load and manage the work force will be an issue of growing significance, as doing so requires the Level 3 details. Since future contracts (most notably RFR and BOP) are based on target price arrangements, it is essential that the operative schedule is resource loaded; otherwise, the Project Team will lack an essential tool for holding the contractors accountable to their budgets. Thus, the DR Team has now recognized that the best use of the C&C Schedule is for developing the plan during the Definition Phase while the integration of the execution schedule should occur at Level 3.



In consultation with the Project Controls Team, we have made certain recommendations related to the path forward for schedule development, including:

- The Master Schedule the Project Team will use to manage the Execution Phase of the DR Project should be populated with fully integrated Level 3 schedules to form the Project's critical path. This Master Schedule should be the primary tool for determining the status of the Project, and include comprehensive critical path and sub-critical paths, as well as full resource loading. The Level 3 activities will be coded to roll-up to Level 2, thus eliminating duplicative effort.
- OPG will continue utilizing the C&C Schedule but not for its originally intended purpose. The DR Team will consider the C&C Schedule as the "Plan for the Plan" that it will use to detail and track the Project Team's efforts to populate the Level 3 schedule. Currently, there are only a small number of executed contracts so fully integrating at Level 3 is not currently possible. As the maturity of the schedule increases, the DR Team can explore further integration at the detailed Level 3. The C&C Schedule will be updated through RQE on a monthly basis, though operative Level 3 execution work, such as the RFR Mockup, Campus Plan and Fuel Handling, will be updated at Level 3 as necessary. This will provide an opportunity for the DR Team to test the schedule well in advance of breaker-open on Unit 2.
- For areas of work for which there is currently no submitted schedule by a contractor, OPG should develop placeholders to the extent necessary. Such placeholder schedules should include enough detail that nature of the work, key milestones and integration points with other work groups are apparent.
- Commercial contracts should reflect specific schedule requirements that govern such things as resource loading, activity durations, float patterns and banning schedule devices that keep a schedule from calculating. To the extent that certain contracts have already been negotiated, OPG should, if necessary, incorporate its expectations for obtaining earned value, including contractor's budgets and actual work hours per schedule activity, as well as schedule development into existing contracts.
- Project Controls will need management support to hold the work groups accountable for developing and utilizing the Master Schedule, including developing forums for discussion of the Execution Phase Master Schedule status and preparation.

To the extent OPG agrees with these recommendations, the Program Schedule Management Plan and related processes will require revision to explain these changes. OPG will also need to address and simplify the WBS coding structure as necessary.

## **B. Engineering**

Engineering continues to make progress in performing the MDR/MDP work that is needed for completing the procurement and scoping of the Project. Engineering reported in October that it had met an interim goal of completing 75 MDRs two months earlier than the milestone date. Engineering's focus on MDP's has resulted in a number of improvements since the start of our engagement:

- Closer working relationships between OPG and the two OSS vendors, AMEC and WorleyParsons;
- Improved quality of the MDP packages;
- Risks are being more closely evaluated, which ultimately will require less contingency in estimates for work;
- Efficiencies have been gained from collocating staff and the 'leaning-out' of the administrative process.

Whereas there is room for further gains in each of these areas, maintaining the current pace of MDP package development will satisfy the schedule needs of the DR Program. There are still 51 remaining MDRs, of which 20 are currently in process. All of these MDRs will need to be completed by April 1, 2014, which means that Engineering will have to continue its focus on producing MDRs/MDPs.

The next challenge for Engineering will be to morph into an organization that can manage the next phases of work, and here remains some concern. Engineering will have multiple roles, from design authority to reviewer of the various EPC contractors' work-product to developing the restart plan for the units. This will require a significant planning effort. However, because the effort needed to produce MDPs has sapped Engineering to such an extent, the knowledge and experience of DR team members is not currently being applied to a forward-look at this next phase of work.

BMcD/Modus has advised the Engineering team to embrace active management of the engineering effort and look for solutions to help the EPC vendors navigate the detailed design phase. We have advised the team to examine certain of the principles in the Construction Industry Institute's (CII) Front End Planning for Revamp and Renovation Projects.

The Engineering Team has completed its review of the phases of engineering and has prepared a new tool for tracking progress and claiming earned value. This work should also help with the Engineering team's attempts to further plan and execute the work.

### **C. Risk**

In our Initial Project Assessment, BMcD/Modus provided our views regarding certain deficiencies in the DR Project's risk program. Since that time, and in concert with the 4c Cost Estimate effort, the DR Team has made an effort to vet the risk database and increase the quality of its content. There has also been an increased effort to adequately train the DR Team on proper Risk Management techniques. This work is ongoing and will require greater focus as the DR Team begins the full reforecast of costs in the next business plan cycle. BMcD/Modus will provide a more detailed status of these efforts in our next report to the NOC.

### **D. Project Team Development**

In the Initial Project Assessment, we stressed the need for the DR Team to recognize the role OPG plays in managing the work, begin to break down the Project-based silos and begin developing the Construction team upon whom the day-to-day management of this Project will reside. Since our last Report, we have seen some steps in this regard, and the Project's Senior Leadership is moving in the right direction. Many of the changes the DR Team is initiating with its scheduling methodology will foster greater focus and a more cohesive view of the Project's development and execution. The DR Team's integration will be of significant focus through RQE and into breaker-open of Unit 2.



# **Attachment A**

## **4Q Risk Perspective**

**Report to Nuclear Oversight Committee**

**4<sup>th</sup> Quarter 2013**

**Darlington Nuclear Refurbishment Project**



## Attachment A – 4Q 2013 Risk Perspective



Area	Observations	Low	Medium	High	Current Status / Mitigation
RFR	<b>SNC/Aecon Performance:</b> Largest Program risk due to overall risk to the DR Project and OPEX				<ul style="list-style-type: none"> <li>Recent performance trend in tooling, procurement and engineering of the mock-up is well below plan</li> <li>Working to late finish milestones, leaving no room for error or delay</li> <li>Project Team has ordered recovery plan by May 15, 2014</li> </ul>
	<b>Class 3 Estimate:</b> Progression to RQE requires SNC/Aecon's Class 3 Estimate to be thoroughly vetted				<ul style="list-style-type: none"> <li>Class 3 Estimate preparation is significantly behind schedule</li> <li>Completing estimate to OPG standards by May 15, 2014 will be challenging</li> <li>OPG team actively engaged in vetting plan and estimate</li> </ul>
	<b>Schedule Development:</b> Level 3 schedule based on payment milestones; task durations and float unrealistic				<ul style="list-style-type: none"> <li>Project Team has taken action and required SNC/Aecon to provided resources loading and measure progress via target schedule</li> <li>Implementing the recovery plan and schedule changes will take transparency and focus</li> </ul>
BOP	<b>Contracting Strategy:</b> Alterations needed to advance work to detailed design as quickly as possible				<ul style="list-style-type: none"> <li>Final approvals for contracting strategy have been obtained</li> <li>Project Team is already working to move work forward</li> <li>Needs final sign-off from all stakeholders</li> <li>More focus by management on engineering and scope coordination</li> </ul>
	<b>ESMSA Performance Issues:</b> Concern over ESMSA contractors' performance and ability to execute BOP work				<ul style="list-style-type: none"> <li>Allocation of work from revised contracting strategy will emphasize each contractor's strengths</li> <li>Risk of ESMSA Performance will continue until improvements on performance issues in Campus Plan are observed</li> </ul>
Scope	<b>Review Period:</b> Urgency mounting for scope review; planning/prep underway for work that may be eliminated; concerns regarding scope				<ul style="list-style-type: none"> <li>Tri-partite review followed a deliberative process and netted positive results</li> <li>Scope removed from DR Project will be engineered and planned</li> <li>Needs final close-out</li> </ul>
Campus Plan	<b>Project Status:</b> D20 Storage Facility work is behind schedule and causing critical path to the TRF				<ul style="list-style-type: none"> <li>Lessons learned are being collected and disseminated</li> <li>Management is taking appropriate action to schedule and plan work</li> <li>Vendor performance/unforeseen issues remain risks</li> </ul>
	<b>Engineering and Planning:</b> D20 provides key lessons learned for remaining Campus Plan and BOP				<ul style="list-style-type: none"> <li>Engineering is co-locating with ESMSA vendors</li> <li>Clarification of RFPs and process ongoing</li> <li>Modifications to planning and scheduling underway</li> </ul>
Schedule	<b>Unlapping and Reduction of Risk:</b> Performance of Unit 2 as a stand-alone will reduce risk				<ul style="list-style-type: none"> <li>Risk avoidance and decision-making prudence have been further quantified</li> <li>Impact on Project plan is being considered</li> <li>Commercial planning and strategy is being developed awaiting BOD</li> </ul>
	<b>Continued Schedule Development:</b> Schedule approach was unproven; integration at appropriate level at risk				<ul style="list-style-type: none"> <li>Project Team has generally accepted BMCD/Modus's recommendations</li> <li>Revised schedule should reflect organizational change to flatten "silos" and manage as a single project</li> </ul>



## **Attachment B**

### **Variance Report 4b v. 4c Cost Estimates**

### **Report to Nuclear Oversight Committee**

**4<sup>th</sup> Quarter 2013**

**Darlington Nuclear Refurbishment Project**

OPG CONFIDENTIAL AND COMMERCIALY SENSITIVE - NOT FOR RE-DISTRIBUTION

Date: Oct 2, 2013

Refurbishment Estimate - Variance -Release 4c - Release 4b

Categories			Description of Work	Definition Phase				Execution Phase											Total Program (Variance)	Comments	
				LTD 2013	2014	2015	Total	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026			Total
Overnight Costs	DPP EPC	Retube & Feeder Replacement	Contract Award, tooling and Mock up	(42)	(76)	24	(94)	(19)	(29)	(131)	(159)	(80)	26	43	141	11	88	-	(108)	(202)	
		Fuel Handling	PM, Engineering and some Materials	(4)	(4)	(26)	(34)	(6)	(12)	(12)	(10)	(10)	(7)	(9)	(1)	-	-	-	(67)	(101)	
		Defueling	PM, Engineering and some Materials	4	4	6	14	1	1	-	0	0	-	-	-	-	-	-	3	16	
		Specialized Projects	SDS/ Vault Cooler	5	4	14	24	12	1	2	1	1	1	1	1	-	-	-	21	45	
		Steam Generators	PM & Engineering only	-	(23)	(16)	(39)	(13)	(11)	(9)	(23)	(11)	2	(3)	11	14	0	-	(42)	(81)	
		Turbine Generators	PM, Engineering and some Materials	(1)	(18)	8	(11)	20	5	5	5	13	17	42	29	26	29	6	197	186	
		Balance of Plant	Pre requisite, PM, SIO and Eng'rg Projects	(27)	(20)	(16)	(63)	24	(11)	(10)	(9)	(5)	(2)	(5)	4	2	8	-	(5)	(68)	
		Islanding	Engineering and ordering of Materials	(9)	1	6	(3)	(4)	8	(13)	1	4	6	6	24	1	7	0	40	38	
		System Shutdown	Engineering and ordering of Materials	(3)	8	15	20	4	(4)	(3)	(1)	(1)	3	5	3	3	3	3	15	34	
		Infrastructure Projects - Refurbishment In-Station	Facilities inside protected area required to support Refurbishment	(3)	(6)	(6)	(15)	(3)	-	-	-	-	-	-	-	-	-	-	(3)	(18)	
		Infrastructure Projects - Holt Rd	Holt Road improvements	(7)	2	6	1	-	-	-	-	-	-	-	-	-	-	-	-	1	
		Total DPP EPC		(88)	(128)	15	(201)	16	(53)	(170)	(194)	(88)	46	80	213	56	135	9	50	(151)	
	Operations/Maintenance Support		All costs (less Trainees)	(2)	4	3	4	(4)	(15)	(19)	(20)	(19)	(9)	(7)	12	25	55	8	8	13	
	Waste Management			-	-	-	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	-	-	(0)	(0)	
	New Fuel			-	-	-	-	-	-	-	(0)	(33)	33	(33)	33	(33)	33	-	(1)	(1)	
	Facilities & Infrastructure Projects (CR Projects)			14	(4)	35	46	(3)	(6)	(2)	(0)	-	-	-	-	(2)	-	-	(13)	32	
	OPG Oversight and Support - DPP	Execution	Proj O/S, Proj Mgrs, Unit Exec., Matrix stf	28	23	17	68	5	(4)	(3)	(1)	(2)	(0)	1	1	10	22	8	38	106	
		Security		(0)	0	0	(0)	0	0	0	0	0	0	0	0	4	5	1	12	12	
		Facility Maintenance		-	-	(0)	(0)	(0)	(0)	(1)	(1)	(1)	(0)	(0)	(0)	(0)	4	4	6	6	
		Engineering	Design, Projects, and VP	(2)	5	6	9	3	1	2	2	1	2	2	2	2	5	2	25	34	
		Ops/Mtce Trainees	Operations Trainees	(1)	(1)	1	(1)	3	0	-	-	-	-	-	-	-	-	-	3	2	
		Proj Planning & Cntls		1	(2)	(2)	(3)	(3)	(4)	(4)	(4)	(4)	(4)	(3)	(2)	(0)	4	3	(22)	(25)	
		Supply Chain & CS	(include Matrix)	(7)	(0)	(1)	(8)	(1)	(2)	(1)	(1)	(0)	(0)	(0)	(0)	0	3	1	(2)	(10)	
Quality Management			2	4	4	10	2	2	2	2	2	2	2	1	1	2	0	17	28		
Program Support		Includes HR, Finance, Public Affairs, External Oversight, Admins	(3)	(4)	(5)	(13)	(6)	(6)	(6)	(6)	(6)	(5)	(5)	(4)	(3)	2	2	(41)	(54)		
		Liability Insurance	-	2	7	9	10	7	3	1	(4)	(4)	(4)	(4)	(2)	2	-	3	12		
		Facility Costs	0	(0)	(0)	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	5	4	8	8		
		Licensing (Reg Office and CNSC Fees)	(1)	2	1	1	1	1	0	(4)	(5)	(0)	(0)	0	(4)	3	1	(6)	(5)		
Preliminary Planning (excluding F&IP)		Release #3	14	(0)	-	14	-	-	-	-	-	-	-	-	-	-	-	-	14		
Nuclear Safety		Excludes ISR	(2)	2	(1)	(1)	(1)	(2)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	-	-	(10)	(11)		
Total DPP Oversight & Support		29	30	27	86	12	(6)	(9)	(12)	(19)	(11)	(8)	(6)	8	57	26	31	117			
Reserve		Contingency	Includes F&IP	(35)	32	21	18	(295)	(234)	(153)	(175)	3	212	243	243	139	98	-	82	100	
	Management Reserve		-	-	-	-	(38)	(38)	(96)	(96)	(38)	(38)	(15)	(4)	(4)	(4)	-	(371)	(371)		
			(35)	32	21	18	(333)	(272)	(248)	(271)	(35)	174	228	239	135	94	-	(289)	(271)		
			(82)	(67)	101	(48)	(312)	(351)	(448)	(497)	(194)	232	261	491	188	374	43	(214)	(261)		
\$ of Year	Interest		(7)	(5)	(8)	(20)	(16)	(30)	(49)	(62)	(30)	10	40	8	22	36	9	(62)	(82)		
	Escalation	Mgmt Reserve not escalated	(14)	(5)	2	(16)	(16)	(25)	(35)	(49)	(22)	47	54	108	47	100	13	223	207		
			(21)	(10)	(6)	(36)	(32)	(55)	(84)	(110)	(52)	57	94	116	69	137	22	161	125		
Subtotal Request to BoD (NR Program)			(103)	(77)	96	(84)	(345)	(406)	(532)	(607)	(246)	290	354	607	257	511	65	(52)	(136)		
Incl. CS Projects	F&IP CS Proj.	F&IP CS Projects	Overnight Costs	0	15	9	24	(31)	(33)	(6)	(1)	(1)	(1)	(0)	-	-	-	(73)	(49)		
		Contingency		(5)	(5)	1	(9)	(3)	(3)	(1)	(0)	(0)	(0)	(0)	-	-	-	(6)	(15)		
		Interest		0	1	1	2	(1)	(2)	-	-	-	-	-	-	-	-	(4)	(2)		
		Escalation		(1)	(1)	(1)	(3)	(5)	(5)	(1)	(0)	(0)	(0)	(0)	-	-	-	(12)	(15)		
	Grand Total (including CS Projects)		(5)	9	10	15	(40)	(43)	(7)	(1)	(2)	(2)	(0)	-	-	-	-	(95)	(81)		
FAC	OM&A		(11)	3	2	(5)	(136)	(13)	(9)	(11)	(15)	(13)	(12)	113	(11)	5	4	(98)	(104)		
	Capital (Including Interest)		(97)	(71)	104	(64)	(249)	(437)	(529)	(597)	(233)	301	366	494	268	506	61	(49)	(113)		
	(Excludes Provision)		(108)	(68)	106	(69)	(385)	(449)	(539)	(608)	(248)	288	354	607	257	511	65	(148)	(217)		
Prvsn.	Retube Waste Containers	Provision	(1)	(3)	2	(1)	(22)	(23)	(15)	(29)	8	39	49	22	31	-	-	61	60		
			(1)	(3)	2	(1)	(22)	(23)	(15)	(29)	8	39	49	22	31	-	-	61	60		
	Grand Total (including Provision & CS Projects)		(109)	(70)	108	(70)	(407)	(472)	(554)	(637)	(240)	327	403	629	288	511	65	(87)	(157)		





# **Attachment C**

## **Detailed Observations from 4c Cost Estimate Review**

**Report to Nuclear Oversight Committee**

**4<sup>th</sup> Quarter 2013**

**Darlington Nuclear Refurbishment Project**

## Attachment C

### DETAILED OBSERVATIONS FROM 4C COST ESTIMATE REVIEW

#### Overview

As summarized in our 4Q 2013 Report to the Nuclear Oversight Committee, BMcD/Modus's review of OPG's 4c Cost Estimate consisted of testing and sampling of approximately 64% of the DR Project's costs to determine whether the DR Team followed accepted standards in developing and characterizing the estimate for Management and Board of Directors review and approval. The portions of the 4c Cost Estimate we reviewed were:

- Detailed vetting of the current SNC/Aecon cost estimate for the RFR work;
- Review of six DSRs in the BOP scope that total \$67 M, or 14% of the BOP Basis of Estimate cost;
- Review of one DSR in the Turbine Generator sub-project scope that total \$119 M, or 17% of the projected turbine Basis of Estimate costs.

This document describes the process utilized for our review and the detailed recommendations we have provided to the DR Team for future estimate preparation.

#### Process for Review

##### A. Estimating Process for Project Bundles:

1. The estimates for Release 4c were based on a "refresh" of the Basis of Estimates (BoE) prepared for Release 4b.
2. The BoE's were adjusted to reflect changes resulting from increased definition of the scope of work (SOW), updated vendor quotes, relevant approved Darlington Refurbishment Decision Record and Analysis Summary Forms (DRAS), approved Change Control Forms (CCF's) and the costs impacts resulting from the scope rationalization effort.
3. The BoE's are prepared as independent assessments of costs to meet AACE Class 5/4 classification for use by the Project Team as they advance through the Gating process. Estimators have met with Project Team members and challenged them to refine the DSR scope in an attempt to achieve a Class 5/4 estimate classification.
4. BoE's were prepared according to the following governance documents:
  - a. N-PROC-LE-0011 R000: Nuclear Refurbishment Cost Estimating Procedures.
  - b. N-INS-00400-1001 R000: Nuclear Refurbishment Cost Estimating Instruction
  - c. N-PROC-LE-0017: Darlington Refurbishment Discovery, Contingency and Management Reserve Procedure.
  - d. AACE Recommended Practice No. 17R-97.
5. Typical expected accuracy ranges for Class 5 estimates are (-20% to -50%) on the low side, and (+30% to +100%) on the high side. For Class 4 estimates (-15% to -30%) on the low side, and (+20% to +50%) on the high side.



## Attachment C

### DETAILED OBSERVATIONS FROM 4C COST ESTIMATE REVIEW

6. Estimates are prepared on excel based spreadsheet templates which are slightly modified as necessary to accommodate the SOW involved for each DSR line item.
7. The primary driver of hard costs is direct “norm” labor hours which are sourced from an F+G library of data bases and OPG Model Work Orders held in Passport. When in-house data was not available, third party sources were used as appropriate; such as international standards, OPCA (Oil and Petroleum Contractors Association), DACE (Dutch Association of Cost Engineering) and RS Means.
8. When the SOW was similar to historical norms, labor hours were sourced directly (unfactored) from data bases. However, when SOW’s differed from historical norms, labor hours were “normalized” (i.e. adjusted) by applied factors (% or formula) in the cell of the respective line item.
9. Once labor hours are established they are further adjusted by productivity and height factors and multiplied by the hourly rate to arrive at labor costs.
  - a. Productivity factors (PF) are unique to OPG and have been compiled over the past 3 years while estimating projects. The PF’s are generated by analyzing a basic 10 hours shift and breaking out the amount of downtime or non-productive time to determine the actual productive time. For BOP, the productivity ranged from 35% to 45%.
  - b. Height factors are unique to OPG and used to account how ascending/descending from scaffolding effects labor hours. Generally, the height of work is broken down to (4) parameters; greater than 30ft, between 21-30ft, between 11-20ft and less than 10ft.
10. Once labor hours and costs are established, “estimating metrics” in the form of % of costs or \$/hr are applied, again as factors within a given range, to determine the respective cost elements for Project Management, Engineering, Indirect Costs, Construction Plant, Scaffolding, Training, Commissioning, Small Tools and Profit.
11. The estimating metric factors are a range of values expressed as \$ per labor hour (\$/hr) or percentage (%) of labor costs. The factors were developed based F+G and OPG historical information.
12. Based on the complexity of the SOW, the estimator selects the value of estimating metric (subject to approval of the Lead Estimator) and applies it to each line item of the DSR.
13. All DSR line items have been assessed without any allowance for rework.

## Attachment C

### DETAILED OBSERVATIONS FROM 4C COST ESTIMATE REVIEW

- a. All assumptions detailed in the BoE for labor hours and costs are based on one (1) unit. Experience factors for lessons learned resulting from repeat work advancing from the first unit to the last unit are applied on the first unit; 1<sup>st</sup> Unit – 1.00; 2<sup>nd</sup> Unit – 0.975; 3<sup>rd</sup> Unit – 0.970; 4<sup>th</sup> Unit – 0.965

#### B. Testing/Sampling – Project Bundles

1. Sampled cost elements (Labor, Material, Construction Plant, Small Tools, Scaffolding, etc.) from six (6) DSR line items totaling \$67M or 14% of total Balance of Plant bundle. For the Turbine Generator Basis of Estimate, one (1) DSR was sampled totaling \$119M or 17% of the TG bundle.
2. Since labor hours are the primary cost driver, the estimating team walked through the labor hour entries. Generally, when the scope of work was similar and lined-up with scopes in the estimating data bases, the labor hour entries were hard keyed with no adjustments. However, in circumstances when scope differed from estimating data bases, a factor (judgment call) was applied to the historical norm labor hours to best approximate the given scope.
3. In regard to applying estimating metrics to the labor hours and labor costs, the Team explained that the selection process of the applied factor was based primarily on the complexity of the DSR line item.
4. Several material costs were also tested. Costs were primarily sourced from Work Orders in Passport and adjusted for inflation. Other material costs were validated by vendor quotes.
5. Profit (10%) is applied only to Material Cost and also included in the labor rates per OPG MSA Contracts.

#### **Recommendations for Future Estimating**

The 4d Cost Estimate will need to reflect an expected leap in Project maturity that will occur over the next 8 to 10 months; thus, we would expect that the quality of OPG's estimate would parallel that increase in maturity. BMCD/Modus provided high-level observations and recommendations for development of the 4d Cost Estimate/2014 Business Plan in the 4Q Report that are based on the following detailed observations.

Observation from 4c Cost Estimate	Recommendations
The primary driver of hard costs in the 4c Cost Estimate is direct "norm" labor hours which are sourced from an F+G library of data bases and	<ul style="list-style-type: none"><li>• With the expected ramp-up of the amount of information needed to support estimates, the DR Team</li></ul>

### Attachment C

#### DETAILED OBSERVATIONS FROM 4C COST ESTIMATE REVIEW

Observation from 4c Cost Estimate	Recommendations
OPG Model Work Orders held in Passport. When in-house data was not available, third party sources were used as appropriate; such as international standards, OPCA (Oil and Petroleum Contractors Association), DACE (Dutch Association of Cost Engineering) and RS Means.	should focus on improving traceability, sourcing and vetting of database information underlying the estimate as this will be even more essential for vetting the Class 3 Estimates.
Platform for Cost Estimate: At the heart of the 4c Cost Estimate, the DR Team has utilized a series of spreadsheet the in the 4c Cost Estimate is direct "norm" labor hours which are sourced from an F+G library of data bases and OPG Model Work Orders held in Passport templates. These spreadsheets utilize a large number of "hard-keyed" entries rather than "lookup" or "reference" functions that refer back to the source data. In addition, many cell formulas are unprotected. This method works but can be inefficient and requires extensive QA/QC as the estimate becomes more detailed.	<ul style="list-style-type: none"> <li>➤ DR Team may consider migrating to a standard estimating platform such as SNC/Aecon is now utilizing for its Class 3 cost estimate. Such platforms allow for greater consistency among estimators, though there is a learning curve for effective implementation.</li> <li>➤ If the DR Team does not adopt a standard estimating platform, it should consider utilizing comment boxes and/or text cells to reference the source data or utilize lookup functions to directly refer to input data.</li> <li>➤ In any event, the team will need to dedicate resources and time for running ongoing QA/QC checks, particularly when including linked spreadsheets and contractor-produced database.</li> </ul>
The 4c Cost Estimate relies on a number of estimating factors, some of which are a product of the current level of Project definition (i.e. Class 5/4). Factors have been used to approximate the result that will come with greater Project definition.	<ul style="list-style-type: none"> <li>➤ Utilizing such factors in estimating is common industry practice. However, OPG should increase the level of documentation regarding the factors that are used so that these are traceable when used.</li> <li>➤ Going-forward, OPG will need a more organized set of estimate templates for vetting of Class 3 estimates and target price proposals from contractors. Utilizing a standard estimating platform (like Timberline) could provide an acceptable alternative.</li> </ul>
Labor estimates used in the 4c Cost Estimate are generally based on productivity and include:	<ul style="list-style-type: none"> <li>➤ Traceability of the source of such factors is critical. Industry-based studies for developing productivity factors can be</li> </ul>

### Attachment C

#### DETAILED OBSERVATIONS FROM 4C COST ESTIMATE REVIEW

Observation from 4c Cost Estimate	Recommendations
<ul style="list-style-type: none"> <li>a crew sheet that analyzes process flow and work series and</li> <li>height of operations</li> </ul> <p>These factors are unique to OPG and have been developed over the past three years.</p>	<p>distinguishable, as can a contractor's experience when work is not entirely similar.</p> <p>➤ Vetting of these factors and record-keeping related to the source will be critical for Class 3 estimate reviews.</p>
<p>OPG Costs: the major drivers the DR Team examined for the 4c Cost Estimate were:</p> <ul style="list-style-type: none"> <li>Impact of unlapping of Unit 2</li> <li>Scope rationalization and impact on overall size of the Project and associated level of effort.</li> </ul> <p>The different work groups were given a blank template for defining their staffing needs; this was later changed to variance reporting against 4b when it was apparent the work groups were exceeding cost boundaries.</p> <p>Costs were eventually brought in line via vetting and challenge meetings with RPET and the efforts of the Finance and Project Controls groups.</p>	<p>➤ Finance and Project Controls developed metrics for showing cost flows and variances over time that were extremely helpful in determining the right-sizing of the team. These (and similar) tools should be incorporated into the metrics the team is reviewing in an attempt to increase cost consciousness.</p> <p>➤ Vetting of OPG costs was also impacted by the timing of the 4c Cost Estimate effort, which began in the middle of the summer months. The next phases of estimate should have a schedule of activities and begin earlier in the year, particularly considering the increased complexity expected for 4d.</p>

**Exhibit 1 to Attachment C – Sampling of 4c Cost Estimate**

No	Bundle/Sub Bundle		DSR Line	Title	AACE Class	Base Scope (\$K)	Contingent Scope (\$K)	Total (\$K)	Component (\$K)	Bundle Sampling (%)	BUNDLE TOTAL (\$K)
1	BOP	Common System	TS0510-11	DNGS Structures: Perform Inspections For Civil Structures in the Reactor Auxiliary Bay (RAB).	5	563	-	563	4,647	12%	494,724
2	BOP	Common System	TS0510-18	DNGS Structures: Repair / Replacement of Civil Structures Located in the Reactor Auxiliary Bay (RAB).	5	-	2,400	2,400	16,900	14%	
3	BOP	Conventional	SIO390-1	Install Flash Tank and Treatment Skid	5	4,887	-	4,887	48,020	10%	
4	BOP	Pre- Refurbishment	TS0630-6	Service Water System	5	13,085	-	13,085	15,527	84%	
5	BOP	Reactor Systems	TS0320-1	Refurbish all PHT Pump Motors by sending them to a repair shop.	5	36,751	-	36,751	56,050	66%	
6	BOP	Reactor Systems	SIO300-31	Dual power supply for Vault Vapor Recovery Dryer	5	793	-	793			
7	BOP	Safety & Control Systems	TS0350-6	Replacement of SDS Computers (DSR's TS0350-1 to TS0350-18) Installation Costs	5	8,350		8,350	62,691	13%	
8	Turbine		SI0010-1		4	119,246		119,246	716,183	17%	716,184
9	Fuel Handling		TS0410-6	Replace all trolley pumps	5	18,341		18,341	151,666	12%	177,078
10	Unit Islanding		TS0810-1	Reactor Building Containment Bulkhead Isolation: Containment Bulkhead Installation	5	84,507		84,507	303,003	28%	303,003
11	Steam Generator		TS0050-4	Assess Ports Installation	4	12,424		12,424	118,629	10%	309,031
12	Shutdown & System Layup		TS0890-2	Unit Layup Modification for Nuclear Systems: Drying of Main HT Circuit	5	5,155		5,155	81,998	6%	132,601
				<b>Total</b>				<b>306,502</b>		<b>14%</b>	<b>2,132,621</b>



# **Report to Nuclear Oversight Committee**

## **1<sup>st</sup> Quarter 2014**

### **Darlington Nuclear Refurbishment Project**



**Burns & McDonnell  
Modus Strategic Solutions**

**March 4, 2014**



## Report to Nuclear Oversight Committee – 1Q 2014 Darlington Nuclear Refurbishment Project



### I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company (“BMCD/Modus”) provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors (“NOC”) regarding the status of the Darlington Nuclear Generating Station’s Refurbishment Project (“Project” or “DR Project”) as of February 21, 2014. The DR Project continues to advance toward its major goal of producing a Release Quality Estimate (“RQE”) for final Board of Directors and Shareholder approval by October 15, 2015.

In this report, we provide current updates regarding the DR Project’s most significant risks. In addition, we provide a high level assessment of the DR Project’s compliance with the principles set forth in the Minister of Energy’s December 2013 Long Term Energy Plan (“LTEP”), and identify recommendations for strengthening OPG’s planning for completion of the Release Quality Estimate (“RQE”). We would also like to note that pursuant to the Project’s Assurance Plan approved by the Audit Committee, BMCD/Modus has prepared independent reports documenting the DR Team’s status as well as further recommendations for improvement. This quarter we have issued an Assurance Report based upon our detailed review of the DR Team’s Risk Management Program. Next quarter we will issue three other Assurance Reports relating to: 1) DR Project schedule process and development; 2) the 2013-2014 Business Plan as it relates to the latest project estimate (the “4C Estimate”) and 3) scope status and process. These full reports will be available for the NOC’s review at its convenience. With respect to our ongoing involvement in the Assurance Plan, we will continue to work at the NOC’s direction.

The following is a brief summary of the Project’s most significant developments over the last quarter:

- **Retube & Feeder Replacement Project Risks:** The RFR project remains the DR Project’s most notable risk, though it appears that SNC/Aecon’s progress on the tooling portion of the work is improving. Through January 2014, the contract remained underspent by \$32.7 M, and SNC/Aecon’s SPI for tooling was 0.81, which reduced its cumulative SPI to 0.88. SNC/Aecon’s original plan to complete tooling delivery by June 2014 will not be met; it has implemented a tooling recovery plan that has recovered some of its earlier delays and mitigated some future deliveries that cannot be fully recovered. Based on its current plan, it will take until August 2014 for SNC/Aecon to return to its baseline schedule. Failure to do so will put stress on OPG’s RQE date. The DR Team is closely monitoring SNC/Aecon’s progress and has recommended SNC/Aecon increase schedule reporting and supplier surveillance.

In addition to the tooling set, SNC/Aecon’s other major activities in the Definition Phase focus on the development of the Execution Phase cost estimate and schedule.

Through February 10, 2014, SNC/Aecon had completed only 32% of the work needed to develop the Construction Work Packages (“CWPs”) that form a key part of the estimate, while expending nearly 70% of the allotted schedule time. SNC/Aecon has instituted a recovery plan for the CWPs and remains committed to completing the Class 3 Estimate on time. However, BMCD/Modus is concerned that accelerating the preparation of the Class 3 Estimate may only result in weakening the quality of the product. Regardless of the success of SNC/Aecon’s recovery plan, BMCD/Modus recommends that OPG consider giving SNC/Aecon more time if quality is an issue with the deliverables, and pursue SNC/Aecon developing and monetizing its contingency as a part of the Class 3 Estimate. Under its Contract with OPG, SNC/Aecon is not required to provide any contingency amounts until the Class 2 Estimate phase. As we have stated in previous reports, we are concerned that this increases the risk of a “surprise” in the final Class 2 Estimate and could complicate target price negotiations with SNC/Aecon. Furthermore, OPG could use this information to provide a more mature 4d Cost Estimate in the fall of 2014.

- **Commercial Risks:** We have encouraged the DR Team to evaluate its major contracts to ensure that the proper incentives and disincentives are included in light of the LTEP. As an example, the RFR Contract includes certain incentives and disincentives that were focused on improving performance unit-over-unit. However, the LTEP and OPG’s decision to “unlap” Unit 2, puts more focus on the success of the first unit. The DR Team should therefore

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## Report to Nuclear Oversight Committee – 1Q 2014 Darlington Nuclear Refurbishment Project



revisit these contract incentives and disincentives to ensure such success. Future negotiation of the SNC/Aecon target price for the Execution Phase should include re-examination and clarification of certain elements that could not have been contemplated at the time the parties negotiated the Contract. Similarly, the ESMSA contracts should be evaluated in light of current considerations.

- **Campus Plan Performance Project Risk:** Performance of the Campus Plan work remains a significant risk. The D20 Storage Facility foundation work has been impacted by subsurface conditions and ongoing engineering challenges and is now projected to complete in April 2016. Based on the current schedule, there is now a 3-month delay to the critical path, impacting OPG's ability to open the Unit 2 breaker in October 2016. Additional work on other key Campus Plan facilities is tracking behind schedule and/or over budget. In addition to recovering the schedule delays to the D20 Storage Facility, it is critical for the DR Team to increase the predictability of this work and identify any lessons learned that could impact the Balance of Plant ("BOP") work that will be performed by the same contractors under the ESMSA terms and conditions.

Both Projects & Modifications ("P&M") and the DR Team are increasing their focus on the remainder of the Campus Plan scope. Project controls (schedule and cost) are currently under intense review, as is the process for engineering oversight. BMCD/Modus recommends that as part of its review, the DR Team refresh its understanding of required end dates for these Facility and Infrastructure ("F&I") projects and examine what appears to be poor schedule logic and unrealistic float that could be masking further delays and performance issues. In addition, BMCD/Modus is engaged in a root cause analysis of the systemic budget variances that have become apparent for this work.

- **RQE Preparation:** RQE development remains essentially on schedule, but will be heavily reliant on the quality of the various inputs. It is essential that the DR Team carefully plan and manage the RQE development process. The DR Team has assigned a manager for the planning and development of the multiple pieces that must come together for RQE. The team is developing an RQE planning schedule and further definition for expectations for deliverables. The Blue Ribbon Panel assigned to review the DR Project's scope has completed its work and its final recommendations have resulted in \$179 million of work being removed from the DR Project, some of which has been cancelled entirely.

Other ongoing challenges to the DR Project include the continued development of the BOP work, further refinement of the Risk Management Program and completion of pre-requisite F&I and Fuel Handling work. Attachment "A" provides an update regarding the DR Project's risks.

## II. Project's Conformance to LTEP

### A. LTEP Principles

The LTEP identifies priorities for OPG and Bruce Power to follow in their respective mid-life refurbishments of DNGS Units 1-4 and Bruce Units 2-8. The LTEP supports the refurbishment of DNGS Unit 2, but states that "the province will proceed with caution to ensure both flexibility and ongoing value for Ontario ratepayers," and "(f)inal commitments on subsequent refurbishments will take into account the performance of the initial refurbishments with respect to budget and schedule by establishing appropriate off-ramps." In addition, the LTEP identifies seven priorities for OPG and Bruce Power to follow in their respective refurbishments:

1. Minimize commercial risk on the part of the ratepayers and the government.
2. Mitigate reliability risks by developing contingency plans that include alternative supply options if contract and other objectives are at risk of non-fulfillment.
3. Entrench appropriate and realistic off-ramps and scoping.
4. Require OPG to hold its contractors accountable to the nuclear refurbishment schedule and price.





## Report to Nuclear Oversight Committee – 1Q 2014 Darlington Nuclear Refurbishment Project



5. Make site, project management, regulatory requirements, supply considerations, cost and risk containment the primary factors in developing the implementation plan.
6. Take smaller initial steps to ensure there is an opportunity to incorporate lessons learned from refurbishment including collaboration by operators.
7. Hold private sector operator accountable to the nuclear refurbishment schedule and price (*not applicable to OPG*).

In addition, the LTEP states that “(t)he government will encourage the province’s two nuclear operators, Bruce Power and OPG, to find ways of finding ratepayer savings through leveraging economies of scale in the areas of refurbishment and operations. This could include arrangements with suppliers, procurement of materials, shared training, lessons learned, labour arrangements and asset management strategies.” We are aware that OPG’s management has engaged in such discussions with Bruce Power but to date no progress has been reported.

### B. BMcD/Modus Assessment

The following is our assessment of the extent to which the DR Team is currently in compliance with the LTEP’s principles. We have also identified gaps that may currently exist and recommendations for strengthening OPG’s compliance with these requirements. In this assessment, we have focused solely on the DR Project’s readiness, as BMcD/Modus has not been retained by NOC to assess each of the considerations in the LTEP. In addition, there are LTEP principles that have commonality, which we identify below.

1. Minimizing commercial risks	
Current Initiatives:	<p>The primary commercial risks to the Province from mid-life refurbishments emanate from the potential for unplanned significant cost and schedule overruns. OPG has recognized these risks and others from prior nuclear projects (Pickering A RTS and Pickering A&amp;B Retube) and has implemented an extensive planning effort with its prime contractors during which OPG is:</p> <ul style="list-style-type: none"> <li>• Locking down project scope well in advance of starting construction;</li> <li>• Engaging in a robust pre-outage inspection campaign that utilizes the units’ maintenance and Vacuum Building outages;</li> <li>• Executing refurbishment and improvements to the reliability of the fuel handling machines that service the station;</li> <li>• Planning and executing pre-requisite work that will support the refurbishment as well as unit life extension prior to the start of Unit 2’s outage; this should provide a testing ground for the Execution Phase;</li> <li>• Building a full-scale mockup of the DNGS reactor and vault that will be used for training and proving the tools needed for the removal and replacement of the reactors’ internals;</li> <li>• Fully developing engineering and planning of the work so that it is 100% complete prior to the start of construction;</li> <li>• Developing a Release Quality Estimate (RQE) in phases that incorporates a high-confidence budget and schedule for the work;</li> <li>• “Unlapping” Unit 2 from Unit 1 so that the focus can be entirely on the planning and construction of a single unit and so that OPG can gain confidence and lessons learned in completing the work;</li> </ul>



## Report to Nuclear Oversight Committee – 1Q 2014 Darlington Nuclear Refurbishment Project



	<ul style="list-style-type: none"> <li>Utilizing target price contracts for the Execution Phase that are based on developing cooperation and transparency with key vendors;</li> <li>Negotiating various off-ramps and stages into the RFR contract with SNC/Aecon, such that SNC/Aecon securing the Execution Phase contract depends on its performance in the Planning Phase and the quality of its estimate and schedule for execution; and</li> <li>Changing its procurement practices for the Balance of Plant ("BOP") work that increases the chances of meeting schedule via direct award of work packages to the ESMSA vendors.</li> </ul>
Potential Gaps:	<ul style="list-style-type: none"> <li>➤ Incentives in the RFR contract were developed and established on the basis of four unit performance, allowing the RFR contractor to make-up cost overruns and schedule delays to the first unit on subsequent units. However, the LTEP prioritizes the urgency of a success on Unit 2.</li> <li>➤ F&amp;I work is behind schedule and is diverting management attention. The ESMSA contractors may require additional review of incentives and conditions for performance on BOP work.</li> </ul>
BMcD/Modus Observations and Recommendations:	<p>With respect to the SNC/Aecon RFR Contract, we recommend revisiting the contractual incentives that were negotiated in 2011-12. The LTEP represents a major strategic revision for the DR Project, such that emphasis on unit-over-unit improvement is much less of a consideration that optimizing performance on Unit 2. Moreover, with the award of the Turbine Generator performance to SNC/Aecon, there are additional opportunities to increase the efficiency and lower the overall cost of SNC/Aecon's work. Similar reviews should be undertaken with the ESMSA vendors to ensure all performance incentives are aligned with the current DR Project goals.</p>
<b>2. Developing contingency plans to mitigate risks</b>	
Current Initiatives:	<p>OPG has considered and developed what appear to be reasonable contingency plans needed to mitigate project risks<sup>1</sup> including:</p> <ul style="list-style-type: none"> <li>OPG's decision to "unlap" Unit 2 from the other units' refurbishment, which predated the LTEP, was intended to mitigate the risk of performance and provide the DR Team with singular focus on one unit's refurbishment at a time.</li> <li>OPG's significant investment in engineering and planning the work in the Definition Phase is the direct result of OPEX from Pickering Unit 4.</li> <li>OPG has made a sizeable investment with the reactor mock-up, during which SNC/Aecon will perform full integration and commissioning testing of the tools needed for refurbishment. The results of those tests will be incorporated into the Tooling Performance Guarantee with SNC/Aecon.</li> <li>The DR Team has developed and implemented a Risk Management Program that is being used to evaluate and prioritize project-related risks and management issues.</li> </ul>
Potential Gaps:	<ul style="list-style-type: none"> <li>➤ SNC/Aecon contract was set-up with the intent of monetizing contingency as part of the target price and not before, and there is currently some ambiguity regarding the pricing of risk in the target price.</li> </ul>

<sup>1</sup> BMcD/Modus has been asked by NOC to evaluate or otherwise assess any aspects of supply.



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	<ul style="list-style-type: none"> <li>➤ OPG's project risk management identification requires additional leadership, visibility and focus.</li> <li>➤ OPG's transition to actively managing the EPC contractors' engineering work will require significant focus.</li> </ul>
BMcD/Modus Observations and Recommendations:	Our recommendations regarding risk and contingency have been discussed in prior reports. The DR Team's senior management is acting on these recommendations.
<b>3. Entrench appropriate and realistic off-ramps and scoping</b>	
Current Initiatives:	<ul style="list-style-type: none"> <li>• OPG has engaged in a deliberate process with numerous off-ramps for the Definition Phase. This process includes significant BOD oversight and approval of yearly releases of funding, and these funding releases and related details are being vetted by Independent Oversight.</li> <li>• The yearly release strategy and gating process for funding individual project initiatives has wide visibility and adherence within the DR Team.</li> <li>• The contract with SNC/Aecon includes provisions that allow OPG to take over the tooling and the mock-up at the conclusion of the Definition Phase if the parties are unable to negotiate the target price contract for the Execution Phase.</li> <li>• OPG has fully examined the scope of the Unit 2 refurbishment project and redistributed or cancelled work based on OPG's regulatory commitments.</li> <li>• As part of scope review, OPG has designated scope in AISC programs for the station which will be performed over a longer period of time.</li> <li>• OPG simplified the scope of the Turbine Generator work by delaying the installation of the turbine controls for Unit 2 until a future outage.</li> </ul>
Potential Gaps:	<ul style="list-style-type: none"> <li>➤ Finalizing the scope recommendations of the Blue Ribbon Panel and fully documenting those decisions for future prudence review.</li> <li>➤ Ensuring the scope that is required for refurbishment, though performed outside of the DR Project, is staffed, funded and executable.</li> </ul>
BMcD/Modus Observations and Recommendations:	In general, we see that OPG has set up the Project with appropriate measures to reduce or eliminate scope depending on the Shareholder's future needs. Unlapping Unit 2 also provides the DR Team an opportunity to incorporate lessons learned into subsequent units.
<b>4. Require OPG to hold its contractors accountable to the nuclear refurbishment schedule and price</b>	
Current Initiatives:	<ul style="list-style-type: none"> <li>• Contracts with major vendors are being developed and vetted utilizing a deliberate, staged and gated process with requirements for budget, schedule and scope identification at each gate.</li> <li>• The terms and conditions of OPG's contracts generally conform to the industry, and the contracts have specific negotiated incentives and disincentives that are calculated toward promoting the contractors' (and OPG's) responsible management of the work.</li> <li>• OPG has chosen to perform the work in the Execution Phase on a target price basis which increases the contractors' transparency. This will enhance OPG's ability to resolve issues as they arise.</li> </ul>



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	<ul style="list-style-type: none"> <li>• OPG is implementing a detailed, integrated Level 3 schedule that will encompass all of the contractors' and OPG's work, as well as a rolled-up Level 2 C&amp;C Schedule that is used as a higher level interfacing tool. The schedule allows for planning and coordination of the work.</li> <li>• OPG has implemented cost control systems that are geared toward holding contractors accountable. These systems include earned value and budget controls through the gate process. In addition, OPG's Corporate Finance has increased its focus and resources to handle the volume of the DR Project's work.</li> <li>• OPG performs analyses of all pricing and check estimates for the contractors' work. These estimates are provided by an independent vendor with experience in the industry.</li> <li>• OPG's senior management has established separate regular steering committees with each of the major vendors' executives which provide senior leadership with a forum to discuss progress, potential and real issues impacting performance and commercial issues. These forums are an essential ingredient in managing contractors' work.</li> <li>• OPG has an opportunity through the Campus Plan work to test many of its core processes and controls.</li> </ul>
Potential Gaps:	<ul style="list-style-type: none"> <li>➤ The gate process is very good in principle although it would benefit from some additional focus and attention in practice. BMcD/Modus's recommendations in this regard were part of our 3Q 2013 report to NOC.</li> <li>➤ The estimating process may require some changes depending on the result of the root cause evaluation of Campus Plan budget variances.</li> <li>➤ DR Team's project controls are in an early stage of development and require testing and adherence by the major contractors. In particular, the earned value system will require significant testing and oversight as different pieces of the DR Project progress.</li> <li>➤ F&amp;I work is not using all of the DR Project's core processes, and those it is using lack consistent adherence.</li> </ul>
BMcD/Modus Observations and Recommendations:	<p>The DR Team has struggled with defining its "oversight" role of the contractors. As we have noted in prior reports, since OPG is ultimately responsible for the Project's outcome, it must actively manage the work of its contractors, which requires a detailed understanding of the contractors' work status and the removing of any barriers to performance as quickly and prudently as possible. Active management, however, does not include interfering with or re-performing the work for the contractors. Finding this balance is a difficult task for an owner, particularly an owner such as OPG who has self-performed and self-managed so much of its past large capital projects. The tools the DR Team will rely upon, including the P6 schedule and Proliance, will need significant attention and ongoing maintenance.</p>
<b>5. Make site, project management, regulatory requirements and supply considerations, and cost and risk containment, the primary factors in developing the implementation plan.</b>	
Current Initiatives:	<ul style="list-style-type: none"> <li>• OPG's plan for RQE assumes that all of the factors listed will be fully considered, planned and budgeted in advance of execution of the work. OPG will invest \$2.4 billion in upfront planning and site preparations prior to the breaker of Unit 2 opening in October 2016.</li> </ul>



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	<ul style="list-style-type: none"> <li>• Taking lessons from Pickering A, the DR Team has committed to completing the identification of all regulatory requirements well in advance of final design and construction.</li> <li>• OPG has also committed to the completion of design, proving of the RFR tools and completing procurement of all necessary components one full year before breaker open.</li> <li>• OPG has implemented project controls and risk management programs and will continue to refine these tools as the outage nears.</li> <li>• OPG has established hard dates for procurement and delivery of all long lead items.</li> <li>• OPG has retained external oversight and engaged other corporate functions in providing input and assurance that the DR Team is meeting its commitments.</li> </ul>
Potential Gaps:	None at this time.
BMcD/Modus Observations and Recommendations:	While OPG's plans for the Definition Phase are robust, execution of these plans will require significant and ongoing effort.
<b>6. Take smaller initial steps to ensure there is an opportunity to incorporate lessons learned from refurbishment including collaboration by operators.</b>	
Current Initiatives:	<ul style="list-style-type: none"> <li>• OPG management approved the unlapping of Unit 2 in advance of the LTEP. As noted, the revised plan will allow for a more measured approach and singular focus on one unit refurbishment at a time.</li> <li>• OPG has filled key positions in its project management team with individuals with direct experience of prior CANDU refurbishments.</li> <li>• OPG has contracted with SNC/Aecon, whose subsidiary, CANDU Energy (formerly AECL), has been associated with each of the prior refurbishments.</li> <li>• SNC/Aecon has invested in studying lessons learned and OPEX from these prior projects and incorporated those into the RFR project. The basis of SNC/Aecon's estimate for DNGS is these past projects with specific understanding and elimination of the issues that caused prior cost and schedule overruns.</li> <li>• The scope rationalization and elimination of Turbine Generator controls installation for Unit 2 should allow the DR Project to establish considerable construction float for BOP work.</li> <li>• OPG has initiated contact with Bruce Power.</li> </ul>
Potential Gaps:	None at this time.
BMcD/Modus Observations and Recommendations:	OPG's management has taken reasonable steps to ensure that the DR Project is proceeding along a deliberate path for success. Execution to that plan is not guaranteed but will be enhanced by the work that OPG has done to date. OPG should continue to explore ways to collaborate with Bruce Power that will be beneficial to both organizations.

In summary, BMcD/Modus believes that OPG is taking prudent steps in fulfilling the LTEP's principles, and these steps largely predated the LTEP's publication. Management also appears to understand the challenges ahead.

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### III. Major Projects – Summary of Key Risks

#### A. Retube & Feeder Replacement

##### 1. Work Status – Tooling, Definition and Mock-up

SNC/Aecon remains behind schedule in the Definition, Tooling and Mock-Up phases of its work, though it has reversed some of the trends apparent in the 3Q 2013 when it earned only 70% of its planned work. Through the end of October 2013, SNC/Aecon's cumulative SPI was only 0.80, and its CPI was a mere 0.51 for 3Q 2013. Since our last report, SNC/Aecon has improved both its earned value and actual progress. SNC/Aecon's cumulative SPI is now 0.88 and in both December and January, SNC/Aecon earned more than planned for the first time since the schedule was baselined in June 2013.

The following is the current performance trend for the three major procurements that BMCD/Modus began tracking in 3Q 2013:

- **RT Platform:** Originally planned to complete June 13, 2013, it is now scheduled to be complete and delivered on July 25, 2014 and commissioned thereafter; this is the critical path for the tooling prove-out in the mock-up. SNC/Aecon has increased source surveillance at the Rolls Royce's facility and Rolls Royce has subsequently improved its scheduled completion by 4-5 weeks since our last report.
- **Procurements of Feeder Tube and Retube Waste Containers:** Originally planned for 2Q 2013, these procurements slipped to 4Q 2013. SNC/Aecon has ramped-up the design and communication with the suppliers. There is an additional risk from the D20 Storage Facility project's construction, which may cause an access issue.
- **Multiple Planning Deliverables:** SNC/Aecon is late in preparing and providing to OPG its suite of processes and procedures for developing the Class 3 Estimate, Tool Quantification, Project Controls and Project Execution. Part of this delay was caused by SNC/Aecon not claiming sufficient progress on this work due to contractual earning rules that kept them from accurately assessing its status. The DR Team and SNC/Aecon are reviewing these and other earning rules that could fog the contractor's progress.

In our last report, we noted that SNC/Aecon initially claimed it was not behind schedule because it was still meeting its late finish "Contract Milestone Schedule." However, OPG's management has corrected this misconception, and SNC/Aecon is now using its reasonable target schedule as the basis of its schedule reporting. OPG has increased SNC/Aecon's accountability by requiring SNC/Aecon to report on its schedule progress more often and with greater focus on realistic target dates. OPG has also communicated to SNC/Aecon needed criticism of the contractor's project reporting which was minimizing its performance deficiencies. SNC/Aecon has responded by improving its metrics and reports, though this is an evolutionary process. In addition, SNC/Aecon has added experienced resources in key positions and those individuals have made a significant impact to date.

As noted, even with these improvements, SNC/Aecon's original plan to complete tooling delivery by June 2014 will not be met. SNC/Aecon's tooling recovery plan has recovered some of its earlier delays and mitigated the impact and sequence of future sub-vendor deliveries that cannot be fully recovered. SNC/Aecon has also re-prioritized some of its work on the feeder assemblies to partially mitigate the impact of these delays. Based on its recovery plan, SNC/Aecon will now complete tooling delivery by August 2014, meaning that the schedule will require successive improvements to avoid causing compression and delays to the completion of the Definition Phase work.

In our 3Q report, BMCD/Modus stated our concern with SNC/Aecon's progress and many of the behaviors that its team was projecting. In the last quarter, we have seen the immediate positive impact from OPG increasing its management of SNC/Aecon. While the recovery will take several more months, SNC/Aecon has accelerated its progress and has increased the level of its accountability. BMCD/Modus is closely monitoring this situation, and has been invited to attend progress meetings with SNC/Aecon's management.



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### 2. SNC/Aecon Class 3 Estimate Status

SNC/Aecon's May 15, 2014 milestone for completing the Class 3 Estimate is significantly challenged at this time. As of February 10, 2014, SNC/Aecon was 32% complete in preparing its "Stage 1" CWP, which are a needed predecessor to development of the Class 3 Estimate. SNC/Aecon reported that it had earned approximately 5% in the prior week, which was its best single week to date. If SNC/Aecon were to continue CWP preparation at this rate, it would complete this work in approximately 13 weeks, or *two months later* than its March 14, 2014 milestone. Moreover, the CWPs SNC/Aecon has prepared to date have focused largely on pre and post-outage requirements and not on the critical work, which could be even more time intensive to prepare. Regardless, SNC/Aecon's Class 3 Estimate recovery plan actually assumes it will prepare CWPs at a rate 50% faster than its best single week performance to date.

BMCD/Modus is concerned that SNC/Aecon's attempts to recover its progress on the Class 3 Estimate could be ineffective and that these delays could: (1) degrade the quality of the Class 3 Estimate; (2) impact downstream estimating activities; and/or (3) further complicate SNC/Aecon's preparation and OPG's vetting of the Class 2 Estimate. OPG's management understands and shares these concerns and is maintaining the pressure on SNC/Aecon to complete on time.

The DR Team will have a better idea of exactly how late SNC/Aecon will be in its Class 3 Estimate preparation in the next 4 to 6 weeks. Assuming the recovery of the estimate target remains difficult to attain, BMCD/Modus encourages OPG to:

- Maintain the level of focus on SNC/Aecon's progress and refresh the projected completion dates based on that progress;
- Review mitigation for receiving the Class 3 Estimate later than planned, which could impact the DR Team's initial preparation of the 4d Cost Estimate;
- Request SNC/Aecon to provide all needed resources from its team OPG will need for its review and vetting of the Class 3 Estimate so that OPG's work will not be an excuse for SNC/Aecon's delays; and
- Have SNC/Aecon provide its assessment of project contingency, which is currently not required under the RFR Contract until the end of Class 2.

SNC/Aecon's Class 3 Estimate is an important step for OPG's ability to provide a strong RQE. It is likely that the DR schedule could absorb receiving the Class 3 Estimate 1-2 months late, in particular if that estimate provides a better baseline for the 4d Cost Estimate and SNC/Aecon's Class 2 Estimate. However, the quality of the estimate needs to be fully vetted.

### 3. RFR Commercial Risks

As noted above, at the time OPG and SNC/Aecon negotiated the RFR Contract, it could not have taken into account recent events—in particular the unlapping of Unit 2 and many of the principles identified in the LTEP. The major provisions that the DR Team should review include:

- Performance incentives for unit-over-unit improvement – to the extent that unlapping and the LTEP have increased emphasis on maximum performance in the first unit, the parties should weigh whether the provisions that incentivize SNC/Aecon to improve from one unit to the next will promote the proper focus on successfully completing the first Unit;
- Cost and Schedule incentives and disincentives should be reviewed under the same light;
- With the award of the Turbine Generator performance work to SNC/Aecon, there are potential economies of scale that could lessen the Project's cost and risk;
- OPG and SNC/Aecon also need to agree on the RFR project risks, which risks will be shifted to the contractor, and whether such risks will be covered by the base cost (including the target price neutral band), contingency or allowed contract changes.



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Because the Execution Phase contract has not technically been awarded, engaging in these discussions should just be part of the final target price negotiations. OPG should consider the timing of starting these discussions so that the current Class 3 Estimate can incorporate the necessary considerations going forward.

### B. Campus Plan

The F&I Campus Plan Projects remain a significant risk to the DR Project. Through January 29, 2014, each of the 15 refurbishment prerequisite projects that are underway (including SIOs), are behind schedule, over budget or both. Some of these projects must complete prior to the VBO outage; others are not essential until Unit 2 breaker-open. However, to date, these projects appear to have been impacted by a combination of poor upfront scoping, engineering delays, lack of planning, insufficient scheduling, and significant misassumptions regarding cost and budget.

The most notable of these projects is the D20 Storage Facility, which has been delayed by unforeseen underground conditions, incomplete scoping of the work, and engineering progress. The following highlight some of the issues the project has encountered:

- Engineering for the D20 Storage Facility was scheduled to be completed by spring of 2013; now that projection is July 2014, over one full year late.
- Late tie-ins to the low pressure service water line have already resulted in a 2 month delay to the Tritium Removal Facility ("TRF") Outage completion. The D20 Storage Facility's delays have the potential to ripple into the construction of the Retube Waste Processing Building, which is being impacted by the waste pile from D20 Storage Facility's excavation.
- All of the schedule float for D20 Storage Facility has been used and if the delays are not mitigated, it will delay breaker open on Unit 2 in 2016. The current completion date for the D20 Storage Facility is projected to be April 2016, which is 6-7 months later than planned and a 3-month delay to the critical path. The operations team needs to receive this building in January 2016 in order to complete commissioning in time for breaker open.
- The budget for the D20 Storage Facility will be exceeded due to increased costs for removal of the soil, delays to the start of the caissons and other scope issues; the DR Team is currently reviewing the extent of the budget overrun.

BMcD/Modus is currently examining the root causes of the significant challenges to the D20 Storage Facility and other F&I projects that are pre-requisites to the DR Project. We have discovered some significant facts that could explain why these projects are so far off their schedule and cost goals:

- The schedule for all the Campus Plan work was initially premised on a DR Project breaker open date of October 2015. When the DR Project's start was postponed one year, these projects had more time but didn't have an additional year of float. However, not only does it appear that some of the original scheduling assumptions were erroneous, the P&M organization did not take advantage of the additional time to improve its front-end planning and reduce the overall performance risk of this work. Instead, work packages and projects simply sat in place and were not aggressively advanced.
- The D20 Storage Facility was the first EPC ESMSA project and the learning curve has been particularly steep. The P&M team appears to have underestimated the impact of the new contracting methodology for performing the work, and has been over-reliant on the ESMSA contractors.
- Initial scope identification was very limited and left open key aspects of the design. The DR Team, having observed the problems with the D20 Storage Facility, changed the process for scope identification for the other modification work, resulting in the development of the MDP packages.
- P&M accepted vendors' quotes for the work that were widely disparate, without a full understanding of what was causing the price differences. Furthermore, even though the work ultimately was to be performed on a cost





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reimbursable basis, P&M significantly weighted the bid evaluation towards the lowest priced estimate, discounting a bidder's experience, qualifications and understanding of the work.

- P&M assumed that the accepted vendor quote it received could be termed a "Class 2 Estimate" even though engineering had not for advanced commensurate with such a classification. Thus, the contingency released at the D20 Storage Facility's Gate 3b was insufficient to cover the known risks, many of which have already materialized.
- P&M's management was not aggressive enough in requiring the ESMSA contractors to submit reliable Level 3 schedules for performance of the work. Currently there are only 4 schedules loaded into the C&C Schedule from F&I work that have sufficient Level 3 detail. Moreover, it doesn't appear that P&M looked at the composite workload on each of the ESMSA contractors until the DR Team required P&M to integrate its schedules in the fall of 2013.
- F&I schedules currently carry unrealistic float, are tied improperly to ending milestones, and utilize incorrect milestones.
- There may be commercial issues getting in the way of the contractors' efficient performance. The ESMSA contractors had initially complained that the secondary compete process made it impossible for them to plan for the proper size and scale of their operations. In addition, the incentives to manage the engineering process may be lacking.

In summary, BMcD/Modus has found that P&M has clearly struggled with how to manage the ESMSA contractors in an EPC arrangement. As noted above, BMcD/Modus is currently examining the root causes of these issues. We expect to arrive at more definitive conclusions by the next NOC meeting.

In the meantime, the DR Project's and P&M's senior management have taken the initiative to call a summit with the ESMSA contractors to further examine and clear barriers to success that are impacting both the F&I and Balance of Plant ("BOP") work. In addition, P&M's and the DR Team's senior leadership are taking action to turn the performance around, including:

- Co-locating OPG engineering resources at the vendor's shops to answer questions and oversee development of the detailed design work and institute regular Steering Committee meetings with project leadership to remove performance barriers.

Continuing integration of all of the F&I pre-requisite work into a single schedule so that the ESMSA's can properly plan and resource load the work and OPG can manage the contractors' work load and performance. As part of this schedule development, BMcD/Modus sees a critical need for the DR Team, P&M and Plant Operations to conduct a joint review to confirm the latest possible delivery dates for all F&I work. Such a review needs to incorporate requisite commissioning time and resources needed for completion of the work, as well as spread resources in an efficient manner.

- Complete the work allocation to each of the ESMSA vendors so that they can properly plan their work. The DR Team has attempted to allocate the work evenly, though it may become necessary to shift work based on performance and resource availability. This becomes a more complex issue with the BOP work scope also needing attention in the coming months.
- Provide additional and focused project management support from OPG to clear barriers to engineering and execution work.
- Engage in constructive high-level dialogue with the ESMSA's senior management.

OPG Management is taking action to turn around the Campus Plan work, including bringing in new leadership for P&M and fostering greater integration between the F&I and DR Project work. The visibility of the issues P&M has encountered will help the BOP, Islanding and Services projects work with the ESMSA contractors.

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### C. Balance of Plant and Other Projects

In our 4Q 2013 Report, we discussed the impact of the review by the Blue Ribbon Panel of DR Project scope. The final recommendations have been made and have been reviewed through the Project Scope Review Board process. As noted on our prior reports, the process OPG used for this review was robust and consistent with the DR Project's management processes. With scope essentially locked down, the attention of the BOP, Services and Islanding projects shift to allocating the work to the performing contractors (mostly ESMSA or SNC/Aecon), completing detailed engineering and establishing target price budgets for the work. Some early indications of scope/pricing from the ESMSA have been mixed. For one such work package, the contractor misunderstood OPG's requirements and submitted a bid premised on re-performing a significant amount of the engineering work that OPG had already performed. The DR Team has rejected these proposals and clarified its requirements, which is delaying the issuance of this work package. The DR Team has increased the time for verifying estimates (from one week to two weeks) to ensure the contractors' pricing and scope are properly aligned. We have recommended the DR Team further align this process by requiring the ESMSA provide its detailed estimates in a manner that facilitates comparison with the internal check estimates from Faithful & Gould. These actions should improve the quality of future ESMSA estimates, though this bears close attention.

### IV. Functional Groups Update

#### A. Engineering

##### 1. Scope Definition

The DR Team has placed significant emphasis on defining scope well in advance of RQE and has set critical milestones for measuring scope definition. One such goal is achieving "Health of Scope" to support detailed design work. The DR Team reports that it is on target to achieve Health of Scope 4, in which all modification work will be known, by the October 2014 milestone. The team's ability to meet this milestone was greatly enhanced by the work of the Blue Ribbon Panel.

Through the end of January, 2014, Engineering had completed 112 Modification Design Packages with 27 known packages remaining. This represents excellent progress over the last year, and the May 2014 milestone for completing MDPs should be met.

##### 2. Planning of Engineering Work

As recommended in the BMCD/Modus 4Q 2013 report, OPG's Engineering attention has shifted from the Definition Phase to planning the next design phases, utilizing the Construction Industry Institute's ("CII") **Front End Planning for Revamp and Renovation Projects** as a source of industry best practices. OPG's focus on planning has initiated a 'bottom-up' work hour estimating process for engineering activities that will lead to a more precise resource forecast. Engineering also initiated the use of an engineering deliverables-based blackout chart, the development of which has identified additional issues with the integrated Level 3 schedule that should enhance the coordination of interrelated activities.

Engineering's focus on planning has also brought attention on the engineering partners of the ESMSA vendors who are responsible for the detail design phase for BOP and F&I work. As noted, ESMSA engineering performance on the F&I projects has been lagging. The DR Team is now taking a much more active role in the management and execution of the F&I projects, and has sought alignment between OPG and the ESMSA's engineering companies' senior management.

The EPC requirements in the ESMSA contracts have compelled constructors and engineering companies who were not previously partnered, to join forces. In our experience, joint ventures of this nature can take several years and several project cycles to mature. The ESMSA joint ventures are still on the early part of this learning curve. The shift within OPG to greater reliance upon external service providers has resulted in some duplication of work effort, churn and mistakes by the ESMSA vendors along with OPG's late recognition of its essential role in managing these vendors. OPG Engineering is moving away from a culture of "observation at a distance" to a much more proactive engagement and active management of the engineering service providers. We continue to encourage this shift in role and perspective.



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### B. Project Controls

#### 1. Schedule

As discussed above, the DR Team's project controls staff has developed a plan for integration of the prerequisite F&I work, calling for full development and integration of the Level 3 schedules for all sub-projects by the responsible ESMSA vendor. This integrated schedule, database in combination with the DR Project integrated schedule, will allow for timely project status and schedule analysis as well as a more cohesive decision making process regarding work flow and resources. This technique is being put in place and utilized by P&M for all of the F&I projects allowing for composite resource analysis, most importantly by the ESMSA vendor resources. Because this process is vitally important to the success of the DR Project, compliance by the P&M organization (including the ESMSA vendors) is imperative.

Until this quarter, the P&M organization has had little success accomplishing the development and integration of the ESMSA vendor schedules. In fact, the number of vendor-developed Level 3 schedules has lagged significantly behind the work. The lack of properly developed, integrated and resource loaded Level 3 schedules has made it impossible to evaluate ESMSA resource needs critical to the DR Project. Furthermore, the lack of an integrated schedule has made critical analysis of the potential impact of delays to the DR Project milestones impossible, and perpetuated the assumption that the F&I work had months of float.

Recent success by the teams working to implement the schedule integration plan has been encouraging and ESMSA scheduling work is improving. P&M and DR Team leadership are now providing clear and concise definition of the division of responsibility between the DR Team, P&M project management and the ESMSA vendors and improving the working model. Meanwhile, the DR Team has identified the points of impact at which the F&I projects could cause delay or changes in execution methodology. These points are now set in the Refurbishment schedules awaiting work ties by the ESMSA vendors so that impacts can be evaluated.

To further facilitate the schedule development, BMcD/Modus recommends that a composite team (DR Team, P&M and Plant Operations) review the F&I schedules developed to date in conjunction with a re-evaluation of the impact points and milestones critical for delivery of the prerequisite projects. This analysis will comprise a review of individual project logic combined with an evaluation of the proper inter-project and milestone logic, sometimes termed a "backwards pass" analysis. This review should also develop a prescriptive plan for final F&I schedule development aligned with the current Level 3 DR Project compliance requirements. The project controls team should prepare a follow-up analysis that focuses on resource loading by the ESMSA vendors. Studies determining regional resource availability requisite with the project needs shall be conducted parallel to this development. Prompt identification of issues related to resource availability have to be quickly identified and fact based in order to properly address and/or provide mitigating actions to alleviate.

#### 2. Project Cost/Estimating

As noted, BMcD/Modus is currently examining the root causes of the budget variances apparent in some of the F&I work. As part of this analysis we will review the initial pricing responses on BOP work to see if they suffer from some of the same noted deficiencies. The DR Team prepares independent estimates of the work for planning and budgeting, as well as providing a check against the contractors' pricing. For the BOP work, these estimates will form the first check against the completeness of the contractor's budget; thus if these estimates are wrong, this would greatly complicate development of the 4d estimate and RQE. We are also examining the commercial risks present in the ESMSA contracts to test if there are provisions that are causing poor behavior by the two contractors. We expect to arrive at more definitive conclusions by the next NOC meeting. The project controls team and the estimating vendor (F&G) are performing their own series of self-assessments and quality reviews on the estimating process.

#### 3. Risk Management Program

As a part of our commitments under the 2014 Assurance Plan, we performed a detailed assessment of the Darlington Refurbishment's Risk Management Program in the fourth quarter of 2013. The purpose of this assessment was to review



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the status of the areas identified for improvement in our August 13, 2013 comprehensive Project Assessment Report. From Mid-July through the end of December, BMcD/Modus monitored and assessed the DR Team's actions regarding the Risk Management Program and note progress in line with our initial observations and recommendations. Although the DR Team still has work to do to effectively implement the program, numerous improvements have been initiated that address matters such as:

- Greater emphasis on risk identification clarity and the progressive elimination of "business as usual" items from the Risk Registers;
- Some formal training has been conducted;
- Improvement to the Risk Register Reports;
- Consolidation and clarification of the applicable risk procedures; and
- The Risk Group has taken a more aggressive role in managing the Risk Management Program.

However, the DR Team has not completed implementation of these essential improvements. The DR Team needs to continue to scrub and clean the risk registers in order to make them an effective tool. The risk reporting tool is somewhat cumbersome and is difficult for end users to sort and analyze information; thereby hindering the effective development and management of mitigating actions. The DR Team has commenced some formal training on the Risk Management Program, however, there needs to be more as evidenced by the current state of the Project Risk Registers. While we have seen some evidence that the Planning and Controls Risk Group has taken a more active role with respect to the implementation and management of the Risk Management Program, we would recommend much more attention in this regard. Additionally, we have not seen much improvement with respect to the identification of opportunities or the development of useful metrics. **Attachment B** to this report is a table which shows the trending on the various areas of the Risk Management Program.

### V. Other Project Risks

#### A. Project Team Development

Some of OPG's procedural and process changes in response to the Auditor General's Report have increased the risk of key personnel leaving the project and will make the hiring and retention of experienced resources more difficult for the DR Project. Enterprise Risk Management carries the retention of key personnel as the biggest program risk to the DR Project, and we would agree that it is certainly among the DR Project's biggest challenges.

BMcD/Modus has pulsed the succession and workforce planning as well as the current and projected staffing levels and found that the DR Team's management is properly focused on this risk. However, the team could benefit from more formal procedural guidance. The unlapping of Unit 2 has also relieved some pressure for immediately staffing the Project Team for the next units.

#### B. Program Management Plan Development

BMcD/Modus monitored the 4Q 2013 update of the DR Team's Program Management Plan ("PgMP"), the primary purpose of which is to demonstrate how the project will be planned, executed, monitored, controlled and closed. A well-constructed PgMP provides a descriptive link between the Project Charter and the lower level procedures; thus, it should be an informative guide for team members and stakeholders alike and subsequent revisions should provide a progressive elaboration of the program management team's plans as they continue to develop.

We found the current state of the DR Team's PgMP to be lacking in detail and clarity. The individual work plans within the PgMP were of inconsistent quality and depth, and these plans were not integrated in a comprehensive fashion. Moreover, the PgMP did not eliminate many of the procedures that are no longer needed or applicable for this work. We would recommend that management make completing the PgMP a priority.



# **Attachment A**

## **1Q Risk Perspective**

**Report to Nuclear Oversight Committee**

**1st Quarter 2014**

**Darlington Nuclear Refurbishment Project**



Area	Observations	High	Medium	Low	Current Status / Mitigation
RFR	<b>SNC/Aecon Performance:</b> Largest Program risk due to overall risk to the DR Project and OPEX				<ul style="list-style-type: none"> <li>▶ Tooling milestone (June 2014) will be missed; approx. 2 months late</li> <li>▶ Tooling and procurement recovery plan in place, showing improvements</li> <li>▶ Mock-up is substantially complete</li> </ul>
	<b>Class 3 Estimate:</b> Progression to RQE requires SNC/Aecon's Class 3 Estimate to be thoroughly vetted				<ul style="list-style-type: none"> <li>▶ Completing estimate to OPG standards by May 15, 2014 will be challenging</li> <li>▶ Ultimate goal of delivery by August 2014 is acceptable</li> <li>▶ Monetizing contingency remains a risk</li> </ul>
	<b>Schedule Development:</b> Level 3 schedule based on payment milestones; unrealistic task durations				<ul style="list-style-type: none"> <li>▶ SNC/Aecon's progress is measured via the target schedule, not payment milestones</li> <li>▶ SNC/Aecon has added resources and improved schedule, reduced float</li> </ul>
	<b>RFR Commercial Risks:</b> Contract provisions currently in place may not drive desired performance				<ul style="list-style-type: none"> <li>▶ Negotiation of the Execution Phase target price should revisit incentives and disincentives</li> </ul>
Campus Plan	<b>ESMSA Performance:</b> D20 Storage Facility work is behind schedule and causing critical path to the TRF				<ul style="list-style-type: none"> <li>▶ Lessons learned are being collected and disseminated</li> <li>▶ Project costs are increasing and likely to exceed budget</li> <li>▶ Vendor performance/unforeseen issues remain significant risks</li> <li>▶ DR Team is reviewing extent of D20 budget overruns</li> <li>▶ Similar trends are being observed with several other F&amp;I projects; budgeting process is being investigated</li> </ul>
	<b>Engineering and Planning:</b> D20 provides key lessons learned for remaining Campus Plan and BOP				<ul style="list-style-type: none"> <li>▶ Engineering is co-locating with ESMSA vendors</li> <li>▶ Clarification of RFPs and process ongoing</li> <li>▶ Modifications to planning and scheduling underway</li> </ul>
BOP	<b>ESMSA Performance:</b> Concern over ESMSA contractors' performance and ability to execute BOP work				<ul style="list-style-type: none"> <li>▶ Allocation of work underway; some issues with cost/scope estimates</li> <li>▶ Risk of ESMSA Performance will continue until improvements on performance issues in Campus Plan are observed</li> </ul>
Engineering	<b>Scope Review:</b> Urgency mounting for scope review; planning/prep underway for work that may be eliminated; concerns regarding scope				<ul style="list-style-type: none"> <li>▶ PSRB has approved final scope recommendations</li> <li>▶ Final scope closure report has yet to be issued</li> </ul>
	<b>Planning of Engineering Work:</b> Engineering work was not well understood and is poorly planned				<ul style="list-style-type: none"> <li>▶ "Bottoms-up" estimating process initiated for engineering activities</li> <li>▶ Increased focus placed on engineering planning for the design phase; new progress tracking mechanisms in place</li> <li>▶ OPG has fostered alignment with the senior management levels of the ESMSA engineering vendors</li> </ul>

Area

Observations

High

Medium

Low

Current Status / Mitigation

Project Controls

**Continued Schedule Development:**  
Schedule approach was unproven;  
integration at appropriate level at risk



- ▶ Project Team is moving toward industry-wide recommended practices for scheduling
- ▶ Substantial work remains to populate detailed level 3 schedule

**Progress Towards RQE:** The plan  
for developing RQE is being  
developed.



- ▶ RQE development remains essentially on schedule, but will be heavily reliant on the quality of the various inputs.
- ▶ The DR Team has assigned a manager for the planning and development of the multiple pieces that must come together for RQE.

**Risk Management Program:** Risk  
registers require scrubbing;  
monitoring tools are cumbersome



- ▶ DR Team is cleaning up the risk register and improving reporting
- ▶ Risk Group is taking a more active role in managing the Risk Program
- ▶ Risk training is being conducted



## **Attachment B**

# **Summary Table from Risk Assessment Assurance Report**

## **Report to Nuclear Oversight Committee**

**1st Quarter 2014**

**Darlington Nuclear Refurbishment Project**





**Report to Nuclear Oversight Committee – 1Q 2014**  
**Darlington Nuclear Refurbishment Project**



**Attachment B**

**Summary Table From Risk Assessment Assurance Report**

Area	Observation No.	Comments	Change from Previous Assessment
Risk Register Reporting Limitations	1	Migration to SharePoint and Excel reporting tool have increased reporting functionality, but there are still limitations.	↑
Lack of Clarity of Risk Titles and Descriptions	2	Significant progress has been made by the DR Team over the last several months on this issue. Current TCD to complete updating of all risks is January 31, 2014.	↑
Numerous Entries in the Risk Registers are not “Risks”, but Business as Usual “Issues”	3	Significant progress has been made by the DR Team over the last several months on this issue. Current TCD to complete updating of all risks is January 31, 2014.	↑
Lack of Appropriate Risk Management Program Staffing & Leadership	4	There will be some significant changes to the Risk Group in January. This issue will have to be monitored once the new team is in place.	↔
Risk Management Program Training	5	There has been a concerted effort to implement formal training by the Risk Group	↑
Missing Identification of “Opportunities”	6	There has been no effort to identify opportunities within the risk register.	↔
Weak Risk Responses	7	The key to a successful Risk Management Program (and overall project success) includes the thoughtful development of effective Risk Responses (e.g. mitigating) actions. Based solely on a review of the Risk Registers, many risk responses appear to be perfunctory and ineffective.	↑
Long Periods Between Risk Register Reviews and Updates	8	Efforts to update all risks have caused more frequent review of risks. OPG should consider having ROC meetings more frequently than once per quarter.	↑
Risk Oversight Committee Effectiveness	9	Three meetings have been held to date and, as the risk program matures, they are progressively improving by focusing less on process and more on substance.	↑
Lack of Trending and Other High-Level Metrics	10	There was no change as of the end of December. However, we have noted some improvement in this area in the last couple of weeks. New metrics are being developed, but not yet rolled out.	↔

Legend: ↑ = improved, compared to Project Assessment  
 ↓ = weaker, compared to Project Assessment  
 ↔ = no change, compared to Project Assessment  
 ⇔ = no change

March 4, 2014

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# **Report to Nuclear Oversight Committee**

## **2<sup>nd</sup> Quarter 2014**

### **Darlington Nuclear Refurbishment Project**



**Burns & McDonnell  
Modus Strategic Solutions**

**May 13, 2014**



## Report to Nuclear Oversight Committee – 2Q 2014 Darlington Nuclear Refurbishment Project



### I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company (“BMcD/Modus”) provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors (“NOC”) regarding the status of the Darlington Nuclear Generating Station’s Refurbishment Project (“Project” or “DR Project”) as of April 30, 2014. The DR Project continues to advance toward its major goal of producing a Release Quality Estimate (“RQE”) for final Board of Directors and Shareholder approval by October 15, 2015.

BMcD/Modus has continued to stress the importance for OPG to embrace its role as the integrator of the work and to actively manage the multiple contractors. To this end, the DR Team has made a significant shift in engineering strategy and will now directly manage and supervise the engineering service providers, rather than continuing the previous “hands-off” oversight approach. This is a bold but necessary move and one that is endorsed by BMcD/Modus. If OPG manages this transition well, we would expect a significant increase in engineering efficiency.

Pursuant to the Project’s Assurance Plan approved by the Audit & Finance Committee, BMcD/Modus has prepared independent reports documenting the DR Team’s status as well as further recommendations for improvement. This quarter we have issued Assurance Reports based upon our detailed review of: 1) DR Project Schedule Process and Development; 2) the 2013-2014 Business Plan as it relates to the latest project estimate (the “4c Estimate”) and 3) Scope Status and Process. Upcoming reports will focus on our review of the Campus Plan cost and schedule overruns, 4d Cost Estimate vetting and RQE preparation. These full reports will be available for the NOC’s review. In addition to our regular, everyday contact with the Project Team, we will continue to meet periodically with the Refurbishment Project Executive Team (“RPET”) to discuss our reports to NOC and our Assurance Reports in order to clarify any recommendations and engage in discussion of appropriate actions. We are also coordinating our efforts with Internal Audit so that we meet our assurance commitments in an efficient and effective manner.

Much of our focus in this quarter’s report was on evaluating the performance of the pre-requisite Facilities and Infrastructure projects (“F&I” or “Campus Plan Projects”). The Campus Plan Projects remain a significant risk to the Refurbishment Project, and provides important lessons learned for the DR Project.

The following is a brief summary of the DR Project’s most significant developments over the last quarter:

- **Campus Plan Performance Project Risk:** Many of the Campus Plan Projects are forecasted to complete significantly beyond the approved budgets and schedules. In fact, schedule adherence is so poor that the Campus Plan work poses multiple threats to the start of Refurbishment. Over the last quarter, BMcD/Modus has engaged in a thorough review of several key Campus Plan projects in an attempt to identify trends and understand the causes of these cost and schedule overruns. Our findings show that the predominant cause was OPG’s Projects & Modifications (“P&M”) organization, who is managing this work for the DR Project, incorrectly applied an “oversight” project management approach for its EPC contracting strategy, leading to a series of cascading management failures and contractor performance issues, including misunderstandings of scope, uncontrolled scope creep, poor quality cost estimates, unrealistic and incorrect schedules and an inability to manage known risks, additional costs and delays. For multiple reasons described herein, P&M was completely overwhelmed in trying to manage Campus Plan Projects – in particular, the two largest of these projects, the D2O Storage Facility and Auxiliary Heat Steam Plant (“AHS”) which were the “pilot” projects for this new contracting model.

Simultaneous to our review, the P&M team’s new leadership has taken aggressive action to correct as many of the major issues as possible. In acknowledgement of many of our recommendations and as a result of its own findings, P&M, the performing Extended Services Master Service Agreement (“ESMSA”) contractors and the DR Team are developing more realistic project schedules for each scope of work that will account for need dates, available resources and optimal work flow. Senior management has committed to a full reforecast of the cost of each of the Campus Plan Projects, starting with the two most notable problem projects, the D2O Storage Facility

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## Report to Nuclear Oversight Committee – 2Q 2014 Darlington Nuclear Refurbishment Project



and AHS. P&M's and the DR Team's senior leadership instructed their managers to actively manage the work henceforth through increased collaboration with the contractors. In particular, OPG's engineering team will be taking on a much more active role in directly managing the remaining engineering work. While these measures are much more likely to be successful, the damage to a certain extent cannot be fully mitigated, as the affected Campus Plan Projects will cost more, finish later and pose a much greater threat to Refurbishment than management initially realized; this is in large part due to the unrealistic nature of P&M's initial project budgets and the way in which scope crept into these projects after these initial budgets were approved. We recommend that OPG look at the impact of these Campus Plan Projects on the Definition Phase budget as soon as possible. Moreover, P&M can only hope to recover these Campus Plan Projects if it receives support from OPG's corporate functions, from whom P&M will require fast action and some needed modifications to processes. Our team has been engaged in closely monitoring the recovery plan and will continue to report on P&M's progress. Our observations and recommendations with respect to the Campus Plan performance to date are summarized in this report and will be the subject of an Assurance Report we intend to issue at the conclusion of the 2<sup>nd</sup> Quarter.

- **RQE Preparation:** RQE development remains essentially on schedule, though the development of the 4d Cost Estimate will be a good test of the DR Team's preparation. Senior management has introduced two new controls to the Project to aid in this endeavor: 1) an Options Review Board chaired by the Senior VP of Refurbishment that is vetting the maturing plans for each scope of work, and 2) a Readiness Schedule and related process which will hold the project managers accountable for meeting interim preparation milestones. These are good measures that will provide additional confidence for RQE. In addition, all of the major Project Bundles except for the Steam Generator Project will be going through Gate 3 prior to the fall of 2015, which should provide the DR Team with an opportunity to re-examine these sub-projects' business cases including scope alternatives, status, methods of delivery, cost estimates, schedules and risks. Strengthening the gate process as we have recommended will provide further levels of vetting for the work planning and should streamline the DR Team's approach to the 4d Cost Estimate.
- **Retube & Feeder Replacement Project Risks:** The RFR project remains the DR Project's most notable ongoing risk, with respect to the Execution Phase as it represents the majority of the work on the Critical Path. SNC/Aecon's performance trends during the Definition Phase needs to be taken into account in the vetting of its Class 3 Estimate<sup>1</sup> (an estimate with an expected accuracy range of between -10% on the low side and +30% on the high side after the application of contingency) and OPG's confidence level for the Execution Phase. Through March 31, 2014, the contract is underspent by \$9 M against plan, though this gap is closing. Additionally, SNC/Aecon's cumulative schedule performance index ("SPI") has improved to 0.94. As noted in our last report, SNC/Aecon's original plan to complete tooling delivery by June 2014 will not be met, and aspects of its recovery plan dates are being challenged by further supplier delays. SNC/Aecon has committed to recover these dates and is reassigning work to different suppliers, though the impacts of these delays could be felt in the tool performance guarantee period. OPG's RFR team is closely monitoring these events and holding SNC/Aecon accountable.

With respect to the Class 3 Estimate preparation, SNC/Aecon met its internal goal of March 15, 2014 to produce construction work packages ("CWP's") and has progressed with its other key deliverables, including the detailed Level 4 schedule. However, the compressed time frame during which SNC/Aecon produced all of these estimate components has put the onus on OPG to review, comment and rationalize SNC/Aecon's estimate by June 15, 2014, which will take considerable effort and coordination. Ultimately, SNC/Aecon must provide OPG with comfort that the Class 3 Estimate meets its committed level of accuracy. Equally important is how the Class 3

<sup>1</sup> Estimate accuracy is classified per the Association for the Advancement of Cost Engineering International (AACEi) standards Class 1 through 5. Class 1 is the most accurate.



## Report to Nuclear Oversight Committee – 2Q 2014 Darlington Nuclear Refurbishment Project



Estimate forms the platform from which the Class 2 Estimate (with an expected accuracy range of -5% to +20%) will be developed for RQE. As discussed below, there are some commercial opportunities OPG must weigh that could impact the cost estimate as well. Given its high importance to the overall project, BMCD/Modus sees OPG arriving at an appropriate comfort level with the Class 3 Estimate as essential to tightening the project's cost estimate, and we would recommend the team take any reasonable time and action needed to reach that level of comfort.

- **Commercial Risks:** The Project Team has taken our recommendation to review commercial incentives and disincentives in the Project's major contracts in light of some changed planning basis and assumptions—including the Shareholder's mandates set forth in the LTEP, the unlapping strategy and the evidence to date of contractor performance. The DR Team took an action to develop a negotiation strategy with SNC/Aecon that will take into account the impact on their work caused by the unlapping Unit 2, prioritization of Unit 2 performance, potential for economies of scale with the Turbine Generator work and other key considerations. Regarding the ESMSA, senior management is instituting a number of changes to managing and executing the EPC model that has proven to be ineffective at driving performance, cost and schedule compliance and reducing OPG's risk. [REDACTED] and OPG theoretically has both the expertise and the essential knowledge needed to more effectively manage this work. Going-forward, it is OPG's intention to take a much stronger role in managing and directing the engineering portion of the work. In doing so, it will be important to for OPG to understand and communicate the impact of the shifting of risk for this added responsibility as well as any impact to warranties provided by the contractors. The success of this new strategy will depend on OPG's ability to attract and retain talent and OPG's ability to drive change down through its organization to implement a new project management philosophy.

Other ongoing challenges to the DR Project include the development of the DR Team for the Execution Phase, further refinement of the Risk Management Program and Fuel Handling work. Attachment "A" provides an update regarding the DR Project's risks.

## II. Summary of Campus Plan Root Cause

### A. Overview

The Campus Plan Projects consist of 26 separate scopes of "pre-requisite" work that are needed to support the DR Project or the station's operations during construction. These projects are being managed by OPG's P&M organization. Prior to this Campus Plan work, P&M executed capital projects for the stations, with annual budgets of approximately \$300M. With the advent of the DGNS Refurbishment Project, senior management sought to use P&M to develop and oversee all of the Campus Plan Projects, allowing the DR Team to focus on planning for the DR Execution Phase. The inclusion of the Campus Plan Projects caused P&M's portfolio to increase by four to five times, and the scale and technical complexity of this work was unprecedented for this organization. At the same time, OPG was under pressure to decrease its staff in line with the Shareholder's requests. As with many utilities in the US, OPG who had once had a very large construction unit that built the current stations and Bruce, and as recently as Pickering A Unit 1 RTS Project in the mid-2000's had considerable in-house construction, planning, procurement and engineering resources, was shrinking even further and the capability for managing and directing large capital projects was sacrificed.

From 2010 until July 2013, P&M was led by its former VP [REDACTED]. [REDACTED] ultimately succeeded [REDACTED] in January 2014. P&M's governance, including most of its business and management processes, were separately developed and maintained from those used by the Refurbishment Project. Also, P&M negotiated and utilized the Extended Service Master Services Agreement ("ESMSA") contract and the two "ESMSA Contractor" consortiums led by Black & McDonald and ES Fox. The ESMSA contract is actually a mix of multiple standard form agreements that could be used in combination depending on the circumstances – e.g. there are separate forms for engineering, procurement and construction that could be combined into an "EPC" contract. The business deals with the ESMSA Contractors were

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the result of a competitive process which resulted in the contractors agreeing to some unique provisions that are used for all contracted work with these vendors. As an example, when used as an EPC, the contractors who lead these consortia are required to bid engineering work on a fixed-price basis with no profit for themselves. The construction work is all cost reimbursable target price, and the performance incentives include up to a 50% reduction of profit, though this and some other disincentives built into the contract have proven thus far to be much less effective in practice than concept at driving the contractors' behavior and performance.

The impetus for having P&M execute the Campus Plan work was that through the Definition Phase of Refurbishment, the DR Team was not assembled as an execution organization, but a planning one. P&M was an existing service resource with some experience in managing the ESMSA contractors. P&M's work on the Campus Plan Projects is funded by Refurbishment and it must report its progress to Refurbishment, though these business units are otherwise autonomous. Until recently, other than these approvals and the fact that both organizations use the ESMSA Contractors, there was very little else in common between Refurbishment and P&M, including the project management procedures utilized for their respective projects. P&M's project management procedures were not developed to manage multi-year projects of the size and scope of some of the Campus Plan Projects. Over the last several months, P&M has begun to manage the Campus Plan projects in accordance with the project management procedures developed for the DR Project in an attempt to implement industry-standard risk, cost and schedule controls. Additionally, the new VP has implemented a series of organizational and strategic initiatives with the goal of improving performance.

As of April 2, 2014, the Campus Plan Projects are estimated to cost in aggregate approximately \$660M (an increase of \$111.5 Million over the Board of Directors approved 2014 Business Case release for this work) and the work varies widely in size and complexity. The performance of the work is largely split between the two ESMSA contractors, Black & McDonald and ES Fox. Deadlines for completion of these Projects vary based on the project's and stations' needs; AHS is scheduled to be complete prior to the DNGS Vacuum Building Outage ("VBO") in mid-April 2015, while all the remaining work is scheduled to be completed one year later, in April 2016, to allow enough time for commissioning prior to the October 2016 Refurbishment Project's breaker open milestone. Many of these Campus Plan Projects involve the construction of commercial buildings that are made more complex because of their location on or adjacent to the nuclear island, which impacts their associated design requirements for such things as nuclear safety, security, and seismic requirements. Additionally, these are brownfield projects on a site where soil quality issues and underground interferences are the norm and coordination with the operation of DNGS must be managed.

Over the last quarter, BMCD/Modus has engaged in a number of activities related to the Campus Plan Projects. In this regard, we have:

- Reviewed the reasons for significant cost variances in five of the largest Campus Plan and Prerequisite Projects: D20 Storage Facility; Auxiliary Heat System Building ("AHS"); Water & Sewer; RFR Island Annex Building ("RFRISA"); and Retube Waste Processing Building ("RWPB"). Our goal was to determine the root cause of the Campus Plan Projects' variances so that past mistakes will not be repeated. We chose to examine the RWPB, which is being built by SNC/Aecon and managed by the DR Team, for a real-time direct comparison with the ESMSA-managed projects.
- Reviewed the Campus Plan Projects' schedules prepared by the vendors to identify any major gaps. This review led our team to make a series of recommendations to the P&M and DR Teams, and our subsequent monitoring of progress of the vendors' ongoing redevelopment of their detailed schedules for each of the major projects.
- Examined the risk management process within the P&M organization, including its ability to properly identify, avoid, mitigate and monetize risk.
- Reviewed the design and scoping process and identified the causes for the extreme inaccuracy of the vendors' engineering cost and schedule estimates.

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- Reviewed the management structure and capabilities of the P&M team that started this work down the current path. We have also spent time with P&M's new VP and members of P&M's restructured leadership team to convey our findings and recommendations and gauge the effectiveness of P&M's current initiatives to improve performance and mitigate these earlier management failures.

As noted, these Campus Plan Projects have been plagued by myriad problems that have resulted in significant schedule and cost variances. Our findings show that the predominant cause of these overruns was P&M's original strategy to use a project "oversight" management model for the EPC contracting strategy utilized by OPG that was inappropriate in application and lead to a series of cascading management failures and contractor performance issues. The oversight management model employed a disengaged, "hands-off" approach by the P&M organization which caused the fledgling P&M organization to: (1) wrongly assume that the contractors understood the scope on the basis of performance specifications that outlined scope initial requirements; (2) utilize inexperienced project managers; (3) allow Operations & Maintenance and other OPG stakeholders to initiate scope changes to these projects long after the conceptual design period ended; (4) to accept the poor schedules and cost estimates by the contractors without appropriate vetting and challenge, and which were not updated to incorporate the impact of scope changes on a timely basis; and (5) to inaccurately or untimely report the projects' progress, risks and cost and schedule overruns to the DR Team and senior management.

### B. OPG Contractor Management and Contractor Performance

#### 1. Summary

Based on the information we have reviewed, it is apparent that P&M put excessive faith in the ESMSA Contractors' ability to perform this work and an over-reliance on the perceived ability of the EPC contracting model to shift project risk to the contractor and alleviate the need for active project management. As a result, OPG chose to provide oversight of the contractor's work at arms-length. In a recent self-assessment related to the D2O Storage Project's delays, the P&M Project team ("P&M Team") noted that at the onset of the Project, P&M believed "the EPC Process" would mitigate known risks via "project efficiency gains due to the expertise and autonomy of the contractor."<sup>2</sup> This exemplified OPG management's initial hands-off approach to project management that P&M piloted under which the contractor was given autonomy to develop its own scope requirements without process monitoring. As noted in P&M's self-assessment, this model resulted in "unclear expectations, re-work, frustration."<sup>3</sup> P&M's error was misunderstanding the essential nature of the ESMSA contracts, which are not fixed-price EPC contracts that shift all risk and responsibility for performance to the contractors (nor were they ever meant to be). The majority of the Campus Plan Project's execution cost is being performed on a cost-reimbursable target price, where contractors have only a portion of their fee at risk in the event that the target price is exceeded. In our experience, the nature of this work (refurbishment and construction of new facilities on an operating nuclear site) and the fact that the contract is cost reimbursable, require the owner to engage in active management of the contractors and coordinate interfaces. This means providing very specific instructions to lock down scope at the project's conceptual design phase and holding the contractors accountable on a daily basis to meet expected cost and schedule.

- Moreover, it is apparent that the P&M Team did not have the necessary experience, training or internal management direction to properly manage this work. Attachment B is a matrix that provides a summary of our observations regarding the five major ongoing F&I Projects. This matrix shows, among other things, that in the management of the work, P&M:
- Routinely accepted poor quality schedules and cost estimates without adequate vetting;

<sup>2</sup> SCR Number D-2013-19100, January 22, 2014.

<sup>3</sup> Id.



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- Mischaracterized the nature of these estimates by assuming anything provided by a contractor was at a very high level of maturity (Class 3/2) when such estimates were based on conceptual (at best) engineering, meaning these estimates could not have been better than Class 5 (-50% to +100%) in nature;
- Failed to establish accountability standards for the contractors;
- Failed to identify or mitigate known risks;
- Did not effectively react to problems when they materialized and accurately and timely report the extent of cost overruns, schedule delays and scope increases to senior management;
- The P&M Team did not seek to lock down the scope at start of this work and allowed the “customer” – Operations and Maintenance – to make significant changes to the design that were not properly understood, quantified or captured in subsequent reports to senior management; and
- The ESMSA contractors contributed to the problem by not transparently reporting or timely identifying how these projects were evolving and failing to provide any reliable metrics—cost, schedule or otherwise – that informed OPG of these brewing problems.

### 2. Indicative Projects - D2O Storage and Auxiliary Heat

In our analysis, BMcD/Modus examined five separate projects in detail, and each exhibited some or all of the management issues to some extent. Attachment C is a brief summary of each of these projects’ cost overruns.

The management failures we observed were most evident and acute with the D2O Storage and AHS projects. These projects were the “pilot” EPC projects for the ESMSA contractors—

[REDACTED]

[REDACTED] In both cases, P&M sought the Board’s full funding approval at a point when very little design was done, only to have to later seek additional funds from the Board once design had matured.

#### a. The Flawed Bidding/Estimating Process

P&M’s management failures can be seen throughout the planning and execution phase of the project. Notable from OPG’s initial negotiation and acceptance of bids for this work is P&M’s mischaracterization of the vendors’ estimates in the approved Business Case Summaries (“BCS”). In August 2011, OPG produced a BCS for D2O Storage that estimated its cost at \$210.6M, [REDACTED]. At the project’s next gate in June 2012, the estimated cost had dropped from \$210M to \$108M. However, BMcD/Modus could not find any attempt by P&M to rationalize or otherwise explain how the cost estimate for this building was cut virtually in half from one approval gate to the next. Moreover, the estimate for design and construction was \$52.2M, which P&M characterized as a “Class 2 Estimate” despite the fact that at the time of the estimate, Black & McDonald had little experience with this type of construction and had performed no engineering or scope definition. Thus, this estimate was more likely a Class 5 Estimate. In retrospect, it is likely that the initial \$210M estimate was more accurate; however, it is certainly clear that the approved \$108M estimate should not have had any greater accuracy attributed to it, since it was not based on a significantly greater level of project maturity. Likewise, the AHS BCS was termed a “Class 3” Estimate, though it was similarly immature.

This estimate classification drove P&M to vastly underestimate the amount of contingency associated with each package. There is no evidence that P&M engaged in the type of vetting of the estimates that we would expect on projects of these size and importance. From interviews with the current P&M staff and the contractors, it appears that these initial BCS estimates were poorly characterized as part of a deliberate management strategy directed by the former VP of P&M. P&M’s managers told us that the contractors were challenged to reduce their bid prices and remove all contingencies for unknowns, despite the extreme immaturity of project definition underlying their respective bids. As

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an example, for the D20 Storage project, Black & McDonald was told to remove from its contract price any contingency for unforeseen soil conditions, even though there was a high likelihood that there would be contaminated soil issues. Moreover, P&M clearly overvalued price as a consideration in the contractor selection process, especially in light of the fact that the work was going to be performed on a cost-reimbursable basis and the bid prices were not binding.

P&M gave only token consideration to determining which contractor had a better approach for executing the work. P&M chose the “low bidder” even though the other contractor’s qualifications and project approach were viewed more favorably. Thus, P&M created the conditions for a perfect storm of cost and schedule overruns. Because the work is largely based on a cost-reimbursable target price with no caps on size, P&M’s artificial beating down the contractors’ prices in the bid phase was a Pyrrhic victory: P&M’s actions did not reduce cost and only served to deprive senior management of realistic cost projections for this work. The budgets for these and other F&I projects were nothing more than paper barriers that were easily surmounted as the design work continued to generate more complex (and expensive) work.

### b. Lack of an Integrated Schedule

Until April 2014, the P&M project teams for D20 and AHS were working without a reliable, integrated Level 3 Schedule. Many on the project and throughout the OPG organization were given a false impression that the Campus Plan Projects, and D20 in particular, had a year of float, and so on-going delays had no impact on the Project. The delays to D20 Storage’s schedule were not forecasted by the project team and were simply reported after the fact. By this point, the schedule had already slipped so that engineering was on its way to an 18-month projected overrun of an original 11-month schedule. However, without a resource-loaded, level 3 schedule, it was impossible to assess the status of the project, let alone calculate with any accuracy any remaining float.

One of the strategic initiatives was implemented by the new P&M VP was to improve the projects’ schedules. This endeavor allowed the project team to see that D20 Storage was actually projected to be completed on April 26, 2016, more than a year after the original April 15, 2015 deadline. Furthermore, once known risks are factored in, it is likely that the D20 project can only achieve this revised date if some of the schedule durations are accelerated—at an additional cost. Even then, these efforts will not improve completion of the schedule by much, but will increase the probability that the April 2016 date can be met. However, none of this would be known if efforts had not been made to improve the schedule.

### c. Risk Management

Based on our observations, it appears that all P&M’s identification of risks is a “check-the-box” activity due the fact that having a list of risks is a prerequisite to obtaining a funding release. P&M does not actively manage its on-going risks as a part of an effective risk management program. As an example, the risk sections of the D20 and AHS BCSs consist of lists of potential risks and some evaluation of their nature, but it is not apparent that these risks in any way influenced the calculation of these projects’ contingency, nor are there any regular reviews or updates of these risks until required to do so in order to pass a gate and obtain a funding release. Once a project obtains full funding for execution, very little, if any, attention is paid to day-to-day risk management, including the ongoing identification of new risks and opportunities as well as the formalized implementation of risk mitigation strategies. Additionally, there is no structured or defined risk program management oversight (such as the NR Risk Oversight Committee).

A recent self-assessment performed by the NR Management Systems Oversight group (SA RF13-000855 dated January 20, 2014) identified perceptions (opinions) of several P&M managers that included the following: “[D]evelopment and use of a Risk Register is seen as purely administrative and not adding value to the Project Managers.” This suggests a lack of understanding of the value of a risk management program or lack of acceptance, which can be addressed by effective training and indoctrination. However, risk management training is virtually non-existent in the P&M organization in distinct contrast to several years ago when quarterly workshops were regularly conducted.



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### d. The Gate Process and Failure to Report Cost and Schedule Increases to Senior Management

BMcD/Modus next explored the relative effectiveness of the gate process for this work, and found that while the process in concept is a good one, it suffers from problems in execution. The BCS documents for D2O Storage and AHS were inconsistent in presentation of key information on cost, risk and scope. As these projects progressed, P&M's management failed to provide visibility to OPG management of the extent or nature of project cost increases. Most notably, P&M failed to update its project reports during the design phase to reflect cost increases due to scope changes in the projects.

AHS provides a critical example. On November 12, 2012, P&M presented its Gate 3A package for approval and full funding release (except for a small portion of costs to be approved in 2014). The P&M Team's gate presentation characterized the AHS cost estimate as a Class 3 estimate in the amount of \$45.6 M. P&M included [REDACTED] of contingency in the \$45.6M estimate, of which [REDACTED] was identified as having a 100% chance of occurrence. P&M expressed an "85% confidence level" in this cost estimate and assessed there were [REDACTED] days of schedule contingency in the estimate—despite the fact that the full scope of the project was not known at that time because detailed engineering had not started. The option of building a new AHS was preferred over seven alternatives, based primarily on the projected cost. At the time of this gate, the project had spent \$1.46M.

Between this gate and January 2014, ES Fox engaged in the design of the AHS, scope changes caused the cost to increase from the initial \$45.6M estimate to \$79.9M. This cost increase is largely attributable to two causes: (1) remediation of contaminated soil that as of the time of bid was known by both OPG and the contractor to be of poor quality; and, (2) prescriptive design requirements that served to make a stock steam boiler design follow nuclear Engineering Change Control ("ECC") processes, which caused an increase in the size, complexity and nature of the work. Moreover, these design requirements and the overall length of the design phase, coupled with the soil issues, has frittered away virtually every day of float.

The fact this project had so substantially changed from the original BCS was not accurately or timely reported to management. The failure of the gate process was that the Gate Review Board members did not provide adequate oversight in ensuring that the AHS project team had a reliable estimate, schedule, and well-defined scope prior to approving the gate and recommending a funding release. As of January 2014, P&M had already expended nearly \$20M, or more than half the approved budget excluding contingency, even though the design was not complete and no construction had begun. However, during this entire time, P&M's estimate at completion ("EAC") in all of the DR Project's and Campus Plan reports **never varied** from the approved BCS amount. Moreover, the DR Project's Program Status Report for March 2014 showed the AHS at 49% spent with a CPI of 1.10 and an SPI of 1.0, clearly not an accurate representation of the Project's status. Part of this failure was based upon some of the P&M project managers' mistaken belief that the reported EAC amounts should not be changed until additional funds had been approved for the projects. This lack of accurate reporting has deprived senior management and the Board the option of revisiting the original BCS analysis in order to determine if building a new AHS facility continues to be the preferred option—and if not, change course. This is particularly true in light of the fact that as of November 2012, three of the competing options to building AHS were priced at less than \$50 M.

D2O Storage provides a very similar example at a much higher overall cost. The cost variance progression from D2O Storage began with an original approved BCS of \$110M, based upon estimated contractor costs of approximately \$77.8 Million. The ES Fox team and design solution were both preferred but Black & McDonald was chosen entirely because its price was \$30M less even before P&M further drove Black & McDonald's estimate down.

D2O Storage's engineering effort was originally scheduled for 11 months, and was supposed to be completed by July 2013. However, even today, engineering is not complete and is projecting to extend to a total duration of 29 months. The P&M team provided sporadic updates to the design milestones as they continued to be missed but failed to convey the potential consequence. In August 2013, P&M reported that CNO Milestone 73472M0015, "D2O Modifications –



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Detailed Design Complete” was expected to miss its planned completion date of August 21, 2013 **by four months** though stated, “there is no impact to the critical path.”<sup>4</sup> As of this same meeting, an action was recorded to “confirm the timing for integration” of the D2O Storage schedule into the master C&C Schedule, the follow-up to which indicated that the schedule would not be available for integration because “it falls short of our requirements for several parameters.”

In September 2013, P&M reported in the Program Status Report that:

Due to the change in design for the connection of the new tanks to the existing, significant additional design work is required. This change of design was required to address water hammer issues with the initial plans which could not be resolved without a significant change in design. A new underground tunnel connecting the two buildings will now be utilized to connect the two buildings.<sup>5</sup>

However, this “significant” design change was not highlighted as a major risk item in P&M’s reporting, and P&M maintained the same EAC for D2O Storage despite having this information in hand. P&M also maintained that there was no impact to the critical path, even though P&M again admitted that the vendor had yet to produce a detailed schedule, which begs the question how could one arrive at such a conclusion regarding float without a reliable schedule.

P&M first reported a variance to the D2O Storage budget in October 2013, which coincided with months of mitigating adverse soil conditions and failing to meet the schedule for tie-ins for the TRF outage. Black & McDonald presented a high-level cost estimate that showed approximately \$49M of increases in foundation work and engineering in October 2013, though this estimate was characterized as a work in progress. This estimate was increased by \$5M in December 2013. P&M finally updated the D2O Storage EAC in the January 2014 DR Program Status Report from \$95M to \$122.7M, though simultaneously, P&M issued a report to the Nuclear Executive Committee (“NEC”) showing a forecasted EAC of \$152M. Thus, P&M’s first reporting to senior management and other OPG stakeholders of any impact of the design changes that had been brewing for nearly two years was inconsistent at best.

In January 2014, Bill Robinson required Black & McDonald to update its costs. Black & McDonald committed to an estimate of \$94M (compared to its original contract of \$67M), which with OPG’s costs was ranged by P&M at a total of \$150-170M, including OPG contingency and financing costs. After coming on board, P&M’s new VP required Black & McDonald to prepare a bottoms-up, high confidence schedule and budget based on the high level of engineering completion. Black & McDonald’s output has trickled in. [REDACTED]

[REDACTED] Black & McDonald has broken down the cost increases into several categories, including: additional scope (\$85.4M), changed assumptions (\$14M), soil remediation (\$17.3 M), delays to the schedule resulting in acceleration (\$9.8 M) and inclusion of items that were either missed or misestimated in the original estimate (\$31 M). Black & McDonald characterized this estimate as a Class 4 even though: (1) the design is 80% complete; and (2) Black & McDonald had just provided a Level 3 schedule for the remaining work which they claimed was comprehensive. Based on these two data points alone, Black & McDonald should be able to produce at least a Class 2 estimate at this time. [REDACTED]

Moreover, throughout 2011-13, P&M did not require Black & McDonald to timely update costs and provide visibility to the cost of these design changes as they were occurring; thus, as with AHS, P&M’s management allowed the contractors

<sup>4</sup> DN Refurbishment Program Status Report Meeting, August 21, 2013

<sup>5</sup> DN Refurbishment Program Status Report Meeting, September 18, 2013



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to run up the tab and incorporate a flood of OPG stakeholder generated late design changes without adequate checks and balances or understanding of the magnitude of these changes.

As a direct consequence of P&M's failure to report these cost and schedule variances, senior management was deprived of the ability to:

- Stop the design changes that led to these increases;
- Stop the project entirely and resort to one of the other evaluated options;
- Identify and characterize the cost increases that are not related to Refurbishment and subject these changes to the same value-enhancing criteria as the remainder of the DR Project's work; and
- Mitigate the impact of the schedule delays and overruns.

Thus, the consequences to OPG are two projects that may cause external stakeholders to question OPG's management prudence.

### e. Vendor Performance Issues

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]



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### 3. Current Schedule Status

P&M's effort to recover these projects began with finally getting the vendors to develop resource loaded, integrated Level 3 schedules, with focus on developing template schedules for D2O Storage and AHS. These schedules are portraying the following significant challenges:

- The AHS project is currently projecting about 3 months behind schedule which will delay the VBO outage. The schedule is currently being impacted by late design, with some twenty outstanding design changes that ES Fox needs to process. This late design could impact the schedule to September 2014 and beyond and frustrate both procurement and construction, which have essentially no float. Based on our review of this schedule, attempts to accelerate the work to recover this time could be ineffective. Instead, BMcD/Modus recommends P&M, in concert with the Station, look to: (1) eliminate these multiple design changes; and (2) rationalize and potentially reduce the time needed to commission the AHS. If these upfront and follow-on tasks can be reduced in duration, the project will regain some much needed time for construction.
- D2O Storage is more complicated. The combination of underground utilities and poor soil conditions, design changes, engineering delays and contractor performance has pushed D2O Storage to a projected completion of April 15, 2016, which has no float to OPG's need date. In analyzing the current status of the work, we have determined that: (1) while engineering has driven significant delays to date, accelerating its final completion will not result in improvement to the overall completion date; (2) the current March 2015 completion date for concrete and foundation work, including drilling and setting caissons, needs to be improved by as much as possible and ideally to complete prior to the onset of winter conditions in 2014; (3) the current duration for building on top of the completed foundations, including structural steel erection, building enclosure and mechanical piping, is a scant 5 ½ months and needs to be substantially improved. Based on this status, we recommend OPG examine: (1) value engineer the foundations and structural design, with the goal to eliminate as much of the building's complexity as possible – the office space and associated concrete structure may be over-designed based on non-Refurbishment requirements added during the attenuated design phase; (2) value engineer the building's piping design, which similarly increased due to ASIC and Station needs; (3) accelerate the caisson drilling so that rebar and foundation work can recover essential lost time.

OPG should also examine other options in light of the overruns on these projects, as less permanent solutions that were narrowly rejected in the upfront BCS may now prove to be more economical solutions. At a minimum, we recommend OPG examine and parse the costs associated with non-Refurbishment scope that was added by OPG's other stakeholders and consider capitalizing those costs separately from Refurbishment for purposes of future rate recovery. In any event, whichever course OPG chooses with these buildings, it is imperative that it act quickly and definitively.

### 4. Corrective Actions by P&M Team

OPG senior management has taken definitive action to turn around the Campus Plan work, including bringing in new leadership for P&M and fostering greater integration between the P&M Campus Plan and DR Project work. The visibility of the issues P&M has encountered will help the BOP, Islanding and Services projects work more effectively with the ESMSA contractors.

P&M's and the DR Team's senior leadership are fostering a more collaborative and cooperative effort between OPG and the contractors, known as the "Collaborative Approach." Essential parts of this Collaborative Approach include:

- For the remaining Campus Plan Projects and BOP work, the OPG teams and the vendors working "shoulder-to-shoulder" to develop project scope basis and corresponding cost estimates. The ESMSA vendors have agreed to perform the work on an open-book, split cost basis. Relieving the ESMSA of the secondary compete bidding

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process through direct assignment of the work should expedite the process, though the funding for this phase of the collaboration has been slow to arrive.

- OPG's Refurbishment Engineering and Design Authority directly managing and supervising the engineering work to reduce scope creep, unnecessary management and supervision costs and delays due to churn. This will include co-locating OPG engineering resources at the vendor's shops to answer questions and involve themselves in the development of the detailed design work and institute regular Steering Committee meetings with project leadership to remove performance barriers.
- Continuing integration of all of the Campus Plan pre-requisite work into a single integrated schedule so that the ESMSA's can properly plan and resource load the work and OPG can manage the contractors' work load and performance.
- Complete the work allocation to each of the ESMSA vendors so that they can properly plan their work. The DR Team has attempted to allocate the work evenly, though it may become necessary to shift work based on performance and resource availability. This becomes a more complex issue with the BOP work scope also needing attention in the coming months.
- Provide additional and focused project management support from OPG to clear barriers to engineering and execution work.
- Engage in constructive high-level dialogue with the ESMSA's senior management on a regular basis. P&M has established weekly meetings with each contractor that senior management attends to deal with any barriers and discuss status of the key projects. OPG has also established a monthly ESMSA Summit that allows for OPG to air and discuss issues with senior management of both contractors together. These meetings have had an immediate and measureable impact on both OPG's and the ESMSA's performance.

These changes will not fully recover the work in progress – in particular D2O Storage and AHS – but should provide some needed relief and better approaches for the remaining Campus Plan Projects.

For P&M, the recent changes in its senior leadership as well as the increased integration with the DR Team are taking root and providing visible benefits. P&M's VP is working through the multiple issues caused by the "hands-off" project management approach. The P&M staff has begun to accept the changes and is becoming motivated to correct its past problems, though the need for continual guidance and mentoring is evident. P&M will need corporate support to execute a full turn-around as discussed below. The DR Team's engineering organization is poised to take on active management of the ESMSA's engineering shops, which is diametrically opposite to how these projects were initially conceived. P&M's problems are now visible, as is the recovery the new team is trying to make, and the DR Team must recognize that P&M needs its support or the Refurbishment of Unit 2 is very much at risk.

### 5. Lessons Learned and Recommendations

Based on our root cause findings, BMCD/Modus's recommendations to OPG are somewhat different for P&M, which is in full recovery mode, versus Refurbishment, which has time (though not much) to incorporate lessons learned from the Campus Plan Projects into its program. For P&M, our recommendations focus on speeding the pace of the recovery, while for the DR Team, these Campus Plan Projects need to be a vivid reminder of what can happen if and when contractors are not actively managed. Ultimately, there are two major questions for the DR Project as a whole: (1) Can P&M succeed in completing the Campus Plan Projects on-time and within reasonable (though much higher than originally considered) cost parameters; and (2) whether the same issues we found related to the mismanagement of the Campus Plan Projects are a threat to the DR Project's BOP work and if so, to take strong and decisive action for eliminating the threat.

Regarding the Campus Plan Projects, we believe these can be turned around to support the VBO and breaker open, though at a higher cost that will require greater management focus than ever anticipated. Moreover, to facilitate this recovery, OPG will likely have to make some accommodations to its normal course of business:

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- **Hiring practices will require increased flexibility** – P&M's ranks are filled with inexperienced personnel who need guidance. OPG needs to recognize that the P&M organization urgently needs qualified people to fill significant management positions in project management, project controls and field supervision that are open at this time. Moreover, because P&M is a business unit with an expected expiration date, it makes for a difficult sell to OPG employees. In our experience, business units such as P&M would not be subjected to the same rules as the company-at-large for the hiring of temporary or transitory employees. Moreover, companies usually provide incentives for employees to work in transitional project environments because it forms a valuable learning experience. Such moves are needed and, in our view, completely justifiable in light of industry best practices. It is likely that Refurbishment will need similar changes to allow the development of its Execution Phase team.
- **Operations & Maintenance's and other OPG stakeholders' ability to change project scope must be contained** – As noted, the processes in place for the Campus Plan Projects allowed Operations & Maintenance and various other OPG stakeholders to make scope and resultant design changes that caused significant increases to the Campus Plan Projects after the conclusion of the conceptual design phase. These changes have crept into cost estimates over time. The appropriate time to add scope to projects is the conceptual design phase, subject to the approval of the authorized stakeholders, not after the project has been approved and passed through multiple gates including approval at the Board of Directors level. The process needs change to eliminate the consideration of major post-award design changes that increase project costs or extend project schedules.
- **Scope of work for Campus Plan and DR Projects needs frequent re-examination** - As a general principle, management prudence requires that scope and objectives be periodically examined in light of current circumstances. Where OPG has information that shows projects trending above approved budgets and beyond schedule milestones, it is prudent to examine both the cause of the overruns and any reasonable alternatives that can be justified based on a renewed net present value calculation. Thus, we recommend that OPG senior management take a second look at the scope and question its value, including re-examining (as necessary) alternative ways to accomplish the originally intended scope of work.

Similarly, where the root cause of the overruns appears to be the insertion of nuclear processes where such are not typically applicable or necessary (i.e. for commercial buildings), OPG senior management should take action to rescale and change the scope of such projects. This may require OPG's senior management to the CNSC to allow changes to its regulatory commitments if such commitments are so costly as to make them unreasonable.

Finally, as noted, if there are reasonable and prudent costs for non-Refurbishment related enhancements that are being spent by Refurbishment, OPG should consider capitalizing such costs separately from the DR Project. As an example, many of the value enhancing changes to D2O Storage were apparently made to handle and process water for non-Refurbishment purposes. These costs may ultimately have been prudently incurred but are likely in the wrong cost bucket for purposes of cost recovery.

- **Supply Chain and Finance need to streamline controls to accommodate changes** – The potential for the Campus Plan and BOP projects to rationalize the scope, develop more realistic cost estimates and schedules and model risk depends on the success of the collaborative process. Initiating this process will require some changes in the Supply Chain and Finance processes to allow for timely award of the work and prompt payment to the ESMSA contractors during the concept development phase. The benefit of this collaboration should be seen as projects reach their subsequent gates, they should be in much better shape with better defined and controlled scope, more accurate cost estimates and more achievable schedule goals. The ESMSA vendors will need appropriate funding to meet these goals. Finance has already moved forward with some measures that will enhance the cash flowing of the contractors' work. Additionally, the Supply Chain procedures with respect to change orders or contract amendments are cumbersome, time consuming, and reduce the project teams' accountability for managing costs. We would expect the project team to have the ability to negotiate and approve change orders directly with the contractor with appropriate controls.



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- **Risk Management needs immediate attention** – Risk management was not taken seriously in the P&M organization, thus many of the problems that have emerged were hidden below the surface. P&M needs a different approach which the DR risk management team is helping to facilitate: (1) the P&M team needs to monetize risks for future gates on a deterministic basis; (2) risks need to be managed on a day-to-day basis as a part of project management; (3) a better understanding of the ESMSA Contractors' risk management programs is needed; (4) formalized risk training is needed within the P&M organization. Most importantly, there needs to be a culture shift towards recognizing risk management as an important aspect of maintaining cost and schedule. This culture shift can only be driven from the top of the organization. Refurbishment has made many strides in improving the risk management program and their improvements should form OPEX for P&M.
- **Security and site access changes are urgently required** – The current time needed to in-process workers and management personnel alike is frustrating the OPG project teams and the ESMSA contractors. The reported average time it takes for clearance is upward of 6 weeks, and the contractors' cost per employee for the screening process is estimated at \$8,000 to \$10,000 per person. Moreover, there are security issues preventing or complicating the contractors' use of essential project-based systems - the P6 Schedule and the Electronic Document Management System (EDMS) are notable examples. BMCD/Modus certainly sees the need for maintaining the company's security, though in our experience with other nuclear utilities there are readymade solutions for these issues that OPG has been slow to adopt. These issues will cause continued risk to the DR Project if not fixed.
- **Contractor performance** – OPG needs to reconsider the scope of the work given to the ESMSA vendors on the Campus Plan and Refurbishment Projects in light of their current performance. OPG should examine the possibility of assigning Refurbishment BOP scope to other contractors performing on the DR Project where this makes economic and strategic sense.
- **Project estimating needs significant improvement** – As discussed throughout this report, BMCD/Modus has significant concerns that need to be addressed with the performance of project estimating by both the contractors and P&M's team. BMCD/Modus recommends that P&M should make changes, and Refurbishment should examine and potentially refine its processes for the following:
  - Check estimates be developed in the same format as estimates provided by vendors – the templates should be developed by OPG and provided to vendors prior to bid, and any submitted bid not utilizing the approved template is noncompliant;
  - All estimates need to be fully vetted and understood, regardless of whether the quoted price is more or less than the expected cost. Drivers of variances (both positive and negative) between bid and check estimates need to be investigated and understood by the Project Teams;
  - Contractors need to be trained in the method of estimating that OPG finds acceptable. The current process SNC/Aecon is using for developing its estimate includes upfront vetting by OPG of the contractor's specific processes and ongoing, real-time review of estimating product in a collaborative manner. These are principles that can be easily applied to the rest of the DR Project's work;
  - Estimates and project metrics/reports must incorporate accurate past, current and forecast cost information. The team needs to receive appropriately detailed contractor cost reports which, coupled with a resource loaded schedule, will enable them to properly status and forecast contractor performance;
  - P&M needs to standardize an EAC process so that all project teams follow the same basic procedures on a consistent basis. A seminar or workshop should be considered so that project team members are taught the fundamentals for preparing a reliable EAC; and





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- OPG needs to examine staffing and resources. Currently, there is only one dedicated cost estimator for all of P&M's work. The DR Team has already taken action to increase staffing levels and add experienced personnel, and P&M needs to do the same.
- **Project Reporting must be accurate, timely and convey information critical to senior management for decision-making** – As noted, the reports P&M provided to senior management on the Campus Plan projects were inaccurate and not updated in a timely manner to enable prudent decision-making. Our examination of P&M's reporting shows a general desire to produce large volumes of surface-level reports that are completely inadequate for managing the work, all the while P&M ignored such critical metrics as an accurate Estimate at Completion (EAC) and detailed schedule of work. Any tendency to "turn everything green" when such is not the case must be resisted - prudent management of complex projects requires full transparency and visibility of anything that is not going well so it can be addressed and fixed. P&M and the DR Team need to increase the focus on accurate, concise reporting with an emphasis on forecasting.
- **P&M needs to break down the silos**—All of the Campus Plan Projects are being performed by two contractors. However all of the Campus Plan work has been managed as 26 separate projects. All of the project management functions—i.e. schedule, cost and risk need to be managed through an integrated approach so that resources and management focus can be applied appropriately. We recommend that P&M look at its organizational structure to optimize the ability of its project managers to have more direct accountability. This may require more and different resources.
- **Campus Plan Projects will require a full rebaseline of cost and schedule** – Irrespective of when these projects' next gates occur, each of the Campus Plan Projects and, likely, each of the P&M non-Refurbishment projects at DNGS and Pickering, will require a full, bottoms-up rebaseline of costs and schedules. With the examples cited herein, BMCD/Modus cannot ascribe any confidence to any project estimate that was developed by P&M's former regime. Bill Robinson has made this commitment and appropriate focus will need to be applied. P&M needs to perform this reforecast on an urgent basis.

With respect to the Refurbishment portion of the DR Project, BMCD/Modus's monitoring of the BOP work to date shows that OPG has spent considerable time and effort in a robust scope definition process that addresses most of the external OPG stakeholder-driven scope issues in a manner that is consistent with the DR Project's charter. The DR Team has embedded in the organization a Director of Maintenance and a team to work our operational concerns and has an independent Design Authority. Moreover, as stated, the DR Team had already acted to safeguard against some of the problems seen in the early Campus Plan Project, notably; (1) the DR Project's institution more thorough scope definition to contractors via the MDPs the engineering team developed was a direct consequence of the OPEX from D2O Storage from over a year ago; (2) it is also apparent to us that while the DR Team had started down the same management path as P&M, it was able to put on the brakes and change course at a much earlier stage. Nonetheless, in light of our review of the Campus Plan Projects, we recommend that the DR Team perform a detailed self-assessment that considers the ways in which the Campus Plan Projects management failures might apply to Refurbishment.

### III. RQE Preparation

With this report, BMCD/Modus will begin a dedicated section for assessing the status of the DR Team's activities that specifically lead to the development of the RQE budget and associated schedule for the October 15, 2015 deadline. With respect to RQE planning, the DR Team has started its specific planning efforts, though soon there needs to be a greater focus on the specific deliverables, the timing of their preparation and a thorough understanding of how the many components will be compiled into a comprehensive estimate. Project Controls has named a manager for this effort and an activity schedule is being developed for incorporation into the Project's plan.

The most imminent upcoming RQE-related tasks relate to the development of the 4d Release Cost Estimate for the 2015 Business Plan ("4d Cost Estimate") that will be prepared for the Board's approval at the November 2014 meeting. The 4d Cost Estimate effort should also provide a template for many of the activities needed for RQE. In this section, we will

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also report on the maturity of the DR Project's development of the project's integrated schedule, which is an important component to providing a reliable RQE.

### A. 4d Cost Estimate

In our Initial Project Assessment, we recommended that OPG consider the 4d Cost Estimate as a "dry run" for RQE. This recommendation has been embraced by senior management. As part of our 4<sup>th</sup> Quarter 2013 Report, BMcD/Modus provided the DR Team with specific recommendations on the development of its cost estimates and lessons learned from last year's 4c Cost Estimate, which we refresh here with some additional observations:

- **Organization of the 4d Cost Estimate:** The DR Team is getting organized for the 4d Cost Estimate effort, which will be considerable. Project Controls has begun with the predecessor work the projects will need to develop their various estimates and is in the process of developing a schedule for these activities. Based on last year's approach to the 4c Cost Estimate, we see more activity occurring at a similar stage though we are still concerned that the development of 4d Cost Estimate will run into summer, during which time very little can be finalized due to the critical individuals taking vacation.
- **Projectizing Costs:** The DR Team is moving toward "projectizing" the functional costs, i.e. attempting to bucket as much of the cost of the functional work as a distinct part of the sub-projects' cost. This is an appropriate methodology and should provide a more accurate cost picture, though the DR Team needs to develop some clear guidelines for how this will be accomplished. Also, since this will mean functional cost centers from the 4c Cost Estimate will be distributed differently, the DR Team should provide traceability between the two phases of the estimate.
- **Bottoms-up Approach:** Given the increase in project maturity since the 4c Cost Estimate, a bottoms-up approach to many elements of the 4d Cost Estimate is appropriate. To the extent that projects have recently passed through a gate, the associated gate documentation should reflect this approach. However, a gate review should not be viewed by the DR Team as an opportunity to reset the clock and the budget on projects that are in trouble. The DR Team should review its processes for rebaselining at gates so that projects that are projecting to over-spend or run late are not given proverbial "get out of jail free" passes.
- **Re-examine Scope and Commitments:** As the Definition Phase has unfolded, it has become apparent that the cost estimates for many scopes of work have greatly exceeded the 4c Cost Estimate. In particular, F&I projects have changed in scope, execution strategy and cost, and many of the BOP projects are showing similar signs, such that the increases in cost would likely run at or above any alternative. The recently initiated Options Review Board (discussed below) has the potential to be a good control to catch projects with wide variances at an earlier stage. As noted above, BMcD/Modus believes that the periodic reexamination of principles on a project as an essential ingredient to prudent management. Thus, we recommend that OPG re-analyze any scope item with a wide cost variance over its 4c Cost Estimate budget allowance by re-reviewing the requirements and any alternatives, including canceling the scope entirely, on the basis of the least-cost alternative at this time. Had this methodology been followed with the F&I Projects, it is now apparent that OPG would have considered different alternatives for a number of projects. OPG should also review such alternatives when a regulatory commitment is at the root of a significant cost increase, as once the extent of the cost increases are fully known, it is possible the regulator would entertain alternatives as well.
- **Increase Efficacy of Project Estimating:** As discussed in the Campus Plan section of our report, BMcD/Modus is concerned that OPG's ability to develop check estimates is challenged by resources and work volume. To the extent that OPG's check estimates are intended to be a control mechanism, these estimates need to be executed with the same information and level of rigor that the contractors/project teams are developing. From our observations to date, the current method used for check estimates at Class 4/5 level: (1) includes the use of too many factors and factored values for check estimates at the Class 3/2 level; (2) suffer from a general lack of transparency of the root sources of information; (3) utilize non-standardized estimating templates despite OPG's investment in the US Cost estimating platform. As the DR Project moves to the next phase of maturity, so

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should the estimating work. We have also observed that the check estimates have gaps and errors that should not occur if the estimates had been performed by qualified, experienced individuals. Moreover, it is becoming evident that estimating is becoming a choke point to the point of causing notable delays in the procurement schedule, and its importance will only increase as time goes on. Thus, we have recommended that OPG examine its vendor's (Faithful & Gould) resources, experience level and ability to support the increase in both the volume and efficacy of the estimates it is preparing. In addition, we recommend OPG utilize the collaborative estimating/vetting approach that it has initiated with the ESMSA vendors and with SNC/Aecon for each of the DR Project's other scopes of work. The DR Team is already acting on these recommendations.

Considering the increased focus on the DR Project from its external stakeholders, it is very likely the development of 4d Cost Estimate will receive significant scrutiny. Therefore, the DR Team needs to organize its efforts, develop appropriate expectations for the deliverables and intensify its efforts as soon as possible.

### B. Schedule

A high-confidence RQE depends on a reliable integrated schedule. In our past reports, BMcD/Modus has identified several concerns and observations with respect to the development of the DR Project Schedule and the Project Schedule Management Program. Over the last few months, the DR Team has made significant strides in addressing many of the issues we have raised. While much work remains to be done, the DR Team has moved forward with a significant number of initiatives calculated to improve both the DR Schedule and the Schedule Management Program, including:

- The DR Team now sees itself as a project management team and is putting programs in place to properly manage its contractors;
- The DR Team has abandoned earlier questionable scheduling methods in favor of developing a fully integrated Level 3 resource loaded schedule that automatically rolls-up to form a Level 2 depiction of the work;
- P&M is becoming the "beta" group for testing the basic standards for managing the Level 3 with the Campus Plan Projects;
- OPG has developed standards for required resource loading of the Level 3 schedules by OPG and the contractors; and
- Detailed schedules for sub-projects that are not let are represented by placeholder activities to be replaced once a contractor is in place.

While these changes are positive, we have made additional observations that should be addressed by OPG in order to improve the reliability of the integrated project schedule, including:

- Development of an improved set of metrics for monitoring the schedule is imperative. As part of the effort to improve the Level 3 integrated scheduling process, a set of metrics needs to be established to categorically monitor improvements made by the Project Teams and their respective contractors.
- Currently, the DR Team is making manual adjustments the cash flows in Proliance, rather than having it be an automated function tying the cost estimates to the P6 dates for cash flow analysis. Ultimately, work hours in cost estimates and schedules must balance and the Work Breakdown Structure ("WBS") should be the binding mechanism. The DR Team is planning on automating this process though it will remain prone to error until that time.
- OPG needs to speed contractors' access to the scheduling network. The OPG and the contractors need to all work from the same network (preferably OPG's or an third party network) in order to operate in a common environment. However, OPG is not granting the contractors network access in a timely manner. Improvements in time and better standards for control of the databases need to be established.

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### IV. Major Projects – Summary of Key Risks

#### A. Retube & Feeder Replacement

##### 1. Work Status – Tooling, Definition and Mock-up

Through March 31, 2014, the RFR contract is underspent by \$9 M against plan, though this gap is closing. Additionally, SNC/Aecon's SPI during this time period has improved to 0.94. Although SNC/Aecon remains behind schedule in the Definition and Tooling phases of its work, the mock-up reached substantial completion in March and is ready to receive, test and integrate tooling.

The tooling recovery plan that was initiated at the end of 2013, however, is currently challenged to achieve its August 2014 target. Tooling engineering is now critical path and the tooling design complete milestone for June 15, 2014 will likely be missed while the follow-on milestones for prototypes complete and qualification complete are in jeopardy as well. Continued problems with SNC/Aecon vendors and sub-vendors are driving many of these delays. In particular, the RT platforms being fabricated by Rolls Royce have continued to slip and are now projected to complete 2-4 weeks later than the recovery plan completion dates of June 30 and July 15, 2014. Meanwhile, SNC/Aecon's supplier ATS is suffering from late delivery of parts from its sub-vendors, delaying assembly on its shop floor. SNC/Aecon has made repeated projections for delivery of these tools that have been further impacted by late deliveries, quality issues, and process missteps. SNC/Aecon has resorted to additional mitigation plans and is making reasonable attempts to recover the time lost. The OPG team continues to monitor SNC/Aecon's progress and is holding them accountable to meet the deadlines. The impact of SNC/Aecon's slippages will be felt in the development of the Class 2 estimate. To mitigate this potential delay, OPG's project team is requiring SNC/Aecon develop a clear plan for monitoring tool testing and productivity in the mock-up to ensure this process moves smoothly and that all the required information is captured and incorporated into the estimate.

In addition, the JV is trending over-budget for the target price portion of its Definition Phase work, which includes engineering, schedule and estimate development, and construction management planning. The fact the JV is projecting to complete this phase of the work 15-25% above its target needs to be considered in establishing the confidence level of the JVs Class 3/2 estimates for the Execution Phase. However, OPG's team plans to dispute any charges advanced by SNC/Aecon for the Definition Phase that were caused by SNC/Aecon's own actions.

Finally, the Definition phase shows signs of slow progress with an SPI at 0.91 as of the February 2014 SNC/Aecon Progress Report. Engineering and procurement dates are slipping, showing similarities with the tooling effort described above. These activities will require close monitoring as the Definition phase moves toward the Class 2 estimate over the next year.

##### 2. Class 3 Estimate and Level 4 Schedule

In our 1Q 2014 report, BMCD/Modus expressed serious concerns with the ability of SNC/Aecon to provide Construction Work Packages (CWPs) and variance reports by March 15, 2014 to support the Class 3 estimate. As of February 10, 2014, SNC/Aecon was only 32% complete in preparing its "Stage 1" CWPs and variance reports. Over the next month, SNC/Aecon significantly increased its production in order to meet this date and, in the process, compressed delivery, creating a large bow-wave of work for OPG to review.

Since our 1Q 2014 report, OPG's estimating group has struggled to keep up with SNC/Aecon's pace and its review and analysis of the variance reports, estimates, and mini-reports that will ultimately comprise the Class 3 estimate is proceeding slowly. BMCD/Modus's concern is that the sheer volume of reports provided by SNC/Aecon, essentially all at once, will result in errors or that OPG will be challenged to make sense of the data. Ultimately, SNC/Aecon should be tasked with providing an explanation of how the products satisfy the requirements of a Class 3 estimate. Per the Class 3 Estimate Plan, SNC/Aecon's commitment for this Class 3 Estimate should include:

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- Completed CWPs formulated for DNGS;
- Variance reports showing differences between the OPEX driven Class 4 estimate and the current estimate;
- A Level 4 execution schedule;
- Detailed reports characterizing how SNC/Aecon prepared the estimate; and
- A well-defined risk register.

All of these SNC/Aecon products will require time for OPG to review and in this case it is our opinion that it is better to provide an extension of time than rush the review of such important material in order to meet a previously set deadline.

Concurrent with the development of the Class 3 estimate, SNC/Aecon is developing its Level 4 execution schedule. The first draft of this schedule was delivered on April 15, 2014 and ongoing review sessions are being held to refine it. First impressions of the schedule were that SNC/Aecon had not brought the best possible schedule for Unit 2 forward. It appeared that SNC/Aecon presented a comfortable, achievable schedule rather than an aggressive benchmark. This created a longer schedule than what would be considered a “target” schedule. In addition, several examples of incorrect logic and misalignment with OPG’s level 1 schedule were identified. OPG is continuing to review and recommend changes prior to the delivery of the Schedule mini-report for the Class 3 estimate on April 30, 2014.

Looking forward from Class 3, it is important for OPG and SNC/Aecon to align around the plan and start preparing for the Class 2 estimate. As we have noted in prior reports, after SNC/Aecon completed the Class 4 estimate, there was a long period with no activity that only served to compress the preparation time for the Class 3 estimate, and that compression is at the root of the current need to rush through its approvals. As the Class 3 report is being developed, the team should endeavor to complete the Class 2 estimate plan so that any opportunities or progression points are identified early. In addition, the tool testing and productivity plan should be incorporated with the Class 2 estimate plan so that results are properly incorporated into the schedule and estimate. SNC/Aecon and OPG need to maintain focus on the finished product and what it means to be Class 2 RQE ready.

### 3. RWPB Building

The RWPB is being performed under many of the same conditions as the Campus Plan Projects as a pre-requisite to Refurbishment but by SNC/Aecon, the contractor performing the RFR retube work, rather than the ESMSA contractors. RWPB is facing very some familiar issues to those described above for D2O and AHS. The start of work is currently being impacted by the soil that was excavated from D2O Storage. There is a possibility the soil is contaminated, which has resulted in additional testing. In addition, the building has or will encounter plant operation coordination, and seismic issues have delayed foundation design and pushed out engineering. As of this report, engineering design complete is showing 43 days of negative float and installation/commissioning is showing an October 24, 2016 completion date. Although this schedule is immature and based on very preliminary engineering, the original plan was completion in June 2016 allowing three months before breaker open. It is vital for SNC/Aecon to utilize the lessons that are being learned from the F&I work in order to keep this building within a reasonable cost and schedule envelope. In addition, if there are cost increases, the Options Review Board should test the decisions being made with regard to building design in light of the fact that it is a temporary building that will be housing heavily contaminated materials. Further, the building should avoid any element of gold plating or permanent design.

### 4. RFR Commercial Risks

We recommended in our last report that the DR Team review some major provisions of the RFR contract in order to ensure that it will drive the proper behavior from SNC/Aecon in order to achieve success on the first unit and that OPG will be able to establish that it adequately and prudently considered the principles set forth in the government’s Long Term Energy Plan (“LTEP”)—primarily success on the first unit and ensuring appropriate risk shifting. This included revisiting: (1) the performance incentives for unit-over-unit improvement as an incentive to the contractor to meet an aggressive schedule for the first unit; (2) whether the cost and schedule incentives/disincentives would drive the right contractor behavior; (3) the treatment and monetization of identified risks; and (4) whether to negotiate a guaranteed maximum price (“GMAX”) once engineering is complete. In addition, OPG and SNC/Aecon will need to incorporate the

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maturing Turbine Generator work into the estimate where economies of scale in project management and other areas are identified. To date, DR senior management has acknowledged that this is an important exercise that must be done with some sense of urgency. However, this sentiment has not been communicated to those individuals tasked with performing the review, who appear not to understand its purpose and are reluctant to even consider the need to modify any portion of the contract.

### B. Balance of Plant and Other Projects

The BOP work should be the direct beneficiary of any lessons learned from the Campus Plan/F&I work. The majority of the BOP work will be performed by the ESMSA contractors based on direct assignment of the work packages. This methodology should readily lend itself to a cooperative, interactive process between OPG and the vendors that should, in theory, eliminate many of the issues we have observed with the F&I work.

With the awards of the containment isolation and Turbine Generator performance work to SNC/Aecon, OPG should consider the benefits of SNC/Aecon treating its overall scope of work as one contract. There are certain economies of scale that can be achieved – plus benefits associated with workforce assignment flexibility and dose management. The DR Team would also benefit from consolidating all of the work in the vault into a single subproject to better manage the critical path and subcritical path interferences.

## V. Functional Groups Update

### A. Engineering

#### 1. Revised Plan for ESMSA Engineering

Amongst other conclusions, the BMcD/Modus Initial Project Assessment (August 13, 2013) recommended improvements to engineering metrics and a close look at the turn-around times for the review, comment and approval cycles. The need for “active management” of the engineering work along with a greater focus on front-end planning was introduced in the BMcD/Modus 4Q 2013 report and expanded upon in our 1Q 2014 report. We continue to stress the importance for OPG to shift their role and perspective from the culture of ‘observation at a distance’ to a much more proactive engagement and active management of the engineering service providers. We also continue to stress the importance of thorough front-end planning.

Since our last report the DR Team’s Senior Leadership has recognized a number of deficiencies with the ESMSA design process, including:

- The quality of planning and scheduling is insufficient. There are no integrated resource loaded schedules. Schedule adherence is very poor - the execution of most of the ESMSA project engineering (e.g. D2O Storage Building, Shield Tank Overpressure Protection, Auxiliary Heating Steam, and Containment Filtered Venting System) is consistently behind plan.
- Cost estimates for the detailed engineering phase are significantly higher than anticipated, particularly given OPG’s development of detailed Modification Design Packages (MDP’s) that were intended to provide the vendors with specific and prescriptive requirements.
- The actual costs to date are significantly above the original budgets (planned value) for all ESMSA projects. A significant portion of these increases are driven by engineering.
- ESMSA quality programs are not aligned with OPG’s quality program. The result is multiple review and comment cycles which add significant cost and time.
- OPG’s intent to shift risk to the ESMSA partnerships was misplaced. The risk associated with the execution of nuclear engineering work is limited by the application of detailed regulatory and OPG standards and procedures. The execution of nuclear engineering work needs to be under the direct control of the OPG Design Authority.

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- Single-point responsibility for coordination of the engineering, procurement and construction elements of these projects through these ESMSA partnerships has not been realized, leading to inefficiency, confusion and rework. Moreover, significant OPG intervention has been required to achieve the results obtained to date.

The results of these deficiencies have become clearly apparent: an inability to predict engineering performance, significant churn, poor cost performance and frustration at all levels of the collective organization. These deficiencies have driven Senior Leadership to make changes to the remaining engineering effort for the ESMSA work. These changes include:

- Shifting to a culture of ‘active management’ of the engineering work;
- Utilizing a collaborative front-end planning methodology for the remaining work;
- OPG taking a leadership role in developing and monitoring the engineering schedules;
- For work in progress, OPG will increase monitoring and provide ready answers through embedded staff within the engineering vendor organizations; and
- For work that has not started, OPG will provide management and direction of the engineering work.

This is a bold but necessary move and one that is endorsed by BMCD/Modus. We will continue to monitor the progress made under this revised plan and provide additional recommendations for streamlining the design process as necessary.

### 2. Scope Definition

Overall, as mentioned in the BMCD/Modus Assurance Report on Scope, we believe that the DR Team has taken a balanced approach to the development of the DR Project scope. The initial scope identification effort incorporated scope beyond that of refurbishment and life extension, potentially increasing the budget and project complexity. However, to balance this out, the DR Team has continuously monitored and repeatedly tested the included scope through scope reviews and de-scoping exercises. Additionally, the team has monitored scope definition through the gate review process and Health of Scope (HOS) metrics. Through this extended process we believe that the DR Team has struck an important balance between overly limiting scope (and risking scope growth during execution) and being overly-inclusive (and risking excessive project budgets).

The resultant Darlington Scope Requests (DSR's) drive engineering. Through April 24, 2014, Engineering had completed 142 MDP's. While this met OPG's goal, the number of MDP's continues to rise and is now at 161 (as compared to 139 in our last report) with 19 known packages remaining. This is particularly important considering the new path OPG has chosen to take for ESMSA engineering.

However, whereas scope definition may be sound, the development of solutions is not. As the revised plan for ESMSA engineering takes root, the DR Team also needs to examine the assumptions and engineered solutions. The DR Team's Senior Leadership initiated a new control, a monthly Options Review Board ("ORB"), the intent of which is to re-review the approaches the project teams are taking and see if the means and methods in the plan are appropriate, cost effective and still required. At the first ORB, the BOP, Shutdown/Lay-up and Services projects identified initial plans for six different scopes that needed to be reconsidered. These different subprojects suffered from many of the same problems evident with the Campus Plan Projects discussed above, thought these problems are being exposed, escalated and resolved. The ORB found:

- OPG's design requirements can cause confusion, misalignment and very expensive solutions that defy common sense. As an example, based on the guidance from the original MDP, the dehumidification of the turbine deck would have cost upwards of ten times more than OPG has spent in the past performing the same work on laid-up fossil units.



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- The performance specifications in some packages provided the vendors with limited guidance, and in such cases, vendors will usually take the most conservative route.
- OPG often relied on the vendors to suggest more creative solutions to their issues when OPG's team knew the best course to take all along. This was evident with the polar crane package inside the plant. OPG left it to the vendors to discern what was needed. The vendors decided to replace all of the cranes, even though OPG's team determined only refurbishment, not replacement, was required. OPG often relied on the vendors to suggest a more creative solution to their issues when OPG's team knew the best course to take all along. This was evident with the crane package for the polar cranes inside the plant. OPG left it to the vendors to discern what was needed, from which the vendors decided to replace all of the cranes, even though the needed scope determined by OPG's team was refurbishment, not replacement.

This initial ORB was a success and will be followed by further, similar reviews of planned solutions. From this and the lessons learned from the F&I work, BMCD/Modus recommends that OPG consider the aforementioned controls on scope, including: (1) reviewing the necessity of performing the work; (2) revisiting prior options; (3) refreshing the view of net present value; (4) questioning whether scopes of work that are driven by regulatory requirements and have experienced significant cost overruns are still cost effective.

In addition, the DR Team is instituting a Unit Scope Review Board that will examine each subproject's readiness at key intervals in the manner employed by the station for outage preparedness. This team will be led by the DR Team's senior management and will test whether a given project has key deliverables in place at required quality levels as it advances toward execution. We believe these tests are part of prudent management and necessary to meet the intent of the Minister of Energy's Long Term Energy Plan ("LTEP").

### B. Project Controls

The DR Project's reports (namely the Program Management Report) needs attention. This report is difficult to read, contains multiple format changes, and has, in the case of the Campus Plan Projects, erroneous and outdated information that is included without verification. The Campus Plan Projects' reporting discussed above provides a vivid example of how reports that lack accuracy and transparency mislead and deprive senior management the opportunity to make key decisions. The DR Team's Project Controls team is bringing needed QA/QC reviews and personnel to test and monitor this and other key reports' information. The tendency by the DR Team is to provide too much data in these reports so that important information is often obscured and lost in the "noise." Furthermore, metrics and reporting are supposed to provide an accurate snapshot of the status of a project. The current Project Reports need work to achieve these goals. Project Controls is endeavoring to improve its reporting suite that both informs and allows for management focus. The team is working currently on revised versions of the "quad charts" that provide metrics and description of the projects' current focus areas. The DR Team has also agreed to abandon the quarterly produced "report card" which was ineffective at communicating the Project's status. This metric was a jumble of key performance indicators, dates, milestones, etc. and only serves to confuse rather than provide useful information.

Moreover, the DR Team's methodology for measuring earned value needs to be stress tested. The DR Project's schedule is now matured to include resource loading to allow OPG to test work hour productivity factors from information contained in the P6 schedule. As the schedule further matures, we will be providing additional focus to the coincidental development of earned value and productivity factors.

### C. Supply Chain

Our observations of the P&M organization and the Campus Plan Projects have raised some concerns regarding the interface between Supply Chain and the project management team. In particular, the current procedures require that Supply Chain negotiate all change orders (also called contract amendments) on behalf of OPG. This appears to be a cumbersome process with a number of built-in walls that only cause for multiple review stages of the same information.

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This process has the potential to cause delays to both the Campus Plan and DR Projects, but more importantly, it disconnects scope, schedule and cost accountability from the project team. We will be further examining these processes as the project progresses, including an upcoming Assessment of the DR Project's Change Management process.

### VI. Other Project Risks

#### A. Project Team Development

As previously noted, Enterprise Risk Management carries the retention of key personnel as the biggest program risk to the DR Project, and we would agree that it is certainly among the DR Project's biggest challenges. The most urgent challenge in this regard is to ensure that the Project has sufficient skilled resources to manage and monitor all of the work that must precede Refurbishment, including supporting the F&I, ASIC and VBO work, while maintaining the pace of the Refurbishment's key developmental activities. In our view, the best way to address this challenge is to continue to ramp up the front end planning effort so that all the work that must be performed is known and identified by schedule window and priority. Once the total needs of the organization are better defined, OPG can address resource needs in a more comprehensive manner. BMcD/Modus also sees monitoring resources in the schedule via fully resource loaded, level 3 schedules and tracking work hours productivity factor indices as essential ingredients in understanding the resource needs for each work group, trade specialty and the like. Senior Leadership of Refurbishment and P&M have coordinated a monthly ESMSA Summit at which resource needs will be discussed in greater detail going forward.

As the DR Team focuses more on developing its team for the Execution Phase, OPG will need to obtain individuals with different skills and experience than it may have currently in-house. OPG's current hiring, banding, salary constraints and onerous, time-consuming onboarding procedures serve as a barrier to finding the necessary experienced and qualified personnel. BMcD/Modus recommends that the DR Team closely look at the optimal Execution Phase organization design so that it can properly cost-out the Execution Team in the 4d Cost Estimate and prepare to deal with the barriers to securing suitably experienced management and staff.

#### B. Program Management Plan Development

In our last report, BMcD/Modus identified some shortcomings with DR Team's Program Management Plan ("PgMP"). The DR Project's Senior Leadership has moved forward with our recommendations to progress the PgMP. Senior Leadership also led the first of what will likely be a series of meetings with key Project Team members to foster alignment of the functional groups into a "projectized" team in which the individual sub-projects will capture the majority of the cost and coordinate the activities in a more focused manner. This initiative exposed for Senior Leadership that it must go farther to communicate roles and responsibilities within this matrix organizational model.

As we noted in our last report, the PgMP is the key unifying document set for project execution; in our experience, it would be tantamount to the project bible that a new employee would use to understand his or her roles and responsibilities. In addition, with the 4d Cost Estimate beckoning, the project teams will need to know the breadth of their matrixed organization and related cost centers to properly allocate the different elements of the estimate. The Project's need for a solid PgMP is further heightened by Senior Leadership's attempts to evolve the organization for the Execution Phase.

In summary, BMcD/Modus recommends that the DR Team simplify the approach it is taking to develop the PgMP so that it is unifying document and increase collaboration across the team. We believe the current efforts of the Engineering team to provide its portion of the plan could establish a model for the other functions and projects to follow.

Area	Observations	High	Medium	Low	Current Status / Mitigation
RFR	<b>SNC/Aecon Performance:</b> Largest Program risk due to overall risk to the DR Project and OPEX.				<ul style="list-style-type: none"> <li>▶ Tooling recovery progressing; next tooling milestones will be missed but impacts are limited and mitigating actions are in progress</li> <li>▶ Tooling and procurement recovery plan in place, some slippage continues</li> <li>▶ RWPB and Definition Phase Engineering showing signs of slow progress</li> </ul>
	<b>Class 3 Estimate:</b> Progression to RQE requires SNC/Aecon's Class 3 Estimate to be thoroughly vetted				<ul style="list-style-type: none"> <li>▶ Completing thorough OPG review by May 15, 2014 will be challenging</li> <li>▶ Ultimate goal of delivery by August 2014 is acceptable</li> <li>▶ Monetizing contingency remains a risk</li> </ul>
	<b>Schedule Development:</b> Level 4 schedule under development; requires challenge to total duration				<ul style="list-style-type: none"> <li>▶ First draft of the Level 4 schedule lacked creativity and boldness</li> <li>▶ Continued review required from OPG project team to push SNC/Aecon for a more aggressive but achievable schedule</li> </ul>
	<b>RWPB Delays:</b> Facing similar problems that have plagued Campus Plan projects				<ul style="list-style-type: none"> <li>▶ Contaminated soil, interferences, and seismic issues delaying engineering</li> <li>▶ Minimize design aspects of gold plating or permanence</li> <li>▶ Utilize/implement lessons learned from Campus Plan work</li> </ul>
	<b>RFR Commercial Risks:</b> Contract provisions currently in place may not drive desired performance				<ul style="list-style-type: none"> <li>▶ Negotiation of the Execution Phase target price should revisit incentives and disincentives/focus on success of the first unit</li> </ul>
Campus Plan	<b>ESMSA Performance:</b> D20 Storage and AHS work is behind schedule and over budget				<ul style="list-style-type: none"> <li>▶ Vendor performance/unforeseen issues remain significant risks</li> <li>▶ Similar trends are being observed with several other F&amp;I projects; budgeting process is being investigated</li> <li>▶ Bids for remaining work are significantly higher than budgets</li> <li>▶ Re-evaluation of business case required in light of new estimates</li> </ul>
	<b>Engineering and Planning:</b> D20 provides key lessons learned for remaining Campus Plan and BOP				<ul style="list-style-type: none"> <li>▶ Engineering is co-locating with ESMSA vendors and taking more active role in directing and managing the work</li> <li>▶ Clarification of RFPs and process ongoing</li> <li>▶ Modifications to planning and scheduling underway</li> </ul>
BOP	<b>ESMSA Performance:</b> Concern over ESMSA contractors' performance and ability to execute BOP work				<ul style="list-style-type: none"> <li>▶ Allocation of work underway; some issues with cost/scope estimates</li> <li>▶ Risk of ESMSA Performance will continue until improvements on performance issues in Campus Plan are observed</li> </ul>

Area	Observations	High	Medium	Low	Current Status / Mitigation
Engineering	<b>Scope Review:</b> New Options Review Board has increased scrutiny of design decisions				► Options Review Board has been effective in challenging scope decisions
	<b>Planning of Engineering Work:</b> Engineering work was not well understood and is poorly planned				<ul style="list-style-type: none"> <li>► OPG engineering is taking more active role in directing and managing the work at the engineering studios</li> <li>► “Bottoms-up” estimating process initiated for engineering activities</li> <li>► Increased focus placed on engineering planning for the design phase; new progress tracking mechanisms in place</li> </ul>
Project Controls	<b>Continued Schedule Development:</b> Schedule approach was unproven; integration at appropriate level at risk				<ul style="list-style-type: none"> <li>► Project Team is moving toward industry-wide recommended practices for scheduling</li> <li>► Substantial work remains to populate detailed level 3 schedule</li> </ul>
	<b>Progress Towards RQE:</b> The plan for developing RQE is being developed.				<ul style="list-style-type: none"> <li>► RQE development remains essentially on schedule, but will be heavily reliant on the quality of the various inputs.</li> <li>► The DR Team has assigned a manager for the planning and development of the multiple pieces that must come together for RQE.</li> </ul>
	<b>Risk Management Program:</b> Risk registers require scrubbing; monitoring tools are cumbersome				<ul style="list-style-type: none"> <li>► DR Team is cleaning up the risk register and improving reporting</li> <li>► Risk Group is taking a more active role in managing the Risk Program</li> <li>► Risk training is being conducted but more is required</li> </ul>

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Project Matrix  
 Campus Plan  
 Observations/Findings

REF.	OBSERVATIONS	PROJECTS				
		Water & Sewer	D20 Storage	Aux Htg Sys	RFR Annex	* RFR Waste Storage
1	Lack of scope definition.	√	√	√	√	
2	Insufficient effort and time in creating engineering requirements.	√	√	√	√	
3	Initial Project was deferred and then reactivated over a period of years ( > 5yrs).	√	√	√		
4	3rd Party Estimates - Mixed results w/F+G being significantly over or under vendor quote.	√	√	√		
5	Change in contracting strategy with Vendor from a E-PC to EPC.	√	√	√		
6	Basis of Estimates do not conform to AACE Recommended Practices.	√	√	√	√	√
7	Project Team has failed to characterize the changes/progression to the estimates from gate to gate.	√	√	√	√	
8	Mischaracterized Estimate Classification - OPG is accepting vendor quote as a "Class 2" or "Class 3 estimate when such quote does not meet the threshold for a Class 2 or 3.	√	√	√	√	√
9	Contingency calculated at ~21% - not clear how contingency and risk assessment are linked, if at all.	√	√	√	√	
10	Risk shifting - Project Team does not fully understand the nature of target price work.	√	√	√	√	√
11	The process of bid evaluation scoring and metrics used varies among Project Teams.	√	√	√	√	√
12	The process of comparing bids and 3rd party estimates varies among Project Teams.	√	√	√	√	
13	Significant differences between Vendor Quotations (from 50% to > 100%).	√	√	√	√	
14	Vendor quotes and 3rd Party Estimates (Faithful + Gould) are not aligned for ease of comparison to facilitate a comprehensive review of differences.	√	√	√	√	
15	The contractor selection process compelled the contract to be awarded to the lowest bidder over other qualifying considerations.	√	√	√	√	
16	Risks materialized greater than expected during execution, i.e. underground utilities.	√	√	√	√	
17	Senior Management is reluctant to increase contingency on the front end despite selecting the lowest bidder.		√	√		
18	Project Manager is young and appears inexperienced to manage size of project.		√	√	√	
19	Project Team has difficulty in obtaining reliable cost and schedule data from contractor resulting in OPG's inability to effectively forecast costs to complete.	√	√	√	√	√
20	Contractor performance issues have increased costs	√		√	√	
21	OPG performance issue has increased costs, or has the potential to increase costs					√
22	Scope growth beyond what was anticipated for the project.		√	√	√	
*	<i>Project is in its early stages.</i>					

**Attachment C – Summary of Cost Variances to Date for Campus Plan Projects  
 BMcD/Modus 2Q 2014 Report to NOC  
 May 13, 2014**

In accordance with recommended industry practices, construction project costs should be periodically evaluated and updated in order to develop reliable estimate at completion (“EAC”) forecasts. Planning for cost forecasting establishes the timing of forecasts, how forecasts are communicated or reported, methodologies and systems/tools to be used, and specific roles and responsibilities for forecasting. EACs should be prepared and issued on an established schedule that is appropriate for the pace of work on the project.

The development cycle of an EAC typically follows a set process with standard guidelines for the project team to follow. For instance, one step would be to review and rigorously vet contractor cost reports to understand the development of costs versus current budget, planned and actual productivity. Based on our review of five (5) Campus Plan Projects, it does not appear that Facilities and Infrastructure (“F&I”) used a set process or guidelines to govern EAC development. When we interviewed the project teams, we discovered that each team was following its own EAC process, indicating that there was neither visibility to cost increases nor internal cost control.

To understand the impact to the project costs and EAC process, we compared the current EAC to the last approved BCS to identify the magnitude of cost increases. The following chart illustrates the cost increases on the projects<sup>1</sup>:

**Overall Cost Variances between the Latest BCS and the Current EAC on F&I Projects**

Project	Board-Approved Costs	Current EAC	Variance	% Increase
D2O Storage & Drum Handling	\$ 110,015	\$ 314,383	\$ 204,368	186%
Auxiliary Heating System	\$ 45,607	\$ 85,102	\$ 39,495	87%
RFR Island Support Annex	\$ 32,504	\$ 40,738	\$ 8,234	25%
Water and Sewer	\$ 45,703	\$ 57,712	\$ 12,009	26%

We then analyzed the project documents to identify the categories of costs behind the increases identified on each of the projects as described below. We also interviewed the project teams to understand their EAC process.

**D2O Storage & Drum Handling**

Our analysis of the RFR Island Support Annex estimates yielded the following summary highlights:

- On this project, nearly every cost category of work has increased considerably ranging up to +537% above approved gate funds, with the exception of Phase I engineering design and award long lead procurement which was contracted on a fixed price basis.
- Engineering work is 82% complete overall versus a planned completion of 100%; 48 of 84 ECs have been issued in Passport. Engineering is forecasting that all ECs will be completed by early November 2014.

<sup>1</sup> The chart contains only 4 projects because Retube Waste Storage is not included; this project has not progressed beyond the definition phase.

### Summary of D20 Cost Variances between the Latest BCS and the Current EAC

Cost Category	BCS/Gate 3b	Current EAC (4/22/14)	Variance	% Increase
TOTAL	\$ 110,015	\$ 314,384	\$ 204,369	186%

### Summary of D20 Storage Building Cost Variances

Cost Element	Variance (\$K)	% Increase
Underestimate of Effort	\$ 30,978	19%
Design Scope Growth	\$ 46,466	29%
Underestimate PM Plant Materials	\$ 33,654	21%
Client Requested Changes	\$ 5,273	3%
Schedule Extension & Acceleration	\$ 9,852	6%
Environmental Requirements	\$ 17,439	11%
Pipe Chase	\$ 4,326	3%
EPSCA	\$ 1,569	1%
Building Relocation	\$ 9,726	6%
<b>Total</b>	<b>\$ 159,283</b>	<b>100%</b>

A brief explanation of the significant changes, as reported by B&M in its updated cost estimate, is provided below:

- *Underestimate of Effort* – This cost element represents the underestimated effort required to execute the project based on the original scope of work. The staffing levels required to manage the work, generate CWP/ ITPs and integrate the project plans into the OPG work management system were much greater than the original budgets allowed.
- *Design Scope Growth* – Represents the increased construction cost of the project from the original concept. The design engineering was a fixed price. Bidding took place on preliminary design requirements and a conceptual design report with many assumptions that were later invalidated. The absence of the MDR at the time of bidding meant that it was impractical to estimate the project beyond an AACE Class 5 quality level.
- *Underestimate of Permanent Plant Materials*
  - 367% increase in the quantity of process and service piping from 3,000M of piping to >14,000M.
  - 340% increase in the quantity of valves from 250 valves to ~1,100 valves.
  - 40 % increase to the electrical load list including additional equipment such as a UPS and Diesel generator that were not previously in the design requirements.
- *Environmental Requirements* – The project was awarded on the basis that the soil and ground water were free of contamination, an assumption that proved incorrect. Soil testing revealed the presence of tritium above acceptable levels, requiring special soil storage and operational requirements to manage the water runoff.
- *Building Relocation* – The original design concept had a new building with a “shared wall” in contact with the existing west wall of the TRF Building. However, the new foundations for the D20 interfered with the existing foundations necessitating a seven (7) meter relocation of the building to mitigate the conflict. This meant that the building now required four (4) architecturally completed sides rather than the original 3-sided finishes. More significantly, the scant pile (caisson) foundation shoring system became significantly more complex.
- *Schedule Acceleration and Extension required for:*
  - Premium time expended to recover lost time on the critical path and meet outage requirements.
  - Premium time planned critical work and make-up days for inclement weather

#### **Auxiliary Heating System**

Our analysis of the Auxiliary Heating System estimates yielded the following summary highlights:

- The current EAC was provided by the contractor just after the 4c estimate effort was complete. The contractor’s EAC was provided in a high-level letter and spreadsheet form, which the project team did not dive into or vet.
- On this project, nearly every category of cost has increased significantly. The overall project, including interest and contingency is projecting an overrun of 87%.
- As of the March 2014 Program Status Report, the project is reporting 60% complete (\$24M earned on a BAC of \$40M).

### Summary of Aux Heating Cost Variances between the Latest BCS and the Current EAC

Cost Category	BCS/Gate 3	Current EAC	Variance	% Increase
<b>TOTAL</b>	\$ 45,607	\$ 85,103	\$ 39,496	87%

The primary cost driver behind the \$9.5M increase in engineering costs include \$5M of additional Phase III engineering \$3M for items that were simply underestimated. For example, HSL underestimated the cost of working in accordance with OPG's review processes; OPG's design review and approval processes are more time consuming than HSL anticipated. The team explained that OPGs EC process is very time consuming as compared with a commercial process. In addition, lack of detail and definition of scope at the beginning impacted the quality of the estimates and bids, including F+G's estimates.

#### RFR Island Support Annex

Our analysis of the RFR Island Support Annex estimates yielded the following summary highlights:

- For the current EAC, the team relied on high level cost data provided by the contractor which the team did not vet. This information was used at Gate 3B in February 2014.
- The RFR Annex Project is currently projecting a project cost of \$40M, or \$8M over its 4c estimate of \$32M at the last project gate, for an overall increase of 25%.
- As of March 2014, the project is reporting 20% complete (\$7M earned of a BAC of \$33M).
- The EPC portion accounts for 91% of the overrun, with engineering comprising half of the overrun, procurement and construction 40%, and OPG costs, contingency and interest making up the balance of the overrun. See the table below for additional details.

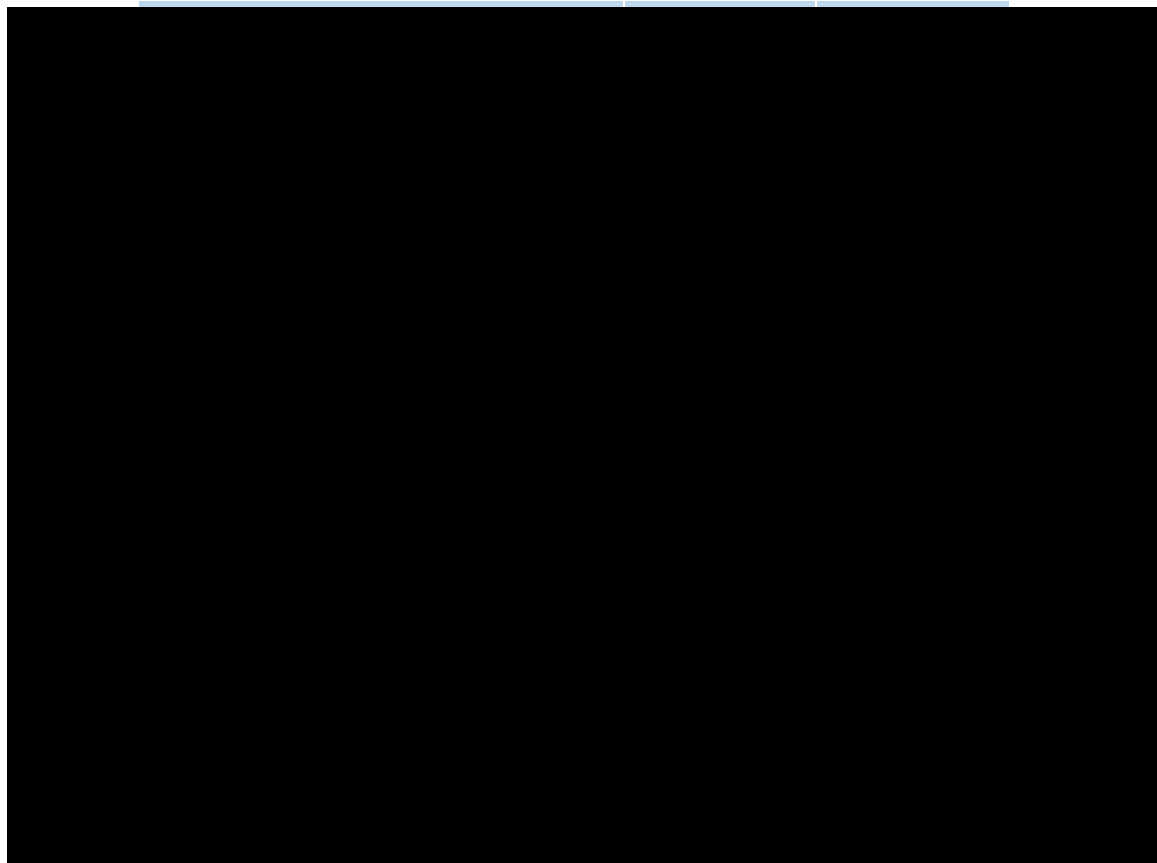


## Summary of RFR Island Support Annex Variances between the Latest BCS and the Current EAC

Cost Category	4C Estimate	Current EAC	Variance	% Increase
Project Costs	\$ 23,265	\$ 31,280	\$ 8,015	34%
Interest	\$ 1,973	\$ 1,966	\$ (7)	0%
Contingency	\$ 7,266	\$ 7,492	\$ 226	3%
<b>Total Project Cost</b>	<b>\$ 32,504</b>	<b>\$ 40,738</b>	<b>\$ 8,234</b>	<b>25%</b>

The following table briefly explains and summarizes the cost increases by \$ and % of the RFR Annex Project is shown as follows:

Cost Category	Variance	% Increase
<b>Engineering</b>		



<b>Total Project Cost Increase</b>	<b>\$ 8,234</b>	<b>25%</b>
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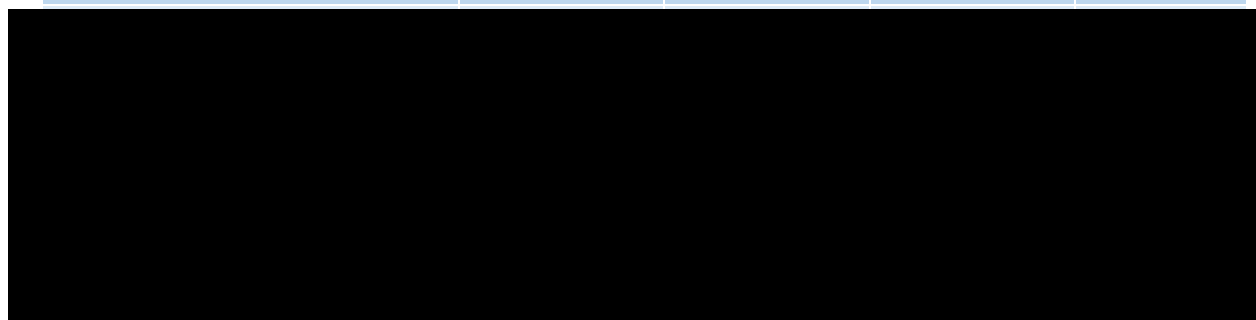
This project team has done a better job of trying to allocate the cost increases between scope increases and contractor underestimates as shown above.

- The main driver of cost overruns on the current EAC is contractor cost, specifically engineering. The primary issue is that the engineer, HSL, is unfamiliar with OPG's internal processes for design review and approval. The project team feels that Engineering is approximately 80% complete though there are no metrics to confirm; 16 of 22 design packages are complete.
- Communication direction between OPG and HSL has been an issue driving up the engineering costs; OPG's and HSL's processes are not aligned. HSL bid the job assuming that it would be a typical "commercial" level job, i.e. would not require extensive owner review and signoff. Instead, OPG's review and approval process has required much more level of effort from HSL than originally bid.
- In other instances, HSL has over anticipated OPG expectations and burned hours performing unnecessary engineering that could have been mitigated by better communications (e.g. the replacing and redesigning pole supporting security camera. OPG expected to simply mount the camera on an existing pole while HSL anticipating camera vibration issues engineered a new pole replacement).
- The ESMSA contract process has caused more engineering cost by shifting more risk and liability to the engineer. The work is subject to more stringent codes and is performed by different trades which HSL did not anticipate. That also drives up the engineering cost. The work is subject to more stringent codes and is performed by different trades which HSL did not anticipate. As a result, cost overruns for engineering alone equate to an additional \$100 per square foot in building costs.

#### Water and Sewer

As of December 2013 the project was reporting 81% complete (\$36.9M earned on a BAC of \$45.7M). The Water and Sewer Project is currently projecting a cost increase of \$8.3M on a budget of \$54.0M or an increase of \$18% as shown below:

Cost Category	BCS/Gate 3	Current EAC	Variance	% Increase
OPG Project Management	\$ 3,237	\$ 3,764	\$ 527	16%
OPG Engineering	\$ 705	\$ 688	\$ (17)	-2%
OPG Other	\$ 983	\$ 2,298	\$ 1,315	134%



<b>Total</b>	\$ 45,703	\$ 57,712	\$ 12,009	26%
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- The major driver of this cost increase is in the cost of the construction contracts, due to contractor underestimating the value of change requests, additional change requests not identified or anticipated and increased contractor indirect costs due to schedule delays.

- On a pure percentage basis, the major driver is the OPG other costs which have proved to be higher due to underestimate of the level of effort needed from OPG's Operations Manager, Operations, Project Oversight and Field Support and Drawing Office.
- The EAC for this BCS was based on actual invoiced additional changes as well as internal OPG estimates of the cost of anticipated contract changes.
- Another increase in overall cost of these projects has been due to the nature of the underground work – unforeseen conditions, soil conditions, and undocumented actual conditions.
- Compared to the other projects, water and sewer is well underway. Phase I is 100% complete; phase II is 100% complete on engineering and 75% construction; phase III is scheduled to complete by November 2014 and construction is scheduled to complete by June 2015. However, the work is demolition of the old water treatment plant and is less complicated than the other earlier scopes.



# **Report to Nuclear Oversight Committee**

## **3<sup>rd</sup> Quarter 2014**

### **Darlington Nuclear Refurbishment Project**



Burns & McDonnell  
Modus Strategic Solutions

August 13, 2014



## Report to Nuclear Oversight Committee – 3Q 2014 Darlington Nuclear Refurbishment Project



### I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company (“BMCD/Modus”) provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors (“NOC”) regarding the status of the Darlington Nuclear Generating Station’s Refurbishment Project (“Project” or “DR Project”) as of July 31, 2014.

Pursuant to the Project’s Assurance Plan approved by the Audit & Finance Committee, BMCD/Modus has also prepared independent reports documenting the DR Team’s status as well as further recommendations for improvement. This quarter we have issued the following Assurance Reports: 1) OPG Operating Experience and Lessons Learned Practices and Procedures; and 2) Schedule Management Practices and Procedures. We continue to meet monthly with the Refurbishment Project Executive Team (“RPET”) and weekly with the DR Team’s Management Systems Oversight group to discuss our reports to NOC and our Assurance Reports in order to clarify any recommendations and engage in discussion of appropriate OPG management actions. The DR Team continues to provide its cooperation and transparency to our oversight efforts. We are also coordinating our efforts with Internal Audit so that we meet our assurance commitments in an efficient and effective manner.

Attached to this report are summaries we have provided regarding key aspects of the DR Project’s current status:

- Attachment A is the updated quarterly summary of the Project Risks with annotations regarding the DR Team’s actions with respect to these risks since our May 13, 2014 report;
- Attachment B is a summary of the current status of the recommendations and observations from our Initial Project Assessment of August 13, 2013 (“Initial Assessment”). Here, we summarize the DR Team’s progress in responding to the issues identified in our Initial Assessment so that the NOC can evaluate the velocity of the DR Project’s progress since last year.

The following is a brief summary of the DR Project’s most significant developments over the last quarter.

#### A. Campus Plan Performance Update

The Campus Plan Projects, and in particular the D2O Storage Facility and Auxiliary Heat System Building (“AHS”) remain significant risks to the overall Refurbishment Project. Leadership of Projects & Modifications (“P&M”) has again changed, which adds to the overall risk of these and possibly other Campus Plan Projects not meeting schedule and/ or budget requirements. In our May 13, 2014 NOC report, we highlighted some management practices that increased the risk associated with these projects under P&M’s prior leadership. Management has taken action to address these issues, as discussed in the June 26, 2014 Supplementary Board Meeting, and those initiatives are continuing, as well as changes in the organization’s leadership. What bears monitoring with another leadership change is whether the P&M team reverts to its prior ineffective practices or whether the team has incorporated the difficult lessons from the prior two years. Where beneficial to the projects, the initiatives started under prior leadership to streamline the work’s execution, increase the contractors’ accountability and move P&M to actively manage the work should continue under the new leadership team.

While many of the Campus Plan Projects appear to be on course, select projects are showing evidence of cost growth and schedule degradation. Each of the Campus Plan Projects need to undergo a full reforecast so that the scope, schedule, cost estimate and risks are re-examined, and lessons emanating from the recent D2O Storage estimating effort should be incorporated into these reviews. This work should be completed so the 4d Cost Estimate (the current DR Project estimate that will be included in the 2015-2017 Business Plan Binder) accurately reflects the potential cost and risk associated with the Campus Plan Projects. We describe the most challenging aspects of the Campus Plan Projects below.



## Report to Nuclear Oversight Committee – 3Q 2014 Darlington Nuclear Refurbishment Project



- **D2O Storage Facility**

D2O Storage is currently projected to complete on January 18, 2017, though P&M has established a target date of August 31, 2016 based on an aggressive acceleration plan. Completion of this facility remains a direct threat to the Refurbishment Project's October 2016 breaker open date because this facility is required for storage of the heavy water that must be drained from Unit 2 in order to begin that unit's refurbishment. Importantly, the August 31, 2016 target date assumes acceleration of the work utilizing two 50 hour/week shifts with significant overtime, and that materials needed for installation will seamlessly arrive just-in-time for installation. In short, this is a very compressed schedule with no apparent margin for error.

Black & McDonald's efforts over the last three months to produce a reliable Class 2 Estimate for D2O Storage have resulted in an improved estimate for half of the remaining work, though Black & McDonald did not provide OPG with the opportunity to vet estimates of work by its third tier construction and first tier engineering subcontractors. As a result, the cost estimate for D2O Storage remains uncertain. Moreover, it is unclear whether Black & McDonald and its subcontractors have performed, let alone included in their plans, either value engineering or constructability reviews as requested by P&M. As a result, it is unclear at this time whether the current cost estimate is accurate which also calls into question whether Black & McDonald and its subcontractors have a reliable detailed schedule for the work, as the estimate and schedule go hand-in-hand. It is our understanding that DR Team Management has chosen not to advance the D2O Storage estimate to the Board at this time, which, based on its status, is appropriate. However, the urgency of finalizing the cost estimate, driving to a reasonable scope and schedule and maintaining progress of the ongoing work cannot be understated.

- **Auxiliary Heat Steam**

The AHS project is also on a tight schedule to meet its April 3, 2015 milestone, the start of the station's Vacuum Building Outage ("VBO"). AHS is currently scheduled to be completed on March 26, 2015, four weeks later than planned. The contractor has presented additional costs to OPG that could use most or all of the contingency for the Project; these costs were not anticipated at the time the last AHS estimate was presented and approved by the Board. These changes, as well as additional engineering costs, need to be challenged by P&M's project management team. In addition, the value engineering proposal requested by P&M for streamlining the steam line connection to the plant has thus far not yielded the expected cost savings. The DR Team is looking at potential mitigation plans to shorten the commissioning timelines and other means to meet the needs for heat during the VBO. The team should examine all reasonable mitigation options in light of how tight this schedule is and the likelihood that costs will increase in pursuing an aggressive acceleration of the work.

- **Contractor Performance**

[REDACTED]

### **B. RQE Preparation**

The DR Team is currently developing the basis of the 4d Cost Estimate which will be an important step in the progression to next October's Release Quality Estimate ("RQE"). As we discussed in our Initial Assessment, by this time, the DR

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## Report to Nuclear Oversight Committee – 3Q 2014 Darlington Nuclear Refurbishment Project



Project's maturity will have increased; thus, there is an expectation of commensurate quality of the 4d Cost Estimate, with tighter certainty bands around estimated direct costs of the work. The DR Team accepted our recommendation that the 4d Cost Estimate be a "dress rehearsal" for RQE such that management and the Board can see the progression of the estimate as well as the gaps that need to be addressed in the coming year. In this regard, the DR Team should identify and explain in detail each of the variances from the 4c Cost Estimate so that they can be appropriately assessed. The RFR, Turbine Generator, Steam Generator and Fuel Handling project estimates have matured significantly and should form the basis for understanding the DR Project's core elements. BOP and other services-related work are less mature, meaning that they may require the greatest amount of review and vetting, particularly with respect to risks, estimate accuracy and contingency. We expressed some concern last year regarding the timing of the cost review efforts associated with the 4c Cost Estimate, which occurred largely in the summer vacation season, and we have those same concerns with this year's estimating process. Management remains committed to the \$10B cost of the DR Project and the veracity of its commitment may result in some future difficult choices that are best made with full understanding of all available options.

### **C. Retube & Feeder Replacement Project**

Because of its size and importance to the overall DR Project, execution of RFR remains the DR Project's most notable risk. Fortunately, the ongoing management effort by the DR Team and SNC/Aecon has moved RFR forward, and the issues we previously reported regarding tooling, development of the Class 3 Estimate and meeting the target price for the Definition Phase have been largely mitigated. SNC/Aecon's Class 3 Estimate has been approved by OPG and the tooling fabrication and delivery is on schedule except for the RT Platform. Detailed engineering is currently tracking behind the target schedule, and if not mitigated, SNC/Aecon's estimating effort could be compressed as a result. SNC/Aecon has rolled-out its plan for developing the Class 2 Estimate which will form the basis for the target price negotiation for the Execution Phase. Limited tool testing has commenced in the Mock-Up and preparations for the remainder are well underway with an expected completion of March 30, 2015.

SNC/Aecon's Class 3 Estimate forms a sizeable portion of the overall program budget, and the vetting of that estimate that was concluded in June 2014 should provide the Board with confidence that this segment of the Project's direct costs are well defined within the prescribed limitations of a Class 3 estimate. With the advent of the 4d Cost Estimate, the DR Team should take SNC/Aecon up on its earlier commitment to provide its view of contingency needed for the RFR Project. In addition, the DR Team should consider how it will incorporate potential changes to contract incentives and disincentives into the 4d Cost Estimate because this will represent a large component of the DR Project's overall cost.

### **D. Balance of Plant**

In last year's Initial Assessment, BMCD/Modus identified the risk that the BOP work would be late in starting and maturing due to the sub-competitive bidding process for each individual project that was required at that time. The BOP scope was also under intense review at that time by the Blue Ribbon Panel that vetted the needs for the work that had been defined at the time. One year later, the BOP scope has been reduced but multiple contracts for the work that remains in Refurbishment's scope have been delayed. It appears that BOP has a reasonable path forward with most of the work, though the DR Team remains appropriately concerned regarding the engineering teams under the ESMSA contractors. Currently, approximately 10% of detailed BOP engineering is forecasted to complete after the team's target of May 2015, and where these delays persist, there could be an impact to the quality of those affected portions of the Project's cost estimate at RQE, the development of the detailed schedule and work planning.

### **E. Engineering**

Engineering risks have been front and center in the DR Team's plans and in our reporting of the Project from the outset. Last year, the DR Team's focus was on completion of the scope defining Modification Definition Packages ("MDP's"), and we saw as a risk maintaining enough schedule float to allow for the vendors' transition to the detailed design phase. Many of the anticipated risks have materialized: while the MDP's were completed on time, some confusion regarding the scope OPG desired remained as the vendors continued to interpret OPG's design intent as conservatively as possible. Some corrections were initiated but valuable time was lost in the process that has compressed the detailed

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## Report to Nuclear Oversight Committee – 3Q 2014 Darlington Nuclear Refurbishment Project



design period. With the work moving to detailed design and with increased visibility to the issues that have impacted the engineering process, the DR Team is attending to problems that have surfaced, including: forecasting engineering performance, efficiently managing the work and arriving at final decisions more readily and quickly.

As noted in our 2Q 2014 Report, the DR Team has made a significant shift in engineering strategy and is now directly managing and supervising the engineering service providers. The engineering team is also pursuing how to recover some of the lost time and confirm vendors' commitments to meet target dates. In the Engineering section of this Report we revisit three aspects of the engineering effort, identifying the progress being made and the major concerns that remain for each: ongoing engineering initiatives; scope definition and management; and engineering metrics.

### II. Campus Plan Update

#### A. Overview

P&M's management of the Campus Plan Projects continues to be under review by the DR Team. There are projects that remain a risk to the DR Project's schedule (particularly D2O Storage) and scope definition of smaller Campus projects may continue to reduce management reserve and contingency without additional action. In our 2Q 2014 Report, we focused on many of the concerning management issues that we believe led to the current cost and schedule overruns for these Campus Plan Projects. In our Supplemental Report to the NOC of June 26, 2014, we attempted to characterize the impact of these overruns. While the cost increases were significant on a percentage basis, the current trends in the cost growth should be containable within the Project's remaining management reserve, thus preserving over \$2B of contingency for the overall Project's working cost estimate.

Over this same period, our team has monitored the progress with the D2O Storage estimate and re-examined and updated our assessment of the other Campus Plan Projects, some of which appear to be on course, others which may require course correction. Below we focus on certain of the Campus Plan Projects that appear to present most of the risks at this time. In addition to D2O Storage and Auxiliary Heat System ("AHS"), some Campus Plan Projects that have received partial funding but are not through their full execution releases are showing early signs of potential scope creep and schedule issues that bear watching.

#### B. Ongoing Campus Plan Project Risk

##### 1. Schedule and Cost Development

P&M has continued to develop and update the project schedules for the Campus Plan Projects though many of these schedules still have significant defects. In our 1Q 2014 Report, we recommended that P&M in conjunction with the Refurbishment team, Operations & Maintenance and other needed stakeholders perform a schedule "back pass" for the Campus Plan Projects to confirm that: (1) the projected latest possible completion dates for the various projects fit within the overall program's plan; (2) there are no severe resource constraints; (3) back end activities (commissioning and start-up) are provided adequate time; and 4) a realistic sequence of critical and near critical path activities using the late start and late finish dates has been established. Unfortunately, the quality of the current vendor supplied level 3 detailed schedules precludes the team from developing a meaningful back pass review at this time.

With respect to cost growth, the most notable project remains D2O Storage though there are other Campus Plan Projects that are showing signs of upward budget pressure. We recommended in past reports that P&M reforecast each of the Campus Plan Projects because the past practices in budget formation have proven to be inadequate. P&M intends to hold challenge meetings on each of the Campus Plan Projects in advance of the 4d Cost Estimate that should delve into the underpinnings of each project's cost and schedule. Equally important is whether there is evidence that lessons learned from the Campus Plan Projects have been internalized and resultant management actions are effective at mitigating these impacts and providing control and discipline to these projects' management.





## Report to Nuclear Oversight Committee – 3Q 2014 Darlington Nuclear Refurbishment Project



### (a) D2O Storage

The D2O Storage project's cost estimate and schedule remain very much in flux at this time. Since our 2Q 2014 Report, despite the ongoing efforts of Black & McDonald, Faithful + Gould (the DR Project's estimating team) and the P&M team, the project estimate for D2O Storage has continued to increase, adding approximately 25% in estimated cost since that report. Importantly, the estimate was not deemed by OPG management to be of sufficient quality for presentation to the NOC for the upcoming Board meeting. Approximately half of the D2O Storage estimate has not been vetted by OPG at this time because Black & McDonald had not provided the portions of its estimate related to fixed-price contract work by its third tier construction and first tier engineering subcontractors. Moreover, the status of the value engineering and constructability reviews P&M requested Black & McDonald to perform is uncertain. As such, the issues with the accuracy of the current cost estimate call into question whether Black & McDonald and its subcontractors have a reliable detailed schedule for the work, as the estimate and schedule go hand-in-hand.

The current target date in the DR Project's schedule for D2O Storage Available For Service date is August 31, 2016, which is 110 days late in meeting the DR Project's optimal schedule date of April 15, 2016. This August schedule target assumes an acceleration plan that shaves 4 ½ months off a current projected completion of January 18, 2017 that was derived without acceleration. Black & McDonald's acceleration plan embeds productivity and performance risk, and even if successful the resultant August 31, 2016 date may prove to be a challenge for OPG to support Unit 2's Breaker Open of October 15, 2016.

There is also continued risk in the D2O Storage schedule until final detailed engineering is completed and all of the potential value engineering and design simplification measures are finalized. Black & McDonald's design subcontractor RCM Technologies ("RCMT") reports that its work is over 80% complete, though this estimate is suspect in that there are more than 20% of the design packages outstanding and RCMT projects a design completion date of February 19, 2015. The DR Team has examined the earning rules used and determined that RCMT's calculation of earned value was not aligned with OPG's; this alignment is in process. Any changes to the building could further delay engineering such that it may not be possible to simplify the design and still meet schedule. RCMT has also stated that it is out of funding for engineering under the current release.

The D2O Storage schedule suffers from the same transparency issues from Black & McDonald's subcontractors as the cost estimate. Black & McDonald's subcontractor Ellis Don's schedule for the concrete and civil construction cannot be verified against its cost estimates because its sub-contractors' pricing is based on fixed-prices that Black & McDonald has thus far refused to provide to OPG. Also, procurement activities need to be scheduled and verified with some level of confidence that currently cannot be associated with RCMT's efforts.

In our experience, a successful acceleration plan of this magnitude must be well-planned and coordinated, and the schedule for the work needs to be reliable with full buy-in from all needed stakeholders and contractors. There are currently a number of challenges with the D2O Storage project that will bear on the confidence in the schedule, regardless of which completion date becomes the target. As of this writing, P&M's new leadership is considering the next steps for D2O Storage.

### (b) Auxiliary Heat

The current March 26, 2015 Available For Service date for AHS is virtually at the start of the Vacuum Building Outage ("VBO"). As with the D2O Storage above, the contractor (ES Fox) has incorporated acceleration in the form of a two shift schedule for piping and electrical work beginning in August of 2014. This acceleration of the work provides no float or cushion for the VBO, which is a critical milestone. ES Fox recognizes that this schedule is very tight and has little room for failure or delay. ES Fox has raised concerns with the pace of OPG's design approvals and final acceptance of vendor drawings, which could further risk the timeliness of the schedule. OPG has embedded Resident Engineers with the Hatch/Sargent & Lundy ("H/SL") design team to respond to issues through the completion of AHS engineering.

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The P&M team is evaluating ways of mitigating the potential delays to meeting the VBO milestone, including shortening commissioning and start-up. The DR Team has committed to maintaining operation of the existing construction boilers and using temporary boilers to augment the steam capacity of the existing facility if necessary. Given that ES Fox's acceleration plan has significant risk associated with it, developing a "plan B" mitigation for the VBO is advisable.

From a cost perspective, ES Fox was asked to provide an estimate regarding a simplified design of the steam line connection from the AHS to the plant, replacing the original design of an underground concrete tunnel with an overhead pipe rack; however, that request was later changed to have them review a simplified under-the-roadway design. ES Fox claims that this change would have no positive impact on the Project's budget, and that it would need time it no longer has to examine different design alternatives. These changes and the costs and schedule savings associated with them need to be evaluated, though this provides a key lesson that value engineering should be performed as early as possible. In addition, it is also our understanding that ES Fox has presented additional engineering costs, scope and delay costs that P&M needs to disposition. These should be vetted so that the budget risk for this project (that has already received full funding approval) can be assessed. At this time, these changes would absorb the remaining contingency for the project.

### (c) Emergency Power Generator #3

The new Emergency Power Generator #3 ("EPG3") is a Safety Improvement Opportunity ("SIO") project that P&M is managing for Refurbishment. ES Fox was selected as the contractor for the work. The project went through Gate 3A for partial funding in November 2013. The current estimate at completion for EPG3 shows the cost is projected grow by another 25% is growing as it is being prepared for the full-funding release at Gate 3B.

Issues that have resulted in cost increases to other Campus Plan Projects are also impacting EPG3, including soil conditions and scope identification during the design process. These changes are adding cost to what was believed to be one of the more straight-forward Campus Plan Projects. Nonetheless, given the issues on the earlier Campus Plan Projects, these changes were reasonably foreseeable. P&M's most recent reports for the EPG3's Estimate at Completion ("EAC") continued to show the project being on or under the Gate 3A estimate. However, ES Fox has provided contract change requests as part of its regular executive updates that date to the 1Q of 2014 which have not all been dispositioned or included in the EAC. These change requests are for: (1) Work that the sole-sourced sub-vendor from whom ES Fox is procuring the stock emergency power generator has refused to modify the stock unit it is supplying, including seismic qualification and controls for the unit; this work has to be performed by others; (2) Shoring and dewatering due to unexpected soil conditions that have been common to the rest of the Campus Plan Projects in the protected area; and, (3) Increased size of air handling units on seismically qualified foundation pads; among other changes. If approved, these changes in their current form would add approximately 25% to the project cost. However, we understand that of this amount, a significant proportion should not be proposed change orders but monetized risk items that should be carried in lieu of a portion of the project's contingency. All of these proposed changes need to be thoroughly vetted, as some appear to have been estimated at a very high level (Class 5) and may be duplicative of other changes sought on different Campus Plan Projects. It is our understanding that the Engineering team is currently challenging the underlying scope of these requested changes to the extent there are remaining questions.

The EPG3 schedule currently included in the DR Project's schedule network needs attention. The original Available for Service date for EPG3 is September 17, 2015. The completion of detailed engineering is projecting to finish December 9, 2014, which is a push of approximately three months since March 2014. The schedule was just rebaselined and still shows multiple concurrent critical paths and potential logic that could drive the completion to be significantly later if not corrected. In addition, there is overlap of construction work and commissioning that may not be possible. The final engineering completion dates need confirmation so that the potential risk to downstream procurement activities can be properly evaluated.

Based on these trends, this project that was reported to be relatively straightforward has been subjected to increased costs and schedule delays. This project would benefit from a thorough drill-down with the contractor and the project

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management team and a full reforecast of the cost and schedule before its next gate so that the basis for the changes in scope can be identified and challenged, and the planning and execution sequence can be confirmed. In addition, to the extent the contractor has provided monetized risk items, these need to be properly accounted in the project's request for contingency at the next gate.

### (d) Containment Filter Venting System

The Containment Filter Venting System is another SIO project that addresses a potential need to release steam from containment under extreme conditions where the station would be subjected to a complete loss of power. The scope of the project was initially addressed in an MDR that was released to ES Fox with preliminary assumptions regarding the size of the venting system that ES Fox and H/SL were required to validate.

As the design matured, additional decay heat studies were performed, ultimately resulting in the current design path in which the required filter system is substantially larger than initially assumed. Because the filter system was significantly larger than originally assumed, the size of the supporting structure for this duct system also had to be increased. Cost growth for these changes is under review but believed to be on the order of 18-30% over the early project estimate that is embedded in the current 4c Cost Estimate. This cost growth appears to be justifiable due to the increased scope, though the estimates for this additional cost should be vetted to ensure they are appropriate and properly priced.

The current schedule for CFVS forecasts a completion date of March 25, 2016. This work was originally contemplated to complete on November 17, 2015. The detailed level 3 schedule suffers from many of the same logic issues and poor critical path definition as noted for EPG3. These issues, as well as the potential cost growth, need to be addressed as soon as possible.

## 2. Risk Management Progress

In our 2Q 2014 Report, we identified that P&M was not utilizing the risk management process in an effective manner, and was merely using risk as a "check-the-box" activity as a prerequisite to obtaining funding for the work. The Refurbishment risk management team has been deployed to help P&M restructure its risk program, and risks are being collected and are now visible on the Project's risk register. However, there is some remaining confusion with the P&M team regarding on-going risk management. The DR Team is in the process of consolidating the risk management program under the Refurbishment organization, utilizing the same processes for risk identification and management with strong scrutiny by the DR Risk Oversight Committee. This should clear up any remaining inconsistencies.

## 3. Vendor Performance Issues

As noted, [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

It is also worth noting that three of the four Campus Plan Projects that we have identified above as having concerns are being performed by ES Fox. While there is no evidence that we have seen that questions ES Fox's safety or quality record, and their team has thus far been very responsive to addressing any issues OPG has raised, the scope creep and cost increases evident in EPG3 and CFVS indicate that P&M should be just as vigilant in managing ES Fox's work. Any lessons from Campus Plan Projects should also be understood by the Refurbishment BOP team, who is using ES Fox for multiple scopes of work. P&M and Refurbishment BOP project managers need to vet ES Fox's estimating methodology, including how ES Fox is using factors for productivity, estimating project management team size and engineering costs, among other things.

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### III. RQE Preparation

#### A. 4d Cost Estimate

The DR Team is currently preparing the 4d Cost Estimate, the last of the planned Definition Phase funding releases that will be requested prior to RQE. The DR Team should see the 4d Cost Estimate as a “dress rehearsal” for RQE, as the DR Project will have substantially matured over the intervening year. We recommended that the DR Team get an earlier start on the development of the 4d Cost Estimate so that appropriate vetting of the various component cost estimates can be performed and have a detailed schedule of vetting activities with visibility to the team. Further, in past reports and at the advent of this effort, we provided the DR Team with more granular recommendations for different aspects of the 4d Cost Estimate development.

To date, there are certain portions of the cost estimate that have followed along their expected paths. The DR Team completed the development, vetting and approval of the RFR Class 3 Estimate in the spring of 2014, and while the review period was significantly compressed, we witnessed good cooperation between SNC/Aecon and OPG that facilitated OPG’s approval of the estimate on schedule in June 2014. The resultant estimate (excluding fee, contingency and incentives) increases SNC/Aecon’s Class 4 Estimate by more than 20%, though this increase was anticipated and the 4c Cost Estimate carried sizeable contingency for estimating accuracy. Other elements of the 4d Cost Estimate, including the Turbine Generator, Steam Generator, Defueling and Fuel Handling work are proceeding down similar paths with submitted vendor cost estimates that the DR Team must now characterize. In all, these project bundles account for approximately 70-75% of the DR Project’s expected direct cost, and 50% of the overall Project cost, excluding contingency, interest and inflation.

The challenges between now and the completion of the 4d Cost Estimate appear to reside largely in the following major areas:

- **Project Bundles:** BOP, Shutdown/Layup, Specialized Projects and Support Facilities bundles which currently do not have the same level of maturity as the other bundles;
- **Functional Costs:** DR management directed the DR Team to “projectize” functional costs, in particular engineering and planning, so that costs that can be attributed to a specific bundle are properly expressed. In addition, Operations & Maintenance’s cost estimate needs sufficient justification;
- **Campus Plan Projects:** as discussed; and
- **Contingency and Management Reserve:** the DR Team must monetize the contingency for all of the DR Project’s direct costs, including RFR, which by contract, does not have to be provided by the RFR contractor until next year.

In our recommendations to the DR Team, we have stressed the need for a bottoms-up approach to developing the 4d Cost Estimate, meaning that the DR Team vets and understands the underpinnings and assumptions of each of the cost components within the estimate. The DR Team currently has embedded in its processes project gate reviews and the Options Review Board, which are opportunities for such vetting; though there are major cost components that, as of the issuance of the estimate, will have not been subjected to such a detailed review that will require additional effort in order to be better understood. In our view, a bottoms-up review should root-out uncertainties and misunderstandings that may exist within the DR Team, as it is better to know those now when there is time to manage them, rather than wait until just before RQE. In addition, such a review may highlight a resolution path for decisions on cutting costs that may be needed in order to preserve the DR Project’s overall economics.

The remaining work for 4d Cost Estimate is sizeable and will be very time consuming. Our team will be closely monitoring the DR Team’s activities and has asked for detailed vetting sessions in late September and mid-October so that we may inform the NOC and the DR Team of our view of the 4d Cost Estimate’s overall quality.



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### B. Risks to RQE Development

The DR Team's goal for RQE is to have virtually all of the DR Project's costs within a Class 2 accuracy band (with a range of -15% to +20%). The AACE guidelines on which OPG has based its progression of estimates refers to a Class 2 Estimate as a project's "Control Budget" which is commonly used in the industry to signify that the scope and planning of the work have sufficiently matured so as to be the basis for comparing cost trends until the project's completion. The application of the Class 2 range when combined with OPG's commitment to hold the DR Project's overall cost to \$10B would imply a need for retention of approximately \$2.0B in contingency at RQE.

The 4d Cost Estimate should be a leading indicator of the risks that the DR Team is likely to encounter in development of the RQE. In addition to the 4d Cost Estimate deadline of November 13, 2014, there are other key milestones that must be maintained so that the intended accuracy of RQE is commensurate with a Class 2 designation.

Program Integrated Master Schedule (PIMS) Milestone	Date
Refurbishment Outage Planning Organization Defined	15-October-14
Health of Scope 4 Achieved	
Unit 2 Long Lead Materials Identified	15-November-14
IIP Approved by CNSC	31-December-14
Vacuum Building Outage (Start)	3-April-15
Detailed Engineering Complete	1-May-15 <sup>1</sup>
RFR Class 2 Estimate from SNC/Aecon	15-June-15

At this time, the RQE predecessor milestone with the most associated risk is completion of detailed engineering by May 15, 2015. A project is subject to variability and uncertainty in cost and schedule until its scope is frozen and detailed engineering is completed. As we observed with the Campus Plan Projects, developing a budget from immature scope and engineering definition can result in significant cost overruns. Thus, the DR Team was correct in highlighting the importance of this milestone and there is strong awareness within the team of the consequences of missing this date. The Project bundles that are currently most at risk for missing the detailed engineering milestones are the same that are lagging behind for the 4d Cost Estimate—BOP, Shutdown/Layup and Specialized Projects—and those projects are utilizing the ESMSA contractors who have thus far failed to meet significant engineering milestones. The collaborative approach the DR Team initiated should help increase the efficiency of engineering work although the DR Team needs to perfect its metrics for measuring engineering so that this progress can be accurately tracked. In addition, while not among the above milestones, project planning and assessing needs to be sufficiently advanced to support a fully developed RQE.

### IV. Major Projects – Summary of Key Risks

#### A. Retube & Feeder Replacement

##### 1. Tooling Fabrication

The tooling program achieved completion of a major milestone in July with Tooling Detailed Design Complete. Although the milestone was achieved two weeks late, SNC/Aecon's tooling recovery plan is on track to recover the schedule by September 2014 with a few minor exceptions, including:

- **RT Platforms:** Rolls Royce and its sub-contractor have continued to struggle to maintain committed delivery dates for the RT Platforms. However, a recent commercial agreement between Rolls Royce and its subcontractor to provide additional resources, overtime payments, and equipment should help to stabilize the

<sup>1</sup> This is a "stretch goal" for the DR Team. The actual PIMS milestone is August 10, 2015, though this date is recognized to be too late to support RQE.





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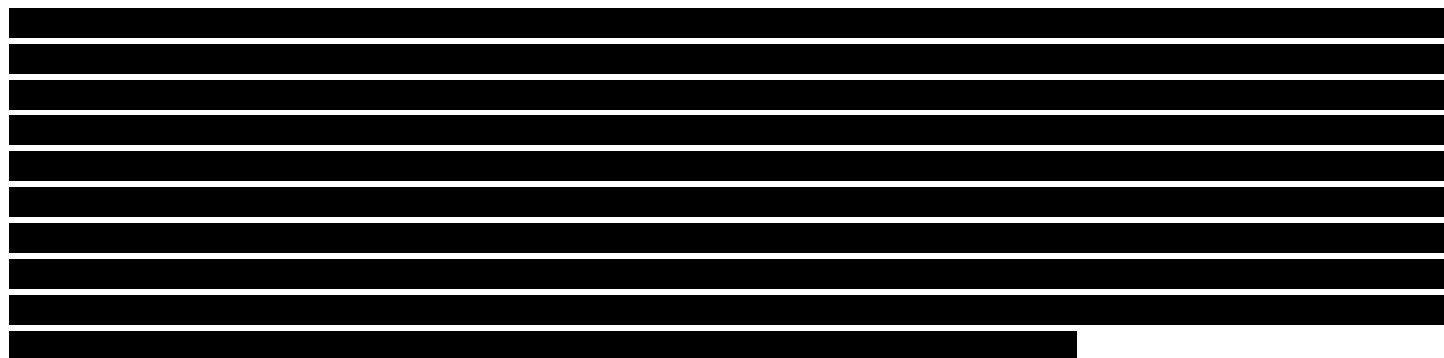
delivery date, which is currently projected to be the third week in September 2014, approximately four weeks behind the recovery schedule. SNC/Aecon has initiated a contingency plan to mitigate these delivery delays, working from fixed scaffolding in the Mock-Up until the moveable RT Platform is delivered.

- **ATS/CANDU Tools:** Several tools being developed by SNC/Aecon's suppliers ATS and CANDU are threatening to miss the Prototype Complete and Qualification Complete milestones, precursors to Tool Performance Guarantee ("TPG") testing in the Mock-Up. However, the DR Team believes that the impact of missing these milestones is minor and can be acceptably mitigated. The Class 3 Estimate currently uses TPG values that were negotiated in the contract that will be replaced for Class 2 by actual measured times from activities tested in the Mock-Up. The testing activities are currently scheduled in series, and if required, many tools could be tested in parallel, therefore reducing the total duration required without consequence to the schedule. This is particularly relevant for the CANDU tools which are much smaller, less complex, and mostly hand tools.

For the larger, complex ATS tools, the DR Team believes it is more important for the tools to be proven through rigorous durability testing than through TPG testing. This is because TPG testing will only test five operation cycles, whereas durability testing will test potentially hundreds of cycles of the machine. In addition, the results of durability testing could be used in the case the TPG tests on the Mock-Up could not be completed. Finally, there is the ability to parallel path some of the TPG tests, as described above.

ATS has committed to complete the durability tests to OPG's satisfaction prior to TPG testing. This will give OPG confidence that the risk to critical path delays during the Execution Phase caused by defective tooling will be reduced. At this time, it appears that the TPG testing can be completed on the Mock-Up per the Schedule.

### 2. Engineering and Procurement Status



Another noted risk is that SNC/Aecon's delay to its procurement activities could complicate the purchasing and delivery of owner-supplied materials. SNC/Aecon's project manager has stated that they now face an aggressive schedule to complete procurements over the months of July and August. Some of the procurements will be made prior to the final certification of the design by the CNSC, although the DR Team believes this is a small risk due to the fact that the RFR engineering is replicated from the existing plant records, so there is no associated modification work.

### 3. Class 3 Estimate and Class 2 Estimate Recommendations

As discussed above, The SNC/Aecon Class 3 Estimate for RFR was accepted by OPG on June 15th, 2014 per the contract milestone date. Overall, the estimate, excluding contingency and fee increased from the Class 4 Estimate by over 20%. This level of growth in the estimate was expected because SNC/Aecon's Class 4 Estimate was by contract based on a "perfect" CANDU refurbishment stripped of all possible and reasonable inefficiencies, while the Class 3 Estimate was the first Darlington-specific estimate representing a reasonable and achievable plan. The estimate will be subject to further refinement in Class 2.

The Class 3 Estimate effort with SNC/Aecon yielded several key lessons learned to be incorporated for a successful Class 2 (as well as for the remaining estimating effort for the DR Project's other projects). Specific to SNC/Aecon, the official review period for the Class 3 Estimate was only about a month long, and in our view, will need to be much longer for

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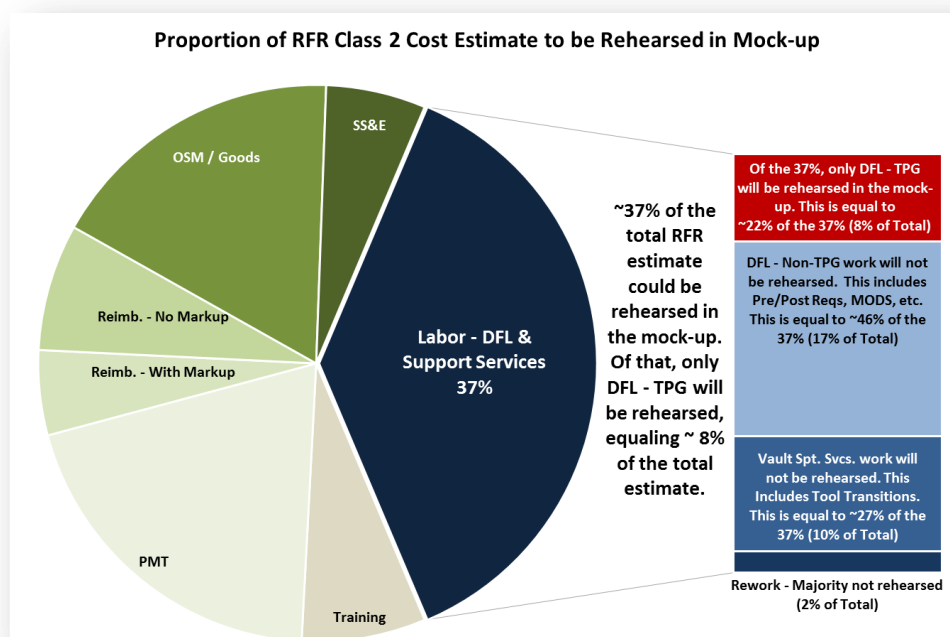
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Class 2. The next estimate will not only be more detailed, requiring more time to review, but the number of interested stakeholders will increase with Class 2. The DR Team is taking an appropriately hands-on approach to the Class 2 development process, using a dedicated estimating team to work shoulder-to-shoulder with SNC/Aecon.

Also, given the amount of time that will be required for review by all interested parties, it is important advance as many of the estimating activities forward in the schedule as possible. The critical path to completion of the Class 2 Estimate currently runs through engineering, and as mentioned above, engineering has generated a bow wave of work requiring a concerted effort in order to meet the December 2014 engineering complete milestone. If engineering is actually holding up the estimating work, this could push development of many of the precursor components of the construction work packages to January 2015, leaving only about 2-3 months to assess the results, incorporate tested TPG times from the Mock-Up, develop the estimate report and Execution Phase schedule. This could result in a very compressed time-frame and will require a significant number of resources, tight coordination, and rigorous quality control. Given that this final engineering work is duplication of the existing design, the OPG RFR team intends to challenge whether engineering completion is a true predecessor to detailed estimating work, which would give SNC/Aecon more time to complete its estimating activities.

Finally, SNC/Aecon is currently planning to only use the Mock-Up to establish measured times associated with the TPG prior to Class 2. We see this as a potential risk to the quality of the Class 2 Estimate. The other work such as support functions, transitions, staging of materials, and the movement of tools and equipment within the confined spaces of the RFR are not currently planned to be rehearsed or tested in the Mock-Up as part of the Class 2 Estimate or even prior to negotiating the Target Price and Schedule. This means that SNC/Aecon will populate its estimate with unrehearsed times for this work, depriving OPG of a significant benefit of the Mock-Up. As shown in the chart below, this “untested work” represents a significant portion of SNC/Aecon’s Class 2 Estimate for direct work:



As shown above, 37% of the total estimate value is work that could be rehearsed in the Mock-Up. However, SNC/Aecon’s current plan is to rehearse only 8%. Without testing this work in the Mock-Up prior to the Class 2 Estimate through rehearsals, time motion studies, and the like, the accuracy of the final estimate for that portion of the work would be uncertain. The more important issue is that OPG should get the benefit of the Mock-Up in setting the Target Price. It is our understanding that the DR Team has recognized this as an important issue and has commenced discussions with SNC/Aecon to see if it will be possible to include rehearsed times in the Class 2 estimate.

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### 4. RFR Commercial Risks

The DR Team is currently considering how it monetizes the contingency, risk and incentives/disincentives in the RFR contract for purposes of forecasting the total project cost for the 4d Cost Estimate. Complicating the picture for 4d Cost Estimate is the fact that under the RFR Contract, SNC/Aecon does not have to monetize its contingency (including all identified risk/mitigation events and uncertainties) that will be included in the Target Price until it issues its Class 2 Estimate in May of 2015. Additionally, the DR Team is reviewing the incentive and disincentive structure to ensure that SNC/Aecon is properly enticed to meet the necessary performance objectives. The DR Team has engaged in preliminary discussions with SNC/Aecon with respect to both of these issues in order to agree upon an acceptable resolution. Considering the potential impact of these items on the overall DR Project budget, increasing the confidence on these projected costs will have substantial and obvious benefits.

### 5. RWPB Building

The Retube Waste Processing Building (“RWPB”) project currently being performed by SNC/Aecon has experienced schedule delays and increases in scope that in many ways resemble those experienced by the D2O and Campus Plan projects. As with D2O Storage, RWPB’s increases in projected cost represent increased functionality and additional scope that the DR Team has determined to be necessary. These changes, described further below, were initiated to mitigate potential Execution Phase delays in processing waste removed from the reactor that have impacted the critical paths or near critical paths of prior refurbishments. The original estimate that was prepared for the RWPB was done at a very early stage without consideration of these efficiency advantages; thus, it is not an accurate gauge for comparison.

The initial construction delays to RWPB were caused by the late turnover of the building footprint for preliminary geotechnical work and the scanning and daylighting of buried services. In addition, there are more buried services than originally anticipated and the RWPB needs to accommodate a contaminated tool maintenance area and low-level waste and flask storage and staging areas that were originally intended to be housed in the powerhouse. This additional space could not be found in the powerhouse and has been included as a proposed extension to the current RWPB design. SNC/Aecon’s RWPB proposal includes space required above and beyond that of the waste tooling and provides a justification for its inclusion in the RWPB scope. The proposal was received from SNC/Aecon at the time this report was written that will require more thorough vetting and analysis to verify the increased scope and estimated cost for the RWPB and extension.

### B. Turbine Generator

The SNC/Aecon Class 4 Estimate was submitted in May and the Class 3 Estimate is targeted for submission for OPG review and comment on August 29, 2014, with final OPG acceptance on September 30, 2014. Further progression to Class 2 is scheduled for March 2015. The scope of work for the Turbine Generator is essentially a large maintenance task and the Turbine Generator estimating team has access to station maintenance logs in Passport (including hours) and is working with OPG’s Operations and Maintenance organization to match this data to scope items. In addition, OPG’s estimating contractor, Faithful + Gould (“F+G”), is developing an independent “check estimate” concurrently with SNC/Aecon, aligning scope to ensure comparability when the estimate is delivered. Both Operating Experience (“OPEX”) and F+G’s check estimate will be used to test reasonableness of the final estimate. We will be vetting and reviewing the development of the cost estimate as it continues to progress.

### C. Balance of Plant

In our Initial Project Assessment of August 2013, we identified a risk that the detailed engineering for BOP work would be delayed by the then-current procurement process which required the ESMSA contractors to compete for each package of work. The DR Team took action to revise its process to allow for direct award of work to vendors who were already judged to be qualified through a competitive process. On this basis we believed that the DR Team had resolved this potential issue which would allow them to complete BOP engineering on time.

However, the Balance of Plant work for Refurbishment is currently tracking behind plan for several reasons, including:

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- **Scope Definition:** The BOP work has experienced some of the same early scope definition problems as the Campus Plan Projects in which the vendors, lacking specific scope identification, initially chose the most conservative design path possible, leading to over-design and the potential for unnecessary or unanticipated project cost increases. Fortunately, the BOP team recognized this trend and stopped these potential increases from materializing;
- **Uncertainty regarding Black & McDonald:** Some work packages that were initially intended for Black & McDonald have been reassigned, and the DR Team is awaiting the resolution of the NCAR;
- **Delays with Project Estimating and other Award Pre-requisites:** Despite abandoning the competitive process, the Project has retained the requirement for check estimates to be performed to compare to the contractors' estimates, and OPG's team and consultant have encountered throughput issues.

As a result, the DR Team has not been able to take advantage of the opportunity presented by the direct award process in order to begin detailed engineering earlier than they had originally planned. In fact, the DR Project is now behind key planned dates and as noted, these delays have put, among other key deadlines, the May 2015 milestone for detailed design completion at risk. While some of this delay could not have been avoided due to on-going contractor performance issues, improved planning and communication could have resulted in the earlier identification and removal of barriers to performance.

It appears that the BOP team has been able to get around some of these hurdles and work appears to be moving forward. The BOP team has developed and put in place a recovery plan in order to mitigate these delays. BOP expects to award three packages (Emergency Heat Sink, Containment and Flux Detectors) by August 1, 2014 and has canceled three others based on positive inspection results. In addition, the final terms and conditions for the repair/replacement valve package appear to be close to resolution. The BOP team has sought confirmation that the vendors could support the May 2015 design completion milestone, and recovery work is in place. Nonetheless, these trends should be closely monitored, as any of these missed milestones could have an impact on the confidence level of a significant slice of the DR Project's estimate at RQE.

### V. Functional Groups Update

#### A. Engineering

The risks associated with engineering have been front and center in the DR Team's plans and in our reporting of the Project. Last year, the DR Team's focus was on completion of the scope-defining MDPs so that detailed engineering could begin with sufficient schedule float. Unfortunately, some of the anticipated risks have materialized: while the MDP's were completed on time, the delay in award of work to contractors has compressed the time available for detailed design.

The Construction Industry Institute ("CII") Research Team 300 has been investigating the most common causes of late deliverables and the severity of their impact on construction activities. This investigation has examined many projects, performed in-depth case studies, conducted questionnaires and surveys and explored the experience of CII member organizations. CII confirmed what is widely believed in the industry, that engineering is the most common late deliverable which also has the most severe impact. While there is wide understanding within the DR Team of these risks, that recognition has not in all cases translated to optimal results.

The DR Team initiated some corrective actions, but valuable time was lost in the process. Once all of the detailed design is underway, the DR Team will need to attend to its ongoing engineering challenges, including: its ability to forecast engineering performance, efficiently managing the work and its need to arrive at final decisions more readily and quickly.

As noted in our 2Q 2014 Report, the DR Team has made a significant shift in engineering strategy and is now directly managing and supervising the engineering service providers' output. The engineering team is also pursuing how to recover some of the lost time and confirm vendors' commitments to meet target dates. In this Report we revisit three

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aspects of the engineering effort, identifying the progress being made and the major concerns that remain for each: ongoing engineering initiatives; scope definition and management; and engineering metrics.

### 1. Engineering Initiatives

#### (a) Active Management

The DR Team has taken some strong steps to actively manage the engineering work: Engineering has issued a change management plan describing the necessary cultural changes; the updated engineering management plan is written around active management; engineers are now resident at the engineering service providers; the change in role has been stressed at several executive face-to-face meetings with the engineering staff; and the VP of Refurbishment Engineering has held informational sessions with the engineering service providers to provide information and guidance with respect to these changes.

The DR Team is exhibiting a growing sense of ownership of the work, developing a sense of urgency in resolving issues, an improved responsibility to make decisions and a desire to find solutions to help the engineering service providers navigate the detailed design phase. In discussing this initiative with the engineering service providers they acknowledge that this transition represents a much needed and positive change for the DR program.

#### (b) Front-End Planning

The DR Team has examined certain principles in the CII Front End Planning for Revamp and Renovation Projects, and Engineering has embraced this concept. The front-end planning engineering initiative is incorporated in the Collaborative Front End Planning ("CFEP") Process guide issued by DR Engineering in 2Q 2014. The intent of the CFEP is to get all key stakeholders together to establish project scope solutions before mobilization of the detailed design effort. The process is intended to reduce the downstream scope additions and changes that have been evidenced in the past as a result of missing information in the design requirements. Whereas it is still too early to measure the benefits of this initiative, it has thus far been well received by the engineering service providers.

#### (c) Collaborative Approach

OPG's original management strategy and administration of the work has impacted the relationships between OPG and the contractors. OPG's "collaborative approach" initiative intends to reverse this situation by addressing the issues and improving the working relationships, and there is evidence that this initiative, in conjunction with the others is beginning to bear fruit.

Work is now being performed under the active management of the OPG design authority, with a greater focus on front end planning and a collaborative relationship with the engineering service providers. Based upon OPG's experience over the last year, there are several lessons learned that the DR Team needs to consider with respect to future engineering work, including: 1) facilitating the active management of engineering work by directly contracting with the engineers; and 2) contracting for engineering on a time and materials or target price rather than on a fixed-price basis.

### 2. Scope Definition & Management

In our Initial Assessment, BMCD/Modus noted that for the RQE to be reliable, detailed engineering must be sufficiently progressed by the 2nd Quarter of 2015 for the DR Team to develop Class 2 cost estimates (cost estimates that are deemed to meet the criterion of the Association for the Advancement of Cost Engineering ("AACE") cost estimating standards. Per the AACE recommended practices, to achieve a Class 2 Estimate, detailed engineering needs to be between 30% and 75% complete and the results of that estimating maturity need to be translated into the project's estimate. Mindful of the need to have detailed engineering in place for RQE, the DR Project set May, 2015 as deadline to have detailed design complete. However, for portions of the Balance of Plant work, the May, 2015 deadline will likely not be met without a significant recovery plan.



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We have previously described the success the DR Team has achieved with the scope definition process deployed for Refurbishment. Furthermore the MDP process was well executed using the OSS vendors. However, the vendors' interpretation of suitable engineered solutions, delays in awarding the detail design work and inefficient engineering processes have all contributed to a compression of the engineering detail design effort. In addition to RQE, the delayed engineering work may also impact downstream procurement and construction activities.

### 3. Engineering Metrics

The DR Team has developed many of the requisite metrics, to provide visibility into the progress of the engineering effort. However, the reported metrics are being challenged by the project managers and are not proving to be reliable. There are observed issues with the quality of the detailed, level 3 schedules for engineering that must be addressed, including resource loading, logic and full detail of engineering tasks. Because the schedule is unstable at this time, it is not an effective tool for measuring performance.

RFR provides an example of what can be done with a reliable schedule. RFR is the one project that as of the date of this Report has a resource-loaded level 3 schedule for the Definition Phase. While engineering and manufacturing are currently behind plan, this slip is visible, highlighting the need for mitigating actions and active contractor management. In fact, the RFR contractor has a recovery plan that indicates its next milestone will be met. Without integrated, level 3 resource loaded schedules, a complete picture of the engineering effort required to complete detail design is not visible, hampering the planning of adequate resources for this work.

In this regard, schedule improvements for the DR Team to address include:

- Completing integrated level 3 resource loaded schedules;
- Establishing engineering work flow streams with vetted rules of credit needed to verify earned value;
- Including appropriate placeholders in the schedule for un-awarded work (without exceptions) for projects that are lacking schedule detail;
- Ensuring that all engineering work needed for the Project is in the schedule as soon as possible; and
- Identifying and correcting errors cited by DR Team members in Engineering performance metrics.

The effort ahead for the DR Team to complete engineering for RQE needs to be supported by reliable metrics so that the team can make reasoned choices if issues with throughput of engineering product persist.

### B. Project Controls

The DR Project's project controls development is behind where we thought it would be by this time this year in our Initial Assessment. The Project's master integrated schedule still lacks the entirety of engineering activities for all of the Refurbishment work. Earned value management remains immature as well in part because establishing planned values has lagged in conjunction with the schedule; because the planned schedule is not robust, earned value is not being properly calculated. While to a certain extent it is expected that there be a "shake-out" period for earned value, for the P&M work, which is in or close to execution, earned value is an essential management tool that is currently lacking. For the Refurbishment work, the earned value information that is currently needed is for engineering. Until these issues are resolved, the DR Project will have difficulty measuring progress, forecasting work completion and associated cost progression.

It is our understanding that the DR Team intends to reorganize its project controls department to allow the project management team more direct control and access to the scheduling team. The DR Team also intends to have a consolidated scheduling team that will be shared between Refurbishment and P&M, which should increase the overall quality of the scheduling effort for both organizations. As we have noted, the Campus Plan Projects suffered from a lack of schedule control and development, the first solution to which was loading the contractors' schedules into the master



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schedule as they were available. These schedules, as described above, turned out to be lacking in many respects. Having a single department with consistent criteria for schedule development should be a positive step.

The DR Project's earned value/performance measurement ("EV/PM") system currently has other shortcomings. Despite not having all of the necessary data inputs in place, a well-functioning EV/PM system should still be able to provide meaningful measurement of performance in those pockets of work that have existing plans. The DR Project's current system shows some deviations between the contractors' reports and those from the DR Project, resulting in the need for manual corrections in order to reconcile the reports. The Project Controls Team should instead instruct the contractors regarding how the OPG system works so that their inputs are correct at the outset. In addition, certain modifications will be needed to support the smooth operation of the scheduling software P6 during the Refurbishment project including aspects of OPG corporate governance. We will provide the Project Controls team with our recommendations in this regard.

### C. OPEX/Lessons Learned Program

Concurrent with this report, BMCD/Modus has issued an Assurance Report regarding the DR Team's OPEX and Lessons Learned Program. Of paramount importance is whether the DR Team can provide some assurance that: 1) it is incorporating the lessons learned of other, similar refurbishment projects; and 2) it is capturing and implementing Lessons Learned from its own performance so that it can implement process improvements as well as incorporate OPEX from one unit to the next. As a result, we have recently conducted an in-depth review of the DR Team's OPEX and Lessons Learned Programs.

In our August 2013 Project Assessment, BMCD/Modus identified the several issues with respect to the OPEX Lessons Learned Program. Since that time, the DR Team has continued to develop, implement and make improvements to the OPEX program. Meaningful improvements have been initiated that address matters such as:

- **Communication of potential OPEX and Lessons Learned items:** Identification and communication of external OPEX is now well established. However, we have noted that broad participation in identifying and communicating internal OPEX still needs to be improved, though the Project Controls Team ("PC Team") is taking specific action to improve internal OPEX generation. This will become increasingly important to inform forthcoming activities, such as RQE, final schedules and Execution Phase processes.
- **Training:** The PC Team initiated an OPEX training program at the beginning of 2014 and has addressed topics such as capturing and reporting OPEX, utilizing the new OPEX website, and identifying Lessons Learned.
- **Coordination with the Corrective Action Program:** Monthly OPEX metrics and Lessons Learned Report are now being addressed in Corrective Action Review Board (CARB) meetings. Beginning 3Q 2014, quarterly CARB meetings have been extended an additional 30 minutes to address details of the OPEX Program.

Overall, the PC Team has a clear appreciation for the value of OPEX and has significantly considered Lessons Learned in numerous aspects of the Definition Phase organization and planning processes. The P&C Team tasked with implementing the OPEX program has been able to make significant progress in a short period of time. However, complete implementation and refinement of the above improvements is necessary to ensure that Lessons Learned are efficiently generated and addressed throughout the life of the Project. To that end, an OPEX/Lessons Learned Strategic Plan is under development, which is expected to advocate specific actions for continuous improvement of the OPEX program. Our Assessment Report identifies four areas where further improvement is needed. These include, but are not limited to:

- **Limitations of Reporting and Tracking Software:** Databases used for documenting and tracking OPEX/Lessons Learned items and their associated implementing actions are still not integrated. It is now scheduled to be in operation by the end of 4Q 2014.

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- **Internal OPEX identification:** Currently, the process is in place for disseminating and evaluating OPEX; and for developing Lessons Learned implementation plans. However, more needs to be done to stimulate the generation of OPEX from within the various projects and departments; and to communicate items to others outside the initiating group. Much of the valuable OPEX and Lessons Learned (both positive and negative) will be derived from the day-to-day management of the contractors. At this time, it appears that lessons learned are generated only as a result of a significant negative event, such as the recent Campus Plan experience. We do note that the PC Team has developed guidance for capturing internal Lessons Learned and has commenced some training activities. Success in this critical area is going to depend on the entire team's awareness of this guidance and their proactive identification and communication of relevant lessons learned.
- **Action Tracking and Management:** OPG has set up an Actions, Issues, Decisions, and Key Assumptions database called AIDA. The intent of this database is to track, review and manage actions and document issues, decisions and assumptions—though “significant” decisions and assumptions have to be further documented through additional processes. The AIDA Actions Database includes activities intended to address lessons learned. In general, the AIDA database has a large number of entries, many of which that have not been actively managed. The condition of the database suggests that many action items are loaded and then forgotten. Obviously, the purpose of an OPEX/Lessons Learned program is defeated if actions to address the lessons are not performed.
- **Implementation of OPEX from Similar Projects:** The question of whether OPG has adequately integrated the lessons learned and OPEX from other, similar refurbishment projects will be a topic of interest for the public and OPG's shareholder. It possible that OPG will have to articulately convey these efforts on an on-going basis. There is clear evidence DR Team has actively sought out and implemented OPEX from these projects. However, OPG's responses to similar-project OPEX and lessons learned are disaggregated throughout its databases or other project documentation. OPG should consider the best way to document and relay its efforts to external stakeholders, particularly its risk mitigation of known significant issues that caused delays and additional costs on other projects.

### D. Supply Chain

In our 2Q 2014 Report, we noted some concerns regarding the interface between Supply Chain and the DR and P&M Project Management teams. This concern regarded the fact that there were on-going and significant delays to the contract award and the issuance of purchase orders milestones for the Campus Plan, SIO, BOP and Shutdown and Layup work. These delays could have potentially serious downstream consequences such as compression of detailed engineering after the vendor contract award, compression of the construction and commissioning planned level 3 schedule degradation of the accuracy of RQE. Over the last month, we have conducted several interviews of Project Managers, Contract Managers and Supply Chain personnel in both P&M and Refurbishment, reviewed the applicable Supply Chain policies and procedures and various other documents including correspondence between members of the various groups.

As noted, the P&M and DR Teams have struggled with getting work ready for award to contractors—even under the ESMSA contracts where a significant portion of the terms and conditions for the work have already been negotiated and there is a “direct award” process. In particular, award of work in Refurbishment's BOP and Shutdown Layup is currently trending 100 or more days behind schedule. Many of the affected purchase orders still have not been issued, though they are expected to be in the coming weeks and recovery plans have been developed and are in the process of being implemented. The DR Team has expressed on-going frustration with Supply Chain's procedures and perceived lack of support for the Project, and Project Schedule.

There is a perception within the DR Team that Supply Chain sees itself as a strict enforcer of technical procurement rules rather than as a helpful member of the Refurbishment team focused on the DR Project's success. This perception, whether true or not, has impacted the on-going working relationships to some degree. We recognize that Supply Chain

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serves an important control function on the Project. Supply Chain's mandate is to ensure that the procurement process is open and fair and that OPG is given value for money for each and every transaction, and to ensure contract compliance and enforcement during execution of the Project. It is not unusual for there to be a natural tension between Supply Chain and the Project Team. This tension can be a good check and balance to ensure that cost, quality and schedule are each championed. However, it is important that the balance is maintained, and that this tension does not become a barrier to the execution of the project. In our review, we have taken a closer look at the interaction and communication between Supply Chain and the project teams as well as the Supply Chain policies and procedures that govern its support of the Refurbishment Project. Based upon our review, we have made several observations, including the following:

### 1. The Project Teams and Supply Chain Do Not Effectively Communicate

We found that one of the biggest drivers to the perceived issues between Supply Chain and the project teams was a lack of effective communication. Misunderstandings and lack of alignment have contributed to the delays leading to finger pointing and frustration. The areas that need improvement include:

- The DR and P&M Teams should communicate clear expectations and priorities to allow Supply Chain to plan and utilize its resources effectively. Additionally, Supply Chain should be an active participant in setting a reasonable schedule and then be accountable for delivering according to the agreed-upon dates. On the Refurbishment side, each of the project managers makes demands on Supply Chain specific to his project. What is lacking is a prioritization of these demands for the overall program. Additionally, dates that the DR Team expects Supply Chain to meet need to be vetted openly in advance to ensure their reasonableness and buy-in. The communication of expectations also includes discussing dates for completion of various activities and holding the responsible party accountable for meeting those dates. P&M has set up a weekly Projects and Modifications Oversight Committee ("PMOC"), the purpose of which is to communicate and discuss its needs and priorities. P&M has indicated that it sets its expectations, including need dates for Purchase Orders at the PMOC, and though Supply Chain is invited to this meeting, it does not send a representative to participate.
- There needs to be a joint effort to identify and remove barriers to performance. The causes of the delays during the procurement cycle are varied, but one theme prevails—many of the issues that have caused impact thus far could have been quickly identified and eliminated if the DR Team, P&M Team and Supply Chain had proactively worked together. Examples of this are the delays reported by the Shutdown/Layup ("SDLU") project bundle, which the project team said were caused by delays to the contracting process even though most of the work was being awarded under existing contracts on a direct award basis. It appears that the cause of this delay was the inability of the third-party estimator to timely produce a "check estimate"—which the project team had interpreted as a requirement of Supply Chain's procurement procedure (OPG-PROC-0058)<sup>2</sup>. As a result, SDLU waited several months for these check estimates to be completed. Supply Chain, however, does not interpret this requirement as so prescriptive and would have accepted SDLU's 4c Cost Estimate for this work, making the completion of a check estimate an unnecessary barrier and the cause of a 3-4 month delay.<sup>3</sup> Thus, the DR Project's limited estimating resources could have been utilized more effectively and efficiently to simply verify and vet the estimate provided by the contractor rather than create a separate full project estimate. Going forward with this understanding, the DR Team can eliminate the step of reconciling both the 4C Estimates and the check estimate to the contractor's proposal, which should dramatically speed the award of the work.

<sup>2</sup> The OPG-PROC-0058 requirement states: "OPG has obtained a cost estimate for the services in question from a third party estimator or internally prior to reviewing a cost estimate from the supplier."

<sup>3</sup> The Project has its own procedures regarding check estimates, but puts it at the discretion of the project manager who has the flexibility to determine the benefit of a third party estimate versus the harm caused by the delay, and seek a waiver for the requirement from DR management.



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### 2. Inadequate Planning and Lack of Scheduling of Reasonable Procurement Durations

Many of the principles in the Supply Chain processes and procedures are dictated by the Ontario Ministry of Finance's Broader Public Sector Procurement Directive. Supply Chain has published and communicated the anticipated amount of time needed for each phase of the procurement process that should be integrated into the schedule by the Project Managers. Supply Chain indicated its willingness to discuss its ability to shorten those durations on a case-by-case basis, a decision which would be based upon objective factors such as the type of procurement, the contractors involved, its internal resources and workload based upon priority. However, it appears that the DR Team did not adequately plan for the expected procurement activity durations in its work planning schedule, nor did it confer with Supply Chain regarding its capability to meet needed milestone dates, some of which that turned out to be unrealistic. As a result, Supply Chain has never "bought in" to the procurement milestone dates in the schedule, and therefore, does not feel accountable to it. Compounding this issue is the fact that the procurement process is only represented by a single "contract award" or "PO issued" milestone in the Level 3 integrated schedule.

Without visibility to the necessary activities leading up to the milestones, it is difficult to manage the procurement process or to identify on-going issues that need to be corrected. The DR Team and Supply Chain should be focused on a realistic schedule that both can support, and Supply Chain should commit the resources needed to meet challenges if the DR Team needs them to, though such challenges should be known and planned as much in advance as possible.

### 3. Confusion With Respect to Contract Management Accountabilities

The P&M and Refurbishment Organizations have a "Strategic Contract Management" organization that is not found anywhere else in OPG. It is our understanding that the Strategic Contract Management group was first established in order to provide specific expertise in developing contracting strategies for a megaproject. Since its inception, the Strategic Contract Management team has gradually taken over performing contract management responsibilities on behalf of the project managers, though some of those responsibilities, including drafting contract amendments and providing contract interpretation are squarely within the province of Supply Chain accountabilities. There is currently no governing document outlining the Strategic Contract Management group's responsibilities, nor is there a division of responsibility that has been agreed to among the necessary parties (DR Team, P&M Team, Supply Chain and Strategic Contract Management).

The lack of clear roles and responsibilities is causing confusion among the project managers and even within Supply Chain and Strategic Contract Management themselves. In some instances, Strategic Contract Management has started activities that would normally be Supply Chain accountabilities (such as drafting a Contract Amendment) due to the perceived inability or unwillingness of Supply Chain to prepare the necessary documents in a timely manner.

In our experience, the commercial support of a megaproject requires embedded resources who understand the day-to-day events, pace and rhythm of work, and these resources need to act and react quickly to challenges when they occur so that the work is not adversely interrupted. This support also involves allowing the project managers to stay focused on their essential responsibilities. The sheer volume of commercial correspondence, contract notices and the like typically generated on a megaproject can be overwhelming if it is not effectively managed. There is no reason to think that the DR Project will be different. We understand that both Supply Chain and Strategic Contract Management are in the process of developing guidance documents to this effect (albeit separately), but we would encourage them to discuss face-to-face and resolve any outstanding ambiguities first and then cooperatively draft the necessary documents, and tabletop these processes with the DR Team's leadership. This is an issue that needs to be resolved quickly, however, as it is a source of on-going frustration and conflict.

### 4. Processes and Procedures

Supply Chain does not believe that the DR Project should have its own Supply Chain rules that are different from any of the hundreds of projects currently on-going within the company. We would respectfully disagree with this assessment,

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as the DR Project is not only very large but commercially complex. We would encourage Supply Chain to look at its policies and procedures from the corporate level to ensure that they are both flexible and agile enough to support the needs of the Project as it proceeds. We find certain processes, such as the need in P&M to revise the Purchase Order for each and every project change to be cumbersome and time-consuming, utilizing resources that could be better spent elsewhere. Additionally, there may be some ways for OPG to take advantage of some streamlining that is already built-in to the process, such as delegation of signature authority.

### E. Project Team Development

With the recent changes in leadership to both P&M and Refurbishment, the team should view this as an opportune time to clearly define the path forward to both RQE and the Execution Phase of the Project. Leadership should embrace the change and develop a strong communication plan that emphasizes the reasons changes were made and clearly sets out the cultural and behavioral expectations required for the DR Program's success. The Campus Plan Projects have provided clear lessons learned for the DR Team to incorporate in their plans relative to contractor management. There are additional lessons that can be drawn from the Refurbishment project, in particular the progression of the RFR Project that can be used as a positive example of the benefits of active management. As the DR Team is finalizing its functional plans for the 4d Cost Estimate, the team leaders should be mindful of the changes needed to actively manage the work through the entirety of the Execution Phase.



## Attachment A – 3Q 2014 Risk Perspective

Area	Observations	High	Medium	Low	Current Status / Mitigation
RFR	<b>SNC/Aecon Performance:</b> Largest Program risk due to overall risk to the DR Project and OPEX.				<ul style="list-style-type: none"> <li>▶ Tooling recovery progressing; final tool production is being accelerated</li> <li>▶ Detailed Engineering behind schedule though impact limited</li> <li>▶ RWPB and Definition Phase Engineering showing signs of slow progress</li> </ul>
	<b>Class 3 Estimate:</b> Progression to RQE requires SNC/Aecon's Class 3 Estimate to be thoroughly vetted				<ul style="list-style-type: none"> <li>▶ SNC/Aecon completed and OPG accepted Class 3 Estimate on time</li> <li>▶ Monetizing contingency remains a risk for 4d Cost Estimate though SNC/Aecon has agreed to provide input</li> </ul>
	<b>Schedule Development:</b> Level 4 schedule under development; requires challenge to total duration				<ul style="list-style-type: none"> <li>▶ Level 4 schedule accepted though there is room for significant improvement</li> <li>▶ SNC/Aecon identified schedule tracking plan that needs to be proven</li> <li>▶ Integration of support activities and logistics in schedule remains a risk</li> </ul>
	<b>RWPB Delays:</b> Facing similar problems that have plagued Campus Plan projects				<ul style="list-style-type: none"> <li>▶ Contaminated soil, interferences, and seismic issues delaying engineering</li> <li>▶ Lessons learned from Campus Plan work are being integrated</li> </ul>
	<b>RFR Commercial Risks:</b> Contract provisions currently in place may not drive desired contractor performance				<ul style="list-style-type: none"> <li>▶ The RFR Team has approached SNC/Aecon regarding the need to potentially renegotiate incentives and disincentives</li> <li>▶ Need to understand potential changes for 4d Cost Estimate accuracy</li> </ul>
Campus Plan	<b>ESMSA Performance:</b> D20 Storage and AHS work is behind schedule and over budget				<ul style="list-style-type: none"> <li>▶ [REDACTED]</li> <li>▶ [REDACTED]</li> <li>▶ Cost estimates and schedule remain in flux</li> <li>▶ D20 is a threat to Unit 2 breaker open</li> <li>▶ Re-evaluation of business case required in light of new estimates</li> </ul>
	<b>Engineering and Planning:</b> D20 provides key lessons learned for remaining Campus Plan and BOP				<ul style="list-style-type: none"> <li>▶ Engineering is co-locating with ESMSA vendors and taking more active role in directing and managing the work</li> <li>▶ Clarification of RFPs and process ongoing</li> </ul>
BOP	<b>ESMSA Performance:</b> Concern over ESMSA contractors' performance and ability to execute BOP work				<ul style="list-style-type: none"> <li>▶ Allocation of work underway; some issues with cost/scope estimates</li> <li>▶ Risk of ESMSA Performance will continue until improvements on performance issues in Campus Plan are observed</li> <li>▶ Detailed engineering milestone at risk due to late assignment of work</li> </ul>

## Attachment A – 3Q 2014 Risk Perspective

Area      Observations      High      Medium      Low      Current Status / Mitigation

Engineering

**Engineered Solutions:** Options Review Board has increased scrutiny of design decisions



- Conservative design decisions are driving up cost
- Misinterpretation of OPG's requirements are creating churn
- Options Review Board has been effective in challenging scope decisions
- Additional scope decisions may be necessary due to cost velocity measured in 4d Cost Estimate

**Planning of Engineering Work:** Engineering work was not well understood and is poorly planned



- OPG engineering is taking more active role in directing and managing the work at the engineering studios
- "Bottoms-up" estimating process initiated for engineering activities
- Increased focus placed on engineering planning for the design phase; new progress tracking mechanisms in place

**Continued Schedule Development:** Schedule approach was unproven; integration at appropriate level at risk



- Project Team is moving toward industry-wide recommended practices for scheduling
- Substantial work remains to populate detailed level 3 schedule
- Logic and critical path definition remains an issue with Campus Plan Projects; backward pass cannot be accomplished at this time
- Placeholder schedules needed for BOP work to assess resources
- Accurate earned value measurement will be delayed until schedule is more stable

**Progress Towards RQE:** The plan for developing RQE is being developed.



- 4d Cost Estimate is an essential step to RQE and will expose gaps and issues
- RQE development remains essentially on schedule, but will be heavily reliant on the quality of the various inputs.
- The DR Team has assigned a manager for the planning and development of the multiple pieces that must come together for RQE.

**Risk Management Program:** Risk registers require scrubbing; monitoring tools are cumbersome



- DR Team is cleaning up the risk register and improving reporting
- Risk Group is taking a more active role in managing the Risk Program
- Risk training is being conducted but more is required
- Campus Plan Projects risk awareness remains an issue

Project Controls

In our Initial Project Assessment of August 2013, BMcD/Modus summarized our conclusions and recommendations for the DR Project in a concluding table. Below, we have revisited these initial issues, risks and recommendations as a way for NOC to see the Project's progress since our Initial Assessment.

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
Scope	The DR Project's scope exceeds the commitments made to the BOD and Shareholder.	<ul style="list-style-type: none"> <li>Continue the process of reducing and optimizing the Project's scope.</li> <li>Reach a consensus on the scope as expeditiously and reasonably as possible so as to reduce the DR Team's work load and unneeded churn.</li> <li>Once the scope recommendations are adopted, the team will need to re-review the schedule to ensure the logic network is sound.</li> </ul>	<ul style="list-style-type: none"> <li>Scope reduction was accomplished via Blue Ribbon Panel review and results were incorporated in 4c Cost Estimate</li> <li>Scope remains an issue with BOP work – some of the design solutions proposed under ESMSA contracts have been excessively complex</li> <li>Options Review Board and strengthening of Gating process required to root-out remaining potential scope busts</li> <li>4d Cost Estimate may result in another round of required scope reductions</li> </ul>
Engineering	The schedule and pace of procurement related activities may not support a high-quality estimate at RQE.	<ul style="list-style-type: none"> <li>Review strategic considerations for procurement of remaining scope.</li> <li>Consider early "shoulder to shoulder" work by EPC design partners to expedite the start of detailed engineering and constructability reviews</li> <li>Review and prepare for likely RFIs from EPC vendors during the Planning and Assessing Phase.</li> </ul>	<ul style="list-style-type: none"> <li>Engineering for major bundles (RFR/Turbine Generator/Steam Generator/Fuel Handling) appear to be largely on course</li> <li>BOP start of detailed engineering is currently as much as 12 months behind plan which may impact accuracy of large portion of RQE</li> <li>Concerns expressed by BMcD/Modus in August 2013 regarding risks have largely materialized due to late award/start of BOP work</li> <li>Metrics for tracking engineering earned value need additional work and lack fidelity</li> <li>Constructability and Planning &amp; Assessing reviews are underway with RFR and Turbine Generator but lagging behind detailed engineering for BOP</li> </ul>

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
Project Management	The Project oriented focus has created management silos that could make integrated program management difficult, resulting in contractor/owner interferences.	<ul style="list-style-type: none"> <li>As the Project matures and contracts with vendors are in place, the DR Team should increase the level of program integration.</li> <li>Address the fact that the Execution Phase may require individuals with different skills for OPG to effectively manage the contracts.</li> <li>Clarify reporting lines for matrixed Project Controls Personnel.</li> <li>Actively seek to assemble the Execution Phase team as soon as possible.</li> </ul>	<ul style="list-style-type: none"> <li>Project team development is progressing though with some notable alignment issues</li> <li>Refurbishment management for execution has been strengthened and “projectizing” of functions is progressing</li> <li>P&amp;M is undergoing a fourth leadership transition since July 2013 and stability and direction is urgently required</li> <li>Project Controls standardization across the entire DR Project is a work in progress and will require significant effort</li> </ul>
	The DR Team plans to implement a C&C Schedule at Level 2 for management which could create a number of coordination issues during the Execution Phase.	<ul style="list-style-type: none"> <li>Continue development of the C&amp;C Schedule through the Definition Phase and migrate to a fully integrated Level 3 schedule for the Execution Phase.</li> <li>Redirect the Project Controls Team’s efforts from the C&amp;C Schedule work to that of monitoring the developing Level 3 schedules from the contractors.</li> </ul>	<ul style="list-style-type: none"> <li>Refurbishment has corrected early potential faults in the schedule methodology and will utilize a Level 3 schedule for execution that is currently under development</li> <li>P&amp;M continues to populate the C&amp;C Schedule though the schedules for individual projects require updating and vetting once final scope and engineering is in place</li> </ul>
Schedule Development	The current schedule development depends on mutual agreement and acceptance of quality standards that owners typically demand, creating the risk that contractors will not comply.	<ul style="list-style-type: none"> <li>Clarify and include in commercial contracts OPG’s requirements for schedule development by the contractors.</li> </ul>	<ul style="list-style-type: none"> <li>DR Project chose not to update its contractual requirements though is seeking a high level of definition from contractors, who appear to be in compliance on Refurbishment but not Campus Plan</li> <li>We continue to recommend that OPG update its commercial arrangements for project controls information that will be propounded by the contractors at the time of finalizing the target price contracts for the Execution</li> </ul>

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
			Phase
Risk Management	The current methods for scoring risks are inconsistent and the risk register includes “issues” or “concerns” that needlessly dilute management efforts.	<ul style="list-style-type: none"> <li>• Provide consistent characterization and scoring of risks.</li> <li>• “Concerns” as currently defined should be eliminated from the Risk Management Program.</li> <li>• Ensure that all relevant parties have a seat at the risk table while maintaining a measure of centralized control in the approach to risk identification and tracking.</li> <li>• Consider revising probability scoring to increase granularity and ranking of risks.</li> </ul>	<ul style="list-style-type: none"> <li>• Risk identification is improving in the Refurbishment organization</li> <li>• Scoring and “business as usual” risks are being addressed</li> <li>• Risk Management Program deficiencies are still present and have not been addressed</li> </ul>
	Leadership, training and wide acceptance of the importance of the Risk Management Program is lacking and the Project Controls Risk Group is understaffed.	<ul style="list-style-type: none"> <li>• Consider bringing in an experienced risk management lead with a demonstrated track record who is singularly focused on the risk function.</li> <li>• Review qualifications within the existing risk team.</li> <li>• Elevate Risk Management to a stand-alone functional group with the same level of prominence as the Schedule team.</li> <li>• Provide training with a focus on the overall importance of the Risk Management Program</li> </ul>	<ul style="list-style-type: none"> <li>• The DR Project’s risk management team has been strengthened over the intervening year and has new energized leadership in place</li> <li>• Additional training and risk discussion is still necessary</li> <li>• Reporting of risks needs additional clarification and work</li> </ul>
	The various databases that the Risk Group is populating suffer from a number of IT issues and lack of focus.	<ul style="list-style-type: none"> <li>• IT needs to resolve the outstanding issues as quickly as possible.</li> <li>• Training should include instruction for populating databases.</li> <li>• The AIDA database should be examined and updated if it is to be useful for rate proceedings.</li> </ul>	<ul style="list-style-type: none"> <li>• Database integration issues remain, and still need to be resolved</li> <li>• AIDA still requires examination for usefulness for rate proceedings.</li> </ul>

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
Cost Management	The DR Team is inconsistently applying AACE guidelines and other processes and procedures central to the BOD's understanding of the underlying quality of project cost estimates.	<ul style="list-style-type: none"> <li>Consistently apply AACE guidelines, and where they are not (as in the RFR project estimates), the DR Team should seek to return to a condition of compliance.</li> </ul>	<ul style="list-style-type: none"> <li>AACE guidelines have been addressed in the continued development of the Project's estimates; contractors appear to have a better understanding of the nature of compliance with AACE standards</li> </ul>
	Revised planning assumptions for the 2014 Business Plan are currently being assessed—the business case for these assumptions is centered on the opportunity to reduce risk and increase positive outcome.	<ul style="list-style-type: none"> <li>Document and characterize the information for the BOD and consider meaningful reporting metrics.</li> <li>Should OPG adopt the revised assumptions, review commercial agreements so as to identify potential issues that could be impacted by the revised plan, as well as other issues within contracts that can be improved based on current OPEX.</li> <li>Review, capture and document Unit 2 OPEX information so maximum benefit is derived from this revised plan.</li> </ul>	<ul style="list-style-type: none"> <li>Documentation of major decisions still could be strengthened</li> <li>Discussion of key commercial agreements (in particular RFR) is pending though have been fully considered by DR Team management</li> <li>Metrics are still under review for effectiveness, as is earned value system</li> </ul>
	The 2015 Business Plan Budget review will likely repeat the process for the 2015 Business Plan in which the budget is refreshed.	<ul style="list-style-type: none"> <li>Perform a full project reforecast for the 2015 Business Plan in order to progress the project's cost estimates as far as possible before the date of the RQE.</li> <li>Such a reforecast will provide management with a detailed blueprint for all of the work needed to satisfy the RQE with information related to the budget that should match the DR Project's growing level of maturity.</li> </ul>	<ul style="list-style-type: none"> <li>4d Cost Estimate work is progressing, though we have concerns that it will fall short of a full Project reforecast. BMCD/Modus sees a risk in holding back on full examination of the underpinnings of the 4d Cost Estimate for certain cost centers that have not substantially matured since 4c Cost Estimate</li> <li>DR Team has appointed a manager of the RQE efforts, who should be engaged to find gaps in 4d Cost Estimate</li> </ul>



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Issue	Risk/Opportunity	Recommendation	Update/Status
	Contingency calculations need closer alignment with the Risk Management Program.	<ul style="list-style-type: none"> <li>• Actions summarized above</li> <li>• Create a clear and repeatable process for calculating contingency at all levels and for all program participants.</li> </ul>	<ul style="list-style-type: none"> <li>• BMCD/Modus will be reviewing and vetting the process for contingency identification for 4d Cost Estimate</li> <li>• As the Project matures, our expectation is for the DR Team to move toward deterministic risk and contingency identification with monetization of specific known risks</li> </ul>
Management Processes	OPG's new processes and procedures are in some cases conflicting and repetitive.	<ul style="list-style-type: none"> <li>• Look at reducing the number and optimizing the process map.</li> </ul>	<ul style="list-style-type: none"> <li>• The Project Management Plan remains a work progress</li> <li>• BMCD/Modus recommended each project manager revise the bundle management plans to incorporate changes to management principles</li> </ul>
RFR	SNC/Aecon's Class 4 Estimate (by contractual design) does not monetize contingency nor will it until the date of the 2015 Class 2 Estimate; this fogs the budgeting process and could complicate target price negotiations with SNC/Aecon over risk identification.	<ul style="list-style-type: none"> <li>• Consider asking SNC/Aecon to monetize risks at a much earlier stage.</li> </ul>	<ul style="list-style-type: none"> <li>• SNC/Aecon has agreed to provide certain information related to risks for 4d Cost Estimate though the extent to which it is helpful has to be determined</li> </ul>
	The Class 4 Estimate represents perfect performance; thus, it will form the basis for comparison with actual results.	<ul style="list-style-type: none"> <li>• The DR Team needs to document and explain the nature of the Class 4 Estimate so that there is no such confusion.</li> </ul>	<ul style="list-style-type: none"> <li>• The difference between SNC/Aecon's Class 4 and Class 3 estimates needs to be properly characterized</li> <li>• The RFR team, with vetting from BMCD/Modus, provided a prescriptive estimating plan for the RFR Class 3 Estimate that clearly defines the deliverables.</li> </ul>
	Project maturation	<ul style="list-style-type: none"> <li>• The Class 3 Estimate</li> </ul>	<ul style="list-style-type: none"> <li>• The Class 3 Estimate addressed</li> </ul>

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Issue	Risk/Opportunity	Recommendation	Update/Status
	specific to the DR Project was not a factor in SNC/Aecon's estimates to date.	<p>preparation should be expedited if possible.</p> <ul style="list-style-type: none"> <li>OPG should seek SNC/Aecon's monetizing of PMT costs.</li> </ul>	<p>these gaps; however, SNC/Aecon did not utilize time well, creating a substantial effort by SNC/Aecon and OPG in a short window of time</p> <ul style="list-style-type: none"> <li>The Class 2 Estimate development must occur at a more predictable pace, as there is less time for SNC/Aecon to prepare it and this estimate will form the basis for target price negotiations.</li> </ul>
	The potential unlapping of the execution of Unit 2 could result in cost increases from SNC/Aecon due to extended overhead and maintaining the workforce for a longer duration.	<ul style="list-style-type: none"> <li>While SNC/Aecon's costs may increase, there are other elements within the contract that should be negotiated that might serve to reduce the overall project's risk.</li> </ul>	<ul style="list-style-type: none"> <li>This remains a work in progress. BMCD/Modus believes it is OPG's intent to close needed gaps in the commercial contract prior to the final Execution Phase negotiations.</li> </ul>
	There are technical improvements that should be reviewed based on OPEX.	<ul style="list-style-type: none"> <li>Study opportunities now that the effort is turning to Darlington.</li> </ul>	<ul style="list-style-type: none"> <li>This is part of Class 3/2 Estimate effort is and under evaluation for the target price</li> </ul>
<b>ThisBOP</b>	The time engineering needs to create MDP packages is delaying the procurement of the work and the commencement of detailed engineering.	<ul style="list-style-type: none"> <li>Accelerate engineering work as necessary / practicable with the OSS vendors.</li> <li>Reduce and optimize BOP scope as soon as reasonably possible to decrease wasted effort.</li> <li>Change procurement method to a packaged approach (see below).</li> <li>Jumpstart detailed engineering by engaging EPC vendors as early as possible in the design process.</li> <li>Eliminate unnecessary duplication of effort between OSS vendors and EPC designers.</li> </ul>	<ul style="list-style-type: none"> <li>MDP preparation was accelerated and was completed ahead of schedule</li> <li>Detailed engineering for BOP work remains a risk; despite changes to the procurement model, assignment of work to ESMSA contractors continues to be delayed or impacted</li> <li>DR Team has initiated a collaborative approach to reviewing and approving engineering product that is intended to eliminate delays in approvals and duplicative effort; results need to be monitored</li> </ul>



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Issue	Risk/Opportunity	Recommendation	Update/Status
		<ul style="list-style-type: none"> <li>Review and eliminate OPG delays in approval of design work.</li> </ul>	
	The procurement process for BOP is designed around packaging two large bundles of BOP work and a Secondary Compete process which adds time to the schedule; the outcome of this “competition” is essentially already known.	<ul style="list-style-type: none"> <li>Assign work to ESMSA vendors based on qualifications in smaller bundles.</li> <li>Use the existing ESMSA agreements and eliminate bidding process.</li> </ul>	<ul style="list-style-type: none"> <li>Procurement process has been changed and Secondary Competition has been eliminated</li> <li>The direct award process has been hampered by process delays</li> </ul>
	The ESMSA contractors have experienced performance problems on the Campus Plan work.	<ul style="list-style-type: none"> <li>Ensure that appropriate performance metrics are in place and aggressively address specific performance trends and problems as they arise.</li> <li>Increase flexibility in the assignment of BOP work to give OPG an opportunity to mitigate ESMSA performance issues.</li> </ul>	<ul style="list-style-type: none"> <li>ESMSA performance problems with the Campus Plan Projects have persisted</li> <li>Metrics measuring progress and resource allocation have not been developed</li> <li>Assignment of BOP work is now capability-based</li> <li>DR Team has re-assigned work from non-performing contractor’s scope</li> </ul>
	There is a risk that scope defining inspections and discovery work during the Execution Phase will add scope not currently anticipated to the BOP work.	<ul style="list-style-type: none"> <li>Optimize the BOP work so that an appropriate schedule window exists for performance of scope adders.</li> <li>Increase visibility of this potential risk.</li> </ul>	<ul style="list-style-type: none"> <li>Scope defining inspections thus far have resulted in narrowing of the DR Project’s scope</li> <li>Risk of additional work is decreasing</li> </ul>
Campus Plan	The D20 Storage Facility work has been delayed and the contractor’s performance has been subpar	<ul style="list-style-type: none"> <li>Continue to devote adequate resources to recover the D20 Storage Facility’s schedule.</li> <li>OPEX from this project should be used to guide management of the future Execution Phase</li> </ul>	<ul style="list-style-type: none"> <li>D20 Storage remains a significant threat to Refurbishment</li> <li>Contractor performance and P&amp;M’s failure to actively manage the work have resulted in cost overruns and continued schedule</li> </ul>

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Issue	Risk/Opportunity	Recommendation	Update/Status
		work.	<p>delays</p> <ul style="list-style-type: none"> <li>OPEX from D2O Storage has been well-studied and was a significant topic of BMcD/Modus's 2Q 2014 Report</li> <li>The DR Team is endeavoring to insert lessons learned into BOP work, though this requires close monitoring</li> </ul>
	Campus Plan work is multi-faceted and schedule driven; the sheer size and timing of the work adds complexity and risk	<ul style="list-style-type: none"> <li>Additional management attention is needed to ensure planning and execution of the work</li> </ul>	<ul style="list-style-type: none"> <li>Management issues with Campus Plan Projects persist</li> </ul>
	The Campus Plan's scope is too large	<ul style="list-style-type: none"> <li>Continue to review the Campus Plan Scope and eliminate unnecessary projects.</li> </ul>	<ul style="list-style-type: none"> <li>Some scope in the Campus Plan Projects was cancelled as part of the Blue Ribbon review—further review and scope reduction may be required.</li> </ul>
<b>OPG Critical Path</b>	OPG-directed work is 25% of the Critical Path of the DR Project.	<ul style="list-style-type: none"> <li>Ensure that this work is given proper focus and resources.</li> </ul>	<ul style="list-style-type: none"> <li>Defueling and Fuel Handling work appear to be progressing after some early delays in awarding contracts and assigning/splitting work with DNGS station.</li> </ul>



# **Report to Nuclear Oversight Committee**

## **4<sup>th</sup> Quarter 2014**

### **Darlington Nuclear Refurbishment Project**

# **ONTARIO POWER GENERATION**

Burns & McDonnell  
Modus Strategic Solutions

November 13, 2014



**Report to Nuclear Oversight Committee – 4Q 2014  
Darlington Nuclear Refurbishment Project**



**I. Executive Summary**

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMCD/Modus") provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of October 30, 2014. Attached to this Report is the updated quarterly summary of the Project Risks with annotations regarding the Darlington Refurbishment Project Team's ("DR Team") actions with respect to these risks since our August 13, 2014 Report ("Attachment A"). The following is a brief summary of the DR Project's most significant developments over the last quarter.

**A. 4d Cost Estimate and RQE Preparation**

The DR Team is presenting to NOC its 4d Cost Estimate, an important step in the progression to next October's Release Quality Estimate ("RQE"). RQE will form the Project's control budget, or baseline of cost. Based on the results of the 4d Cost Estimate, Management remains committed to not exceeding the \$10B (\$2013) cost for the DR Project. Our team observed the DR Team's process for developing the 4d Cost Estimate and found it to be reasonably robust and followed frequently-seen practices as related to an AACE Class 3-5 estimate. This is in line with what we would expect to support progress to a reliable RQE.

**B. Campus Plan Performance Update**

The Campus Plan Projects remain a concern. Based on current projections (excluding the D2O Storage Facility and certain of the Facilities & Infrastructure projects ("F&IP") that have not started and will likely be cancelled) F&IP costs have increased by 20% since the cost estimate in the 2014 Business Plan ("Release 4c"). This growth is largely due to the maturation of scope; though these projects continue to be compared to and impacted by poor quality initial cost estimates and some of Project & Modification's ("P&M") legacy processes. P&M's leadership acknowledges these trends and is developing a plan to improve management of these projects and stabilize costs. The following is an update to certain key events discussed in our prior Reports.

- **D2O Storage Facility**

On October 16, 2014, OPG terminated Black & McDonald's purchase order for the D2O Storage Facility. In our last

Facility. Based on these events, the DR Team has intensified its efforts in its preparation of a mitigation plan to ensure that there is no impact to breaker open while pursuing options for completing the D2O Storage Facility with another vendor. OPG is preparing a revised business case in which it will fully evaluate options and its next steps with D2O Storage Facility considering the least cost and most prudent option.

- **Auxiliary Heat Steam Building**

The AHS project has an in-service milestone of March 15, 2015, just prior to the start of the station's Spring 2015 Vacuum Building Outage ("VBO") scheduled to begin April 3, 2015. AHS is currently forecast to be in-service on May 25, 2015, nine weeks later than planned. This schedule is currently being reworked but there is a risk that the project may slip beyond the current late finish date. OPG has put into place a mitigation plan so that these delays are no longer a threat to VBO. Additional costs due to poor initial estimates will remain a risk until P&M has finished its detailed vetting the vendor's latest cost estimate.

- **Contractor Performance**

In our 2Q 2014 NOC Report, we highlighted concerns with Black & McDonald's performance on the Campus Plan Projects, and its termination from the D2O Storage Facility does not alleviate those concerns. Black & McDonald is still

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performing important predecessor work for the Refurbishment Project, including work that must be performed during the VBO. Black & McDonald's performance needs to be closely monitored so that the same issues that impacted its work on D2O Storage Facility are not repeated.

ES Fox has generally performed more predictably than Black & McDonald and has been much more responsive to OPG's requests and concerns. Nonetheless, ES Fox's scheduling and cost estimating practices need to be improved and P&M's project team needs to request more substantiation and transparency from ES Fox related to project estimates, changes in scope and schedule revisions. On October 15, 2014, OPG met with ES Fox's team and secured its commitment to provide more detailed estimates and schedules, starting with the AHS. Once received, this additional detail will help P&M improve its performance metrics, gate packages, and cost projections. In addition, aggressive action by P&M in seeking this critical information from the ESMSA contractors will improve contractor monitoring.

- **P&M Management**

P&M management is aware of the performance issues we have raised in past Reports and has plans for strengthening the organization, demanding increased rigor from its project teams and sharing processes and resources with Refurbishment. P&M now holds bi-weekly meetings with both of the ESMSA contractors that have key stakeholder involvement and are a good forum for providing visibility to issues, solving problems and improving alignment. Furthermore, OPG's active management of the engineering process is yielding some positive results.

However, P&M's controls currently in place to review and approve changes in scope have proven to be insufficient for forecasting overruns and are not aligned with the DR Project's processes. P&M's senior management is increasing its focus on the project controls program by evaluating and reworking its processes, though it will need to move more quickly in order to have an impact on the on-going work. We recommend all of the project managers be more diligent in establishing and reviewing trends and identifying the causes of adverse trends so that they can be reversed or mitigated. To this end, the DR Team should obtain and vet detailed information (cost and schedule estimates) from the performing contractors and then as the design progresses, closely monitor any scope changes (and their impacts to cost and schedule) to allow for more accurate forecasting during execution.

### **C. Retube & Feeder Replacement Project**

Generally, the Retube & Feeder Replacement ("RFR") Project is progressing well, with a positive working relationship between OPG and SNC/Aecon. SNC/Aecon has performed according to its Recovery Plan and recovered some of the delays to tooling, and mitigated any downstream impacts. The recovery of SNC/Aecon's tool performance provides a good example of the DR Team's identification of an issue through reliable performance metrics and subsequent mitigation of the risk utilizing active contractor management.

The RFR Project's current major work streams include: (1) completion of the tooling for the mock-up; (2) completion of engineering; (3) tool performance guarantee testing in the mock-up; and (4) development of the Class 2 Estimate for the RFR work. Each of these phases is running on or slightly behind schedule at this time.

Our main concerns with respect to ongoing RFR Definition Phase work are: (1) the Class 2 Estimate does not currently contemplate including an assessment of logistics (such as material staging and tool transitions) supporting the removal and refurbishment of the reactor's internal components; (2) further delays to the design and construction of the Retube Waste Processing Building ("RWPB") could pose cost and schedule risk that could divert management attention from the main project work.

As part of the Class 2 Estimate, SNC/Aecon needs to provide an appropriate basis of estimate for its tool transitions, material staging and logistics, and other support activities. Because a significant amount of both the critical path and total hours of work on the RFR project relies heavily on the coordination of activities, not engineering product, it does not fit cleanly into the AACE Class 2 recommendations. The OPG team has proposed that this portion of the estimate should be supplemented through full mock-up simulations and other analytics, which are not currently in SNC/Aecon's plans. OPG and SNC/Aecon are currently working together to see how this logistical work can be incorporated into the



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schedule. If OPG and SNC/Aecon can reach an agreement, it will reduce uncertainty in the Class 2 Estimate and will ultimately provide confidence that the Target Price is both reasonable and achievable.

Delays to the RWPB's definition are compressing the schedule and causing concerns at this time. However, DR Team has appropriately evaluated its options for the RWPB. The recent Options Review Board meeting set two conditions for the decision on the size of this building that have now been satisfied. This decision clears the way for the design to be finalized without further slippage to the completion date. The RFR project team is continuing to work with SNC/Aecon to improve its schedule. To that end, SNC/Aecon is designing the foundations, and will continue with their construction in parallel with the building design.

**D. Other Major Projects**

Planning and engineering work for the remaining scopes of work continues to progress. The design phase for the Turbine Generator is ongoing. OPG made the decision to maintain the existing Unit 2 controls without modification which will further simplify that work. Balance of Plant ("BOP") and Shut Down/Lay-up work is lagging, in part due to the late award of this work that was further complicated by the issues with Black & McDonald. The DR Team has put in place recovery plans for these projects in order to mitigate delays and the work is being awarded, defined and advanced to this plan. Defueling, Fuel Handling and Specialized Projects appear to be on pace at this time.

**E. Engineering**

Over the last quarter, we have examined the status of OPG's engineering in light of the initiatives the DR Team launched earlier this year. We looked at the impact of the DR Team's decision to actively manage the work, increasing front end planning and collaboration with the vendors. In general, we have observed improvements in the engineering process and vendor commitment, though this is largely anecdotal information. As we will discuss, better engineering performance metrics will allow objective confirmation of these observations.

Engineering's PIMS milestone completion date for all detailed engineering is in August, 2015, though the team is working to a May 15, 2015 target date, often referred to as the "stretch goal" ("May 15<sup>th</sup> Milestone"). While the August date is adequate for purposes of having all detailed engineering completed prior to the Execution Phase, this milestone is not optimal for supporting estimate development for RQE. Thus, the DR Team is currently working to be approximately 90% complete with detailed engineering by May 15, 2015, with the remainder of detailed engineering to be complete by August 2015. Assuming the work planning and assessing can proceed as planned, the majority of the major project work will have advanced to support the development of Class 2/3 cost estimates for RQE. The DR Team will need to carry larger bandwidth of contingency for any project estimate that cannot be categorized at Class 2/3 levels.

Currently, the DR Project reports that it is 69% complete with design engineering, which is approximately 5% behind plan. The major scopes of work which comprise approximately 65% of the DR Project—RFR and Turbine Generator—appear to be on pace or slightly behind the May 15<sup>th</sup> Milestone. The work that is behind appears to be confined to the BOP, Shut Down/Lay-up and Refurbishment Additional Facilities, the latter of which includes a number of projects that will be cancelled or deferred, as well as some of the remaining Campus Plan Projects. Thus, the engineering work that risks missing the stretch goal represents approximately 7-8% of the total direct cost value of the DR Project.

OPG continues to develop an integrated, Level 3 resource loaded schedule for engineering, and this is needed to provide clarity to the current plan. OPG's current summary metrics show a very steep rate of detailed design package completion to meet a May 15<sup>th</sup> Milestone, meaning that a large number of engineering packages will be completed and submitted to OPG at the same time. These metrics need to be further substantiated. We believe that OPG should supply sufficient evidence that this plan is reasonable and achievable including how OPG will perform it is necessary design reviews within a compressed timeframe, and provide assurance that the engineering providers have sufficient resource capacity to complete the work. Further, the DR Team would benefit from giving visibility to those engineering packages that are most likely to miss the May 15<sup>th</sup> Milestone, and what impact, if any, there would be to RQE. This was an effective strategy the DR Team employed to meet its goals for the recently concluded Health of Scope campaign.

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**F. Project Management and Controls**

The DR Team's Outage Management and Execution organizations have each developed detailed staffing and plans for actively managing their respective portions of the work. We see this as a major step in the DR Team's acceptance of its role and obligations for the Execution Phase.

All DR Team bundle and functional schedules are integrated in the Level 3 master schedule database at both Level 2 and Level 3. Over the last several months, we have witnessed a marked improvement in the Execution Phase schedule's development. All DR Team bundle and functional schedules are integrated in the Level 3 master schedule database at both Level 2 and Level 3. While these schedules are expected to mature further, the master scheduling plan establishes the right set of priorities and requirements that OPG will need for active management of the contractors.

In our past Reports, we have highlighted some concerns with the Project's Earned Value Management System. During the past quarter, we have performed a detailed assessment of the Cost Management and Earned Value Management Systems. The DR Team's metrics are still maturing and the goal is to have meaningful and industry-standard earned value metrics that provide a complete picture of contractor and Project performance. The DR Team has recognized certain gaps in its processes and is currently working on an improvement plan.

**G. Corporate Support**

In our last Report, we identified certain communication, performance and process issues with Human Resources, Supply Chain and Information Technologies that were impacting or had the potential to impact the DR Team from outside the Project. In particular, the Supply Chain issues related to communication and accountability to the Project are the most immediate concerns to the DR Project. Leadership of Supply Chain has been responsive and has shown a willingness to help the DR Project. Supply Chain and the DR Team have participated in face-to-face alignment meetings which have had an immediate impact on the working relationships. While this will require a continued effort, we are encouraged by efforts made so far.

**II. Assurance Reporting**

In addition to our on-going independent oversight efforts, we have been tasked with providing detailed observations and recommendations on various high-risk areas of the Project as a part of OPG's "Assurance Plan" in conjunction with Internal Audit and Nuclear Oversight. Over the past year, we have issued six Assurance Reports covering the following areas:

- Risk Management Practices and Procedures
- Scope Definition Management and Process
- Release 4c Process
- Schedule Management Program
- Campus Plan
- OPEX Program

BMcD/Modus has been working closely with the DR Team with respect of implementation of acceptable management responses to the observations and recommendations found in these Reports. Attachment A is a summary of all of the Reports completed to date. This summary will be submitted to the Audit & Finance Committee as a part of Internal Audit's composite report of the Assurance Plan for the DR Project. Over the next year, we plan to update our earlier findings as well as evaluate and provide assessments in the following areas:

- Release 4d Process/Gaps for RQE
- Cost Management System
- Commissioning Plan
- Change Management Processes
- RQE Development and Process





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We also meet almost daily with members of senior management, Engineering and the project teams for RFR and BOP to monitor Project cost and schedule status, engineering progress and project planning for these high-risk activities. Additionally, we continue to meet monthly with the Refurbishment Project Executive Team (“RPET”) and weekly with the DR Team’s Management Systems Oversight group to discuss the recommendations we have made in these Reports to NOC in order to engage in discussions of appropriate OPG management actions. The DR Team continues to provide its cooperation and transparency to our oversight efforts.

### **III. Campus Plan Update**

#### **A. Overview**

The Campus Plan Projects continue to have schedule and cost risk (particularly D2O Storage). Scope definition of smaller Campus projects may continue to reduce management reserve and contingency. Over the last year, the Campus Plan Projects, excluding D2O Storage Facility, have incurred approximately 20% cost growth overall. While these projects are generally smaller in size and, in aggregate, represent ~5% of the program cost, their success remains important to Refurbishment. In addition to D2O Storage and AHS, some Campus Plan Projects that have received partial funding are showing signs of scope creep and schedule issues; OPG is actively monitoring and mitigating these issues to the extent possible and has increased the effectiveness of its regular meetings with the ESMSA contractors and associated metrics that are intended to root out problems before they increase in severity.

The D2O Storage Facility remains the principal focus for P&M due to its size, growth, lack of predictability and importance to Refurbishment. OPG is currently estimating the cost of the D2O Storage Facility to be \$373M, an increase of \$263M from the full funding release request in May, 2013. The on-going performance issues with the principal contractor, Black & McDonald have diverted management attention from the other projects. While the work needed to replace Black & McDonald and mitigate the impacts will require an intense effort by P&M, the change in course for D2O Storage Facility should have an overall positive impact on P&M and the F&IP work.

#### **B. Major Campus Plan Projects**

##### **1. D2O Storage Facility**

On October 16, 2015, OPG terminated Black & McDonald that its purchase order for the D2O Storage Facility. This termination was limited to D2O Storage Facility; Black & McDonald is expected to continue with its remaining purchase orders for both P&M and Refurbishment, though OPG had previously announced its intentions to restrict or reassign much of that work to other ESMSA contractors. Under the provisions of the ESMSA, OPG has also provided a written notice to Ellis Don that OPG will be assuming direct control of its subcontract to continue work in the field on the D2O project. For the time being, the work will proceed on site according to the current schedule while the DR Team considers the next step.

In light of the termination, OPG will need to reassign or rebid the work to another contractor while it develops a mitigation plan capable of draining the water from Unit 2 with minimal impact to Refurbishment. OPG will need to devote significant attention to vetting the new plan so that it is developed with sufficient quality to meet the needs of Refurbishment. The DR Team has assigned a team consisting of appropriate Engineering and Operations & Maintenance personnel to develop options for an alternative approach that will allow the DR Project to meet the breaker-open date for Unit 2 in the event that D2O Storage is not complete. Such a solution should be properly planned and made ready for execution with a mature a Class 2 level cost and schedule on the assumption that it could, at some point, be the only alternative for storing water from Unit 2.

OPG is currently considering its available options and is developing a revised business case for proceeding. We recommend that OPG consider the following options in its business case:

- *Reassign the D2O work to one of the other ESMSA contractors (assuming there is another ESMSA in place with capacity to handle the work) through either direct award or a secondary compete process. The new ESMSA*





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contractor would have to quickly mobilize, take possession of all purchased materials, plan and schedule the work, subcontract off-site prefabrication and other work, and perform on an accelerated basis in an attempt to complete the building prior to Unit 2's breaker open (or as soon as possible thereafter). The alternative approach will be used only as a mitigation strategy so as not to delay breaker open; or

- *Issue an RFP to qualified contractors that assumes an aggressive schedule in order to complete the work as quickly as possible.* Again, this option would require quick mobilization and acceleration costs. Bid evaluation will be based upon rate sheets, overhead, supervision costs, fees and potentially the best construction plan, but the bid period will be short so that a full schedule and estimate of the work cannot be developed and evaluated as a part of the bid. This plan would allow negotiation of a project-specific contract that would incorporate appropriate milestones for developing cost and schedule as well as incentives and disincentives for contractor performance.
- *Issue an RFP to qualified contractors assuming that the completion milestone will be extended for a reasonable amount of time allowing for a true "competitive bid" process based upon completed engineering.* In this scenario, OPG would implement the mitigation plan to drain the water and complete engineering and some of the current excavation work. Once engineering is complete, the project can then be re-bid on a competitive basis, seeking both a realistic schedule and pricing for the Project. This would also give OPG time to re-examine the needs for the D2O Storage Facility and decide whether the design properly addresses that need, and whether the cost is justified based upon a sound business case. This scenario may also allow OPG to achieve some of the value engineering solutions for reducing the D2O Storage Facility scope in a less compressed time frame.

While the design work is largely complete, the first and second options will require quick action for another contractor to assume the work, develop a cost estimate and schedule and re-plan the work effort to minimize lost time. Such a plan will likely include added costs for acceleration, and even with those added costs, the new contractor may not be able to complete in time to support breaker open. Moreover, whichever contractor takes on the work is likely to include a premium in its price due to these circumstances. The third scenario could provide OPG the opportunity to establish the true cost of the project (whether or not the design changes) in a competitive bid environment, and to show that the cost increases are reasonable and based upon increased scope. It may also enable OPG to seek a different commercial arrangement for its construction. The third option would have the disadvantage of OPG having to incur added carrying costs, which could actually make this option cost prohibitive, but it should be evaluated as a part of the business case.

Under any scenario, completing the D2O Storage Facility to support the start of the Unit 2 Refurbishment has a considerable amount of risk and the option OPG chooses to procure the completion of the building needs to fully account for those risks. Thus, having the alternative solution for draining the water from Unit 2 should be assumed for any modeled scenario, and we would recommend management establish a well-defined decision point appropriately in advance that specifies the direction the team will take if ongoing construction work on D2O Storage Facility cannot meet the needs of Unit 2's schedule. That plan needs to consider long lead items, approvals needed from external stakeholders and impact on operations, at a minimum OPG is reviewing its options at this time, and is preparing a revised business case that should consider these and any other reasonable scenarios for the Board of Directors' review.

## 2. Auxiliary Heat

The Auxiliary Heat System ("AHS") originally was scheduled to be in service prior to the start of the VBO. The current schedule for commissioning the new Auxiliary Boilers shows an in service date of May 25, 2015, nine weeks beyond the original target. P&M management has pivoted its focus on the likelihood that the new AHS will not be available for the start of VBO. The existing boilers will remain in place until the new AHS is available for service, which will meet OPG's needs for VBO. The remaining issues are with the AHS's cost and schedule predictability. As noted, ES Fox has also agreed to deliver to OPG its full estimate for AHS and is working with OPG to further refine its schedule. ES Fox is already working two shifts on the critical AHS work in an attempt to recover as much time as possible. The P&M team is evaluating ways to shorten commissioning and start-up and staging release dates for the equipment.



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### **3. Containment Filter Venting System**

In our last report, we identified that CFVS was one of the P&M projects that needed additional attention, as the cost of the project was projected to increase by as much as 35%. There has been an increase in scope, and thus its corresponding cost, however, the contractor's cost estimates lack rigor and P&M's has accepted large cost increases without sufficient justification or explanation.

When the project team proceeded to the Gate Review Board ("GRB") for its partial execution funding to perform some preparatory work before the onset of winter, the estimate for the work presented had not progressed beyond Class 4. This was despite the fact that the design was sufficiently mature to support the development of a much more detailed estimate at that time. Although the GRB rejected the request for being insufficiently supported, the estimate presented by the project team identified a project management weakness that P&M needs to address. As of this September GRB meeting, ES Fox had not provided a quantity breakout of its current cost estimate, and had submitted requests for change orders that were not vetted by the project team; nonetheless, the amount of these changes were included in the estimate at completion ("EAC").

Under the ESMSA contract, the Contractor's actual costs are open book and are subject to audit by OPG upon request. Moreover, the Contractor is obligated to follow OPG's scheduling standards and provide an integrated schedule, and report progress and status on weekly basis. It is essential that OPG enforce these contract requirements; otherwise, it is difficult to evaluate whether changes in scope are necessary and properly estimated. The project team's representation of an EAC that had significantly increased without proper vetting highlighted the need for the P&M project managers to have a better ongoing understanding of the cost impact from design changes, and for the contractors to provide more detailed and timely information to support cost increases. P&M's management is developing a plan to address these deficiencies.

### **4. Vendor Performance Issues**

Black & McDonald is still performing work other than the D2O Storage Facility that is important to Refurbishment. As a result, OPG will have to closely monitor this work to ensure that Black & McDonald is meeting expectations for safety quality and performance.

ES Fox's performance has thus far been more predictable and its team has been very responsive to addressing any issues raised by OPG. However, the scope creep and cost increases evident in some of its work indicate that P&M needs to be vigilant in managing ES Fox's work. Any lessons from Campus Plan Projects should also be understood by the Refurbishment BOP team, which is using ES Fox for multiple scopes of work. Thus, the need for P&M and Refurbishment BOP project managers to vet ES Fox's estimating methodology, including how ES Fox is using factors for productivity, estimating project management team size and engineering costs, among other things.

#### **C. Schedule and Cost Development**

P&M's efforts to develop and update the project schedules for the Campus Plan Projects has had mixed results. The team met an initial goal to have detailed schedules loaded into the OPG network, though many of those schedules were found to have quality issues. As a result, the schedule performance index ("SPI") for these projects may not be reflecting the project's actual progress. The DR Team is intensifying efforts to increase the accuracy of these schedules by performing back pass reviews which have established needed milestone dates for these projects and by holding focused reviews to correct logic and duration issues. However, the contractors' schedules still need improvements in critical path definition, logic and resourcing.

The following chart illustrates the current status of the P&M schedule development for the major F&I projects currently underway. We have distinguished those projects currently in the Execution Phase from those still being planned, as those projects need an executable schedule in place immediately.



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F&I Project Description	EPC Contractor	Schedule Development			Phase of Work/Comments / Schedule Confidence Level
		In OPG Schedule Network	Schedule Developed	Schedule Perf. Index (SPI)	
OSB Refurbishment	Black & McDonald	Yes	Yes	0.87	In the execution phase. Schedule appears adequate for project completion
D20 Handling & Storage Facility	TBD	Yes	No	0.55	In the execution phase. Schedule will have to be reworked by new contractor.
Auxiliary Heating Steam	ES Fox	Yes	No	0.98	In the execution phase. Low schedule confidence. Schedule in rework to address logic issues.
SIO - Emergency Power Generator 3	ES Fox	Yes	No	0.99	In the planning phase; execution schedule to incorporate recovery plan.
SIO - Containment Filtered Venting System	ES Fox	Yes	No	0.59	In the planning phase. Schedule for execution being reworked.
SIO - Powerhouse Steam Venting	Black & McDonald	Yes	Yes	0.89	In the planning phase. Schedule is currently under development for project execution.
Shield Tank Overpressure Protection	Black & McDonald	Yes	Yes	0.79	In the planning phase. Schedule appears adequate for project execution.
Water and Sewer	Black & McDonald	Yes	Yes	0.91	In the execution phase. Project is nearing completion.
RFR Island Support Annex (RFRISA)	ES Fox	Yes	Yes	0.78	In the execution phase. Schedule appears adequate for project execution.
Refurbishment Project Office	ES Fox	Yes	Yes	0.79	In the execution phase. Schedule appears adequate for project execution.
Electrical Power Distribution	Black & McDonald	Yes	Yes	0.73	In the execution phase. Schedule appears adequate for project execution.

The above SPI's for these projects reflect both the status of the projects and a number of deficiencies in the schedules themselves. In order to better understand the true performance trends, the following schedule issues need to be sorted out:



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- Because P&M's rules for change management only allow the schedule for a project to reflect approved scope, the budgeted hours used for calculation of SPI appear to be skewing the indices. There should be place holders for known scope that approximate the effort associated with unapproved changes.
- These schedules were built utilizing principles commonly associated with outage or plant modification schedules, with each project's Engineering Change ("EC") packages having independent logic, rather than a typical construction schedule where work is depicted and logically tied by discipline. Scheduling by EC package does not allow for efficient management of contractor resources or prioritization of work—which is important when managing multiple projects, as some carry greater risk.
- As projects pass through gates, P&M allows the work to be fully rebaselined such that prior delays are no longer apparent. As a result, this and the quality of the current vendor supplied Level 3-detailed schedules continue to make efforts to establish meaningful earned value and schedule adherence metrics problematic.

As noted, P&M's project team also needs to increase its vigilance and perform more analysis of performance (schedule and cost) trends. P&M has recently increased its efforts to understand and adequately vet the projects' cost estimates. P&M has met with ES Fox to determine its methodology for developing cost estimates and specifically to obtain a copy of its detailed estimate for AHS to use as a template for all of the other projects. ES Fox was responsive to OPG's goals and has committed to providing its estimate and its cooperation. This is a good initial step though there is substantial work to be done, because the accuracy of earned value indices suffers without reliable cost estimates and planned values.

As noted, the Project Controls Team has been asked to review and standardize the approach P&M is using to conform to that of Refurbishment. However, because P&M is in the execution phase of its work, it needs an earned value system that is seamless to implement, will not cause interruption to ongoing work effort and is useable in the shortest possible time. The DR Team currently has devoted resources to improve P&M's earned value system. We have provided recommendations directly to the P&M and Project Controls teams regarding the method and structure of earned value for these projects. The temptation to over-complicate the implementation of earned value for these smaller, in-flight projects should be resisted. Once the base elements for earned value are defined and reported, the calculation of the performance metrics can be done very simply to allow for proper contractor management and tracking. In order for the earned value system to be useful for the P&M Refurbishment Prerequisite and Campus Plan Projects, it must be developed within the next quarter. We will continue to monitor and vet these activities.

#### **IV. Major Refurbishment Projects – Summary of Key Risks**

##### **A. Retube & Feeder Replacement**

###### **1. Tooling Fabrication**

In our prior Reports, we raised a risk regarding the potential for late tooling delivery to impact the quality or timing of the Class 2 Estimate. Much of our concerns have been alleviated over the last quarter as SNC/Aecon's tooling recovery plan achieved its target of returning to an SPI of 1.0 in September. Those few late tools did cause the SNC/Aecon to miss the Prototype Complete milestone on September 30<sup>th</sup> and are pushing the December 31<sup>st</sup> Qualification Complete milestone, though the impact of these missed milestones is minimal. Further, the project should benefit from a more rigorous qualification process that will result in a much more durable toolset during execution.

In addition to the above, as the tooling schedule has recovered and the delivery dates have approached, the predictability and adherence to the schedule from the tooling vendors has also improved. This has allowed SNC/Aecon to revise its schedule for tool performance guarantee testing, which will commence in earnest in November 2014 and run through March 2015, supporting the input to the Class 2 Estimate. A significant first step in preparations for tool performance guarantee testing was achieved in the first week of October with the delivery and installation of RTP-1 at the DEC mock-up facility. The focus will now be to drive the final few tools to qualification completion and delivery to the DEC to maintain the tool performance guarantee testing schedule.



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## 2. Engineering and Procurement Status

As of the end of September, detailed engineering was 53% complete and showing an approximate one and a half month delay to the contract completion date of June 15, 2015. This delay is largely being driven by a delay in procurement of three subcontractor packages, with the vault crane upgrades being the most severe. SNC/Aecon is expediting the procurements and is working with the vendors to optimize the schedules in order to attempt to mitigate the delay. We will continue to monitor engineering progress throughout the winter months to gauge any impact late engineering could have on the Class 2 Estimate deliverables.

## 3. Class 2 Estimate

The Class 2 Estimate is progressing slowly at this point, although SNC/Aecon has indicated that it expects to meet the June 2015 completion date. The engineering is compressing the available time for completion of the Stage 3 construction work packages and the associated assessment of that work; however, SNC/Aecon will have completed enough engineering to support the AACE Class 2 Estimate guidelines. Similarly, the tool performance guarantee testing is progressing and, as discussed above, does not pose a risk to the Class 2 Estimate. The largest risk remaining to the completion of a quality Class 2 Estimate at this time is the completion of "validation" work for non-tool performance guarantee tasks. Validation work includes running rehearsals, story boards, and modeling of tool transitions, material staging, and other logistics both in the mock-up and/or in computer simulations. This work does not cleanly fit the AACE guidelines because it relies more on logistics activities and laydown space, which is not an engineering product. This work represents a significant amount of both the critical path and total hours of work on the RFR project and without a solid basis for the estimate of this effort; the Class 2 Estimate could be weakened. At this time, discussions with SNC/Aecon are ongoing to determine the work that will be validated in the mock-up over the coming months. If OPG and SNC/Aecon can reach an agreement, it will reduce uncertainty in the Class 2 Estimate and will provide confidence that the Target Price is both reasonable and achievable.

## 4. RWPB Building

The design, construction, and commissioning of the Retube Waste Processing Building ("RWPB") is a concern at this time and is being addressed by OPG and SNC/Aecon. The RWPB will house the tools that reduce the volume of the reactor components after they are removed from the vault. To this point, the RWPB has been delayed awaiting decisions on the final sizing of the waste tooling equipment and the determination of necessary staging and buffer areas around that equipment. In July 2014, SNC/Aecon submitted a revised proposal for the RWPB which has been under evaluation by the RFR project team. In early October, aspects of the proposal was presented to the Options Review Board which gave a conditional approval to move forward with foundation design and construction, as well as resizing and extending the RWPB, pending final evaluation of two alternatives, which have been subsequently closed off as too costly.

Concurrent with OPG's review of the proposal, SNC/Aecon revised its schedule for the RWPB and incorporated it into the master schedule. The result shows a very tight schedule to breaker open, with commissioning of the building to be completed in late January of 2017. OPG is working with SNC/Aecon to rationalize this schedule and improve the completion dates.

The RFR team believes it is important to enclose the building by fall/winter of 2015 so that the waste tools can be delivered, installed, and commissioned prior to breaker open in the fall of 2016. To support this schedule, SNC/Aecon is moving forward with caisson design and construction in parallel with the building design to mitigate the delays in the engineering of the resized and extended RWPB. To ensure the foundations can support the developing design, SNC/Aecon will have additional design margin to support the size of the building and any potential code changes, which is a common practice in the industry at large. In addition, lessons learned from the D20 building are being incorporated into the foundation design to prevent a repeat of the issues that have been encountered on that project. The progression of caisson design and construction, as well as the building design, will be monitored closely over the coming quarters to gauge the impact of any further delays.





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**B. Balance of Plant and Shutdown/Lay-Up**

The Balance of Plant ("BOP") and Shut Down/Lay-up bundles have been impacted by the reassignment of work from Black & McDonald to ES Fox and by a need for better comparative cost estimates of work scopes. The BOP and Shut Down/Lay-up teams have increased the active management and collaboration with the contractors and the owner's estimator, Faithful + Gould. In addition, the scope of the work continues to narrow based on favorable results from in-plant inspections and further re-examination of the work through the Options Review Board and gate reviews. BOP has identified \$14M that has moved from base scope to contingent scope based on future inspections of plant conditions, and has another \$30M in work that it has similarly targeted. In addition, the recent 4d Cost Estimate work each team performed was very detailed and gives senior management the opportunity to fully examine this work.

Over the next two quarters, BOP and Shut Down/Lay-up will need to mature rapidly to make up for the initial delays in awarding the work. Both BOP and Shut Down/Lay-up have developed recovery plans and are now working toward those plans. The DR Team has now awarded all purchase orders for Shut-Down/Lay-Up and expects to have all of the purchase orders for BOP (except for the Adjusters) in place by the end of November 2014 at which time OPG will have detailed schedules. The estimating process is also being addressed based on lessons learned. Detailed design of many of the Balance of Plant and Shut Down/Lay-up work packages are behind schedule, but the main risk of these delays is limited to increasing the contingency for this work for RQE. Ensuring that the Shut Down/Lay-up work matures quickly is a higher priority right now than BOP as much of this work needs to be well-planned prior to breaker open. The DR Team is also examining the appropriate schedule windows for this work so that staffing plans can be further rationalized and schedule float maximized.

**V. Functional Groups Update**

**A. Engineering**

Over the last two quarters, we have been particularly focused on the DR Team's engineering efforts. In all manner of construction, engineering is typically a leading indicator for the execution phase. Moreover, engineering progress is a major factor in determining the Project's maturity and readiness for RQE.

**1. Progress of Engineering Initiatives**

During the latter part of 2013 BMCD/Modus stressed the importance for OPG to embrace its role as DR Project's integrator and to actively manage the multiple contractors hired to perform the work. We also recommended a greater focus on Front End Planning and suggested a more collaborative approach to working with the different engineering service providers. In early 2014, the DR Team made a shift in its engineering strategy and Engineering launched several initiatives aimed at improving the efficiency and effectiveness of the engineering portion of the program.

In order to assess the impact of these initiatives, our team has monitored the progress of the engineering effort including meeting independently with the engineering service providers to pulse their reaction to the changes OPG has initiated. Our observations confirm that these initiatives have generally improved the communication and work flow between OPG and its engineering vendors. It appears that management and staff have become more engaged, are developing a sense of ownership, and are working to resolve issues with a greater sense of urgency. Evidence that these initiatives are working include:

- OPG Engineering has developed an expediting team that is monitoring the work within the engineering firms on the Campus Plan Projects. This team has been effective at reducing the response time for outstanding inquiries by the vendors, and speeding the process for design reviews. So far, the four projects that have reached design completion have done so in less time as a result of this effort.
- OPG resident engineers have been located in the offices of the engineering service providers, which has eliminated several layers of management and supervision, improved communications and provided a clearer line-of-sight between the OPG Design Authority and the engineers performing the work.



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- Process check points have been implemented so that detail design does not begin until the pre-requisite planning steps have all been satisfied.
- Design Authority decisions are being made on a more informed and timely basis, and the Design Authority is actively engaged in reviewing and answering questions at much earlier stages.
- Senior management has interceded and stopped Operations & Maintenance's untimely COMS reviews that had previously resulted in changes to approved design work at the 60% and 90% complete levels.

The benefits from these initiatives will continue to be realized as the DR and P&M projects advance. Reduced review and comment disposition cycle times, timely approvals, consistent stakeholder alignment to the adopted solutions, more rapid escalation, collaborative issue resolution all serve to enhance the effectiveness and efficiency of the engineering effort. OPEX from the F&I Projects has demonstrated that passive oversight, churn, late design changes, lack of stakeholder alignment, unclear direction, miscommunication and indecision delays the schedule and adds significant cost to the project. The full impact of any cost savings from the engineering initiatives will not be known until the execution phase. The expectation is the upfront planning work will eliminate or minimize late COMS reviews generating design changes and field changes. The DR Team should look for ways to track the overall savings derived from these initiatives.

All of the above have reduced the amount of time and effort required to produce the work product. Further gains in the efficiency of the engineering process and the effectiveness of the design solutions are possible and we encourage OPG and the engineering service providers to take the necessary steps to continue to improve.

## 2. Engineering Progress

Engineering's PIMS milestone completion date for all detailed engineering is in August, 2015, though the DR Team is working to a May 15, 2015 target date, often referred to as the "stretch goal" ("May 15th Milestone"). While the August date is adequate for purposes of having all detailed engineering completed prior to the Execution Phase, this milestone is not optimal for supporting estimate development for RQE. Thus, the DR Team is currently working to be approximately 90% complete with detailed engineering by May 15, 2015, and the remainder of detailed engineering to be complete by August 2015. Assuming the work planning and assessing can proceed as planned, the majority of the major project work will have advanced to support the development of Class 2/3 cost estimates for RQE. The DR Team will need to carry larger bandwidth of contingency for any project estimate that cannot be categorized at Class 2/3 levels.

Currently, the DR Project reports that it is 69% complete with design engineering, which is approximately 5% behind plan. The major scopes of work which comprise approximately 65% of the DR Project—RFR and Turbine Generator—appear to be on pace or slightly behind the May 15th Milestone. The work that is behind appears to be confined to the BOP, Shut Down/Lay-up and Refurbishment Additional Facilities, the latter of which includes a number of projects that will be cancelled or deferred, as well as some of the remaining Campus Plan Projects. Thus, the engineering work that risks missing the stretch goal represents approximately 7-8% of the total direct cost value of the DR Project.

OPG's effort to produce an integrated, Level 3 resource loaded schedule for engineering continues, as the engineering service providers updating their Level 3 work schedules to incorporate awarded work. Some completion dates are currently being constrained by the May 15th Milestone, resulting in a depiction of the EC Completion that appears to be unachievable and unrealistic. We recommend that OPG verify that the engineering suppliers are prioritizing their work for the May and August milestone dates so that the higher value and achievable engineering work is prioritized completed in time for providing the basis to RQE.

The DR Team is also planning to develop a post-RQE check estimate prior to breaker open in 2016 at which time the remaining scopes of work can be refined and the Project's control budget adjusted as needed. At that time, the remaining design packages that are completed after August 2015 can be trued-up in the RQE control budget.



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### 3. Recommendations

The DR Project's goal to complete all of the Detailed Design work prior to the May 15<sup>th</sup> Milestone is considerably challenged at this time. There are multiple contributing factors:

#### (a) Engineering Metrics and Schedule of Activities Need Improvement

OPG engineering's performance tracking metrics are missing a needed level of granularity and as a result, these metrics can be misconstrued. Current metrics in use by OPG and the contractors have been formulated on the basis of earning rules that track completed deliverables. These metrics are not based on resource loaded work schedules, which make progressive schedule performance (i.e. the status of each deliverable as they are being developed) more difficult to determine. The earning rules also incorporate level of effort activities that can skew the earned value picture. Thus, this metric shows a dramatic "cliff" of completion without the appropriate level of granularity to show that design completion can reasonably be achieved in this manner.

Our concern here is two-fold: (1) the engineering work down curve is not providing enough assurance of the work that leading up to the May 15<sup>th</sup> Milestone can be achieved; and (2) if this work-down curve is accurate, there will be a large bow wave of work at the end that will overstress OPG's engineering resources for its approval cycle.

BMcD/Modus sees the following as essential next steps to refine these metrics: (1) Engineering should include a better depiction of the events leading up to the May 15<sup>th</sup> Milestone and the August completion dates so that steps in the actual work effort are more visible; (2) the metrics Engineering is producing for the major bundles need to be verified against the contractors' plans so that there is confidence in the data; (3) to the extent that any design packages are going past the May 15<sup>th</sup> Milestone, those packages should have visibility so that priorities may be vetted; i.e. any work that carries a potentially high value can be prioritized for purposes of RQE.

We recommend that the DR Team adjust the engineering schedule and the related metrics to reflect more realistic expectations, prioritized by the importance of completing the work to the quality of the RQE, and provide more organized input into the downstream activities of estimating, procurement, construction work package development and on-line wiring.

#### (b) Further Gains in Execution Efficiency

OPG's EC process is intended to provide a systematic risk based approach to plant modifications—the higher the technical risk, the more rigor that is demanded. The EC process has been well established for the Project. It is consistent with sound engineering practice within the nuclear industry in North America. Despite the process being sound, from our interviews with the engineering service providers and observations of the execution of the process, the manner in which the work is performed still contains inefficiencies. OPG has embraced a number of activities to further improve the efficiency and effectiveness of the engineering execution summarized below:

- **Non-Value Added Activities:** To address execution inefficiencies, OPG will undertake a LEAN Value Stream Mapping assessment of the engineering performance of the EC process, performed by a third party experienced in this type of evaluation.
- **Value Engineering:** Value engineering is an important step in engineering design and OPG has formal value engineering requirements for the EC process. There is growing evidence that this work has not been performed to the level of rigor expected by OPG as part of the plant modification detail design. OPG are examining this in greater detail.
- **Options Review Board.** The ORB was initiated to deal with the emergence of less than optimal solutions finding their way into the design process despite the various challenge points built into the EC and Gate review processes. The ORB meetings are still evolving, but they do currently supply provide a forum so that the DR Team can make appropriate engineering decisions.





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**B. Project Controls**

We noted in our 3Q Report that the DR Project's project controls development had not matured as expected by this time in the Project. The following is a current assessment of the state of the DR Project's Master Schedule and Cost System development.

**1. Schedule Mechanics**

OPG's schedule network is currently set up and functional with all DR Team bundle and functional schedules represented in the database at both Level 2 and Level 3. However, not all of the DR Project's contractors are currently working inside the active OPG schedule database. The DR Team has scheduled a summit to finalize a plan that drives contractor participation in OPG's network for early November of 2014. While the schedule development is somewhat behind, OPG has spent a great deal of time and effort developing the Level 3 Schedule Management Plan, that once implemented, will establish the right set of priorities for developing the Execution Phase schedule. We have reviewed the Level 3 Schedule Management Plan to verify that reasonable scheduling concepts have been incorporated.

**2. Schedule Quality Assessment**

Although each project now has produced a detailed Level 3 schedule, Balance of Plant, Shutdown/Layup and some of the facilities that support the DR Project are the least mature due to the issues as discussed in this Report. It is our understanding that the Level 3 schedule for Balance of Plant and Shut Down/Lay-up is in progress and will be completed in November 2014 with the exception of the Adjusters scope.

The DR Team is focused on developing and integrating the schedule details for the prerequisite work that must be completed prior to execution of Unit 2. The project controls leads for each team are currently focused on this key part of the live schedule. This effort needs to be completed as soon as possible to ensure that the execution work can begin on time. OPG is also growing its execution team and incorporating appropriate placeholders in the schedule for undefined work. The schedule organization is now embedded with the Outage Planning organization providing additional assurance that proper integration will occur.

As we have noted, resource loading is vitally important to measuring contractor schedule and cost performance during the Definition and Execution Phases. This is especially true given the target price nature of the majority of the contracts. The DR Team is currently working to resource load the schedules to support the earned value management system.

**3. Cost Management, Earned Value and Performance Measurement**

During the past quarter, we have performed a detailed assessment of the Cost Management and Earned Value Systems. Based on that assessment, we have made the following observations:

- In general, the Project's Cost Management System functions as we would expect for a project of this size. The DR Team's cost data is now standardized across all of the project bundles, and provides a controlled environment to provide reliable cost data.
- One of the concerns with the Cost Management System is that the data input is a manual process that requires a lot of time and effort. Project Controls is developing a process to automate this.
- Because the current work is mostly engineering and procurement, the DR Team is using deliverable counts as the basis of earned value. However, deliverable counts typically depend on completing by milestones. There can be considerable work needed between milestones that can be difficult to see and forecast. For long-range activities, the time between milestones can create "cliffs" in earned value metrics that appear to be unachievable. To the extent possible, we recommend OPG confirm that the current progress to the milestones will result in the milestones completing on time.



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- For Execution Phase work, earning rules should be structured to emphasize installed quantities and work-hours to determine project performance. OPG agrees and has created a draft of its earning rules for each of the procurement and construction phases of the Project. The construction phase earning rules are based on installed quantities and will track work hours.
- The performance metrics and reports that are currently being generated from the Earned Value Management System need more detail to support active management of the contractor by the project managers and functional managers. In particular, these metrics need more focus on performance trends.
- The change control processes need to be improved. This includes improving the baseline estimates against which cost is measured and the utilization of an estimating database and standard estimating templates. Additionally, early recognition of trends through forecasting by certain project management teams is not effective.

OPG has recognized many of these issues and has devoted resources to review and implement solutions for these gaps. In particular, two teams have been developed to look at techniques for tracking and measuring man hours and quantities and to develop more effective and standardization of reports. The DR Team is reviewing its estimating and change control processes in light of these programs.

Additionally, the DR Team is planning to utilize the US Cost estimating database to facilitate the evaluation of quantities and work-hours. This database will bring continuity across the project teams and should provide a baseline for performance measurement and project forecasting. The next task at hand is for the Project Controls Team to increase its ability to accurately forecast the Project's cost and schedule based on better estimates and change control. Time remains for the DR Team to move forward with these project enhancements, though we would encourage the team to establish these as possible, given the importance of establishing a sound reporting regime.

# Attachment A – 4Q 2014 Risk Perspective

Area	Risk	High	Medium	Low	Current Status / Mitigation
RFR	<b>SNC/Aecon Performance:</b> Largest Program risk due to importance to the DR Project and OPEX				<ul style="list-style-type: none"> <li>▶ Tooling recovery achieved SPI of 1.0; minimal challenges remain</li> <li>▶ Detailed Engineering behind schedule though impact limited</li> <li>▶ RWPB behind schedule; working to optimize schedule</li> </ul>
	<b>Class 2 Estimate:</b> Progression to RQE requires a robust Class 2 estimate that is thoroughly vetted				<ul style="list-style-type: none"> <li>▶ Class 2 work is just commencing and is currently on-schedule</li> <li>▶ Schedule is very tight and being further compressed by late engineering and TPG testing; OPG engaged in an iterative review process with SNC/Aecon to ensure early reviews and feedback are provided.</li> </ul>
	<b>Schedule Development:</b> Level 5 schedule under development; requires challenge to total duration				<ul style="list-style-type: none"> <li>▶ SNC/Aecon identified schedule tracking plan that needs to be proven; schedule durations to be challenged as part of Class 2 review.</li> <li>▶ Integration of support activities and logistics in schedule remains a risk</li> </ul>
	<b>RWPB Delays:</b> Potential risk to RFR schedule; RWPB and waste tools required for start of removal work				<ul style="list-style-type: none"> <li>▶ RWPB extension conditionally approved by OPG; allows foundation design/construction to move forward, concurrent with building design</li> <li>▶ Current schedule shows commissioning of RWPB occurring parallel with defuel, reactor drain, etc. with little room for error or delays</li> <li>▶ Lessons learned from Campus Plan work are being integrated</li> </ul>
	<b>RFR Commercial Risks:</b> Contract provisions currently in place may not drive desired contractor performance				<ul style="list-style-type: none"> <li>▶ The RFR Team has approached SNC/Aecon regarding the need to potentially renegotiate incentives and disincentives</li> <li>▶ Need to understand potential changes for Class 2 Cost Estimate accuracy</li> </ul>
Campus Plan	<b>ESMSA Performance:</b> D20 Storage and AHS work is behind schedule and over budget				<ul style="list-style-type: none"> <li>▶ D20 is a threat to Unit 2 breaker open; alternatives being evaluated</li> <li>▶ Black &amp; McDonald terminated from project, options under consideration for completing the project; civil contracts assumed by OPG and field work continues.</li> </ul>
	<b>P&amp;M Engineering &amp; Project Management:</b> Process improvements are required in areas of vendor management, project controls, change management, and estimating				<ul style="list-style-type: none"> <li>▶ Engineering co-location and active management beginning to yield results</li> <li>▶ Bi-weekly ESMSA meetings providing visibility to issues</li> <li>▶ More detailed vetting of vendor estimates and schedules required</li> <li>▶ Some improvement in active PM oversight of scope, cost, schedule, and risk, but more is needed to control project baselines</li> <li>▶ Need to improve project controls metrics</li> <li>▶ More rigorous change management process required</li> </ul>
BOP	<b>ESMSA Performance:</b> Concern over ESMSA contractors' performance and execution ability				<ul style="list-style-type: none"> <li>▶ Allocation of work underway; some issues with cost/scope estimates</li> <li>▶ Risk of ESMSA Performance will continue until improvements on performance issues in Campus Plan are observed</li> <li>▶ Detailed engineering milestone at risk due to late assignment of work</li> </ul>

# Attachment A – 4Q 2014 Risk Perspective

Area	Risk	High	Medium	Low	Current Status / Mitigation
Engineering	<b>Engineered Solutions:</b> Options Review Board has increased scrutiny of design decisions				<ul style="list-style-type: none"> <li>Conservative design decisions are driving up cost</li> <li>Options Review Board has been effective in challenging scope decisions</li> <li>Additional scope decisions may be necessary due to cost velocity measured in 4d Cost Estimate</li> </ul>
	<b>Planning of Engineering Work:</b> Engineering work was initially not well understood requiring focus on re-planning				<ul style="list-style-type: none"> <li>OPG engineering is taking more active role in directing and managing the work at the engineering studios</li> <li>"Bottoms-up" estimating process initiated for engineering activities</li> <li>Increased focus placed on engineering planning for the design phase; new progress tracking mechanisms in place</li> </ul>
	<b>Engineering Metrics:</b> Current metrics lack granularity				<ul style="list-style-type: none"> <li>OPG needs assurance that engineering can be substantially complete by May 15, 2015</li> <li>Metrics need more detail evidencing resources and planning</li> </ul>
	<b>Continued Schedule Development:</b> Schedule approach was unproven; integration at appropriate level at risk				<ul style="list-style-type: none"> <li>Project Team adopting industry-wide recommended scheduling practices</li> <li>Substantial work remains to populate detailed level 3 schedule; placeholders schedules incorporated; resource loading started but progressing slowly</li> <li>Logic and critical path definition remains an issue with Campus Plan projects; some backward passes have begun</li> </ul>
	<b>Progress Towards RQE:</b> With 4d delivered, focus must quickly turn to executing the plan for RQE				<ul style="list-style-type: none"> <li>4d Cost Estimate delivered within \$10B range; bundle team challenges will require considerable effort to achieve savings targets included in 4d</li> <li>RQE development remains essentially on schedule, but will be heavily reliant on the quality and timing of the various inputs</li> <li>The DR Team has assigned a director to manage RQE integration</li> </ul>
Project Controls	<b>Risk Management Program:</b> Risk registers require scrubbing; monitoring tools are cumbersome				<ul style="list-style-type: none"> <li>DR Team is cleaning up the risk register and improving reporting</li> <li>Risk Group is taking a more active role in managing the Risk Program</li> <li>Risk training is being conducted but more is required</li> <li>Campus Plan Projects risk awareness remains an issue</li> </ul>
	<b>Cost &amp; Performance Measurement:</b> Current system effectiveness/efficiency should be reevaluated; project controls metrics need improvement				<ul style="list-style-type: none"> <li>Earned value management techniques need to mature</li> <li>Tools for earned value tracking have limitations that need to be reviewed</li> </ul>



**Supplemental Report to**  
**Nuclear Oversight Committee**  
**Observations Regarding 4d Cost Estimate**  
**4<sup>th</sup> Quarter 2014**  
**Darlington Nuclear Refurbishment Project**

**ONTARIOPOWER**  
**GENERATION**

Burns & McDonnell  
Modus Strategic Solutions

November 13, 2014



Supplemental Report to NOC – 4<sup>th</sup> Q 2014  
Darlington Nuclear Refurbishment Project



I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") provide the following Supplemental Report to the Nuclear Oversight Committee of the OPG Board of Directors ("NOC") regarding the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "Refurbishment Project") 2015 Business Plan and Release 4d Cost Estimate ("4d Cost Estimate" or "4d") as submitted to the NOC. The 4d Cost Estimate is the last in a series of Project estimates included in the planned interim Business Plan releases OPG has prepared as part of its progression to the Project's Release Quality Estimate ("RQE"). OPG will deliver the RQE to the Shareholder in 4<sup>th</sup> quarter of 2015 which it intends to use as the Project's control budget and with underlying cost estimates in general conformance with AACE guidelines<sup>1</sup> for a Class 2 to Class 3 estimate. The content of this Supplemental Report contains information that is commercially sensitive and has been prepared at the direction of counsel.

In this Supplemental Report, we provide our observations related to the process the Darlington Refurbishment Project Team ("DR Team") used for developing the 4d Cost Estimate, including a general characterization of the nature of the estimate, risks and opportunities identified in 4d's development. We also identify gaps and recommendations for strengthening the Project's estimating practices that in our view need to be addressed before RQE, many of which the DR Team has already accepted and are in the process of incorporating into their RQE plan. Throughout the process, the DR Team was fully transparent and very cooperative with our efforts to review the status and trends for Refurbishment's costs. The DR Team included our team in all of its 4d Cost Estimate activities, including all challenge meetings, and provided us with progress reports and all documents necessary. We provided the DR Team with immediate feedback and recommendations as necessary, and our suggestions were well received and many have been taken into account for RQE.

While the DR Team's preparation of the 4d Cost Estimate is an important milestone on the Project's path to RQE, the result should be viewed in the appropriate context. The DR Team prepared the 4d Cost Estimate based upon the current maturity of the Project, with a goal of deriving a cost estimate with a range of variability in line with an AACE Class 3/4 estimate. In the DR Team's view, and we concur, the 4d Cost Estimate should be looked at as the best estimate of cost available at this time; it should not, however, be viewed as having the requisite maturity to form the basis for the Project's control budget with underlying estimates at the Class 2/3 level that the DR Team has committed to provide in next year's RQE. RQE should address all the identified gaps to date including areas for potential cost-saving opportunities with sufficient lead time so as to allow the Project Team to take advantage of those opportunities. In our prior reports to the NOC, we have referred to the 4d Cost Estimate as a "dress rehearsal" for RQE in that it provides the DR Team with an opportunity to measure its progress and identify whether there are significant threats to the overall viability of the Project.

The purpose of this report is not to offer an independent opinion or analysis of the specific monetary values in 4d Cost Estimate. Rather, our focus was on the process the DR Team utilized in deriving the estimate's component parts and whether that process generally conforms with our experience and the industry at large, and identifying gaps that should be addressed so as to improve the confidence of the RQE estimate. BMcD/Modus confirms that 4d Cost Estimate is generally (but not in all cases) as the DR Team describes: an estimate in the range of AACE Class 3 to Class 5. We have some high-level observations from our review, vetting and oversight of the 4d Cost Estimate effort:

- **Estimate Maturity:** Approximately 64% of the project bundle derived cost estimate is currently at the Class 3 level, while other portions are less defined. Estimates for the largest cost components – the RFR and Turbine Generator bundles – are at a Class 3 level or better. Thus, the major building blocks for the estimate have advanced as expected and provide a solid basis for understanding the Project's current level of maturity. Estimate enhancements must advance for smaller Project components, including Balance of Plant, Shutdown/Layup, Defueling and Specialized Projects. Notably, engineering and planning definition of these bundles will need to progress rapidly over the next 6-8 months, as planned, as a condition precedent to providing a high-confidence for those elements of RQE. The precision of the contingency calculation should also be advanced as the base estimate is refined, so the DR Team needs to allow sufficient time for its development for RQE.

<sup>1</sup> See AACE's Recommended Practice No. 17R-97, Cost Estimate Classification System (November 29, 2011) and Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (November 29, 2011)





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- **Commercial Strategy is a Key Driver to RQE:** The 4d Cost Estimate has embedded assumptions regarding the expected outcome of future commercial negotiations that will transpire before RQE, in particular with SNC/Aecon over the final terms of the RFR and Turbine Generator contracts. Management has allocated in excess of \$700M in savings relative to SNC/Aecon's Class 3 estimates from these negotiations and further maturation of the work planning. There is a significant risk that the outcome of those negotiations will fail to yield the level of cost savings the team has assumed, and as such, OPG is carrying contingency for this event. Senior management has already advanced the start of the formative reconciliation of the estimate and management goals with SNC/Aecon, which is an important first step. SNC/Aecon's Class 2 estimates for Turbine Generator and RFR are due to be completed by March 15 and May 15, 2015, respectively, by which time the DR Team's planning assumptions embedded in 4d can be revisited. OPG has established an iterative process to review the development of the estimates between 4d's acceptance and May 15, 2015.
- **Functional Costs Need Further Development and Refinement:** Functional costs represent ~30% of the 4d Program Direct Cost Estimate. As part of the 4c Cost Estimate, senior management issued across-the-board directives to the functional group leads to reduce costs, though for the most part, the team did not take up these challenges until 4d. The overall definition of the functional groups required for the Execution Phase has increased significantly since last year's 4c Cost Estimate, and the associated cost estimates facilitated appropriate levels of challenge. Approximately 75% of the total 4d reductions were the result of challenges from the DR Team and the Refurbishment Project Executive Team ("RPET"). Our concern is that the remainder of these reductions occurred late in the process and have not been fully developed or implemented. However, management issued these challenges based on a detailed set of round table reviews and they reflect realistic planning assumptions, though some of these cuts will require the team to rethink elements of their work. Management is putting review and tracking milestones in place to verify the status of these adjustments to their conclusion. To date, the DR Team has incorporated many of the challenges. Meeting management's 4d challenges is necessary if functional costs are to be reigned-in and this will require a determined effort.
- **Campus Plan Project Risks:** The Campus Plan Projects remain a risk to both the cost of the Project and the schedule for Unit 2's refurbishment. One very likely consequence of the DR Team's recent action to terminate Black & McDonald from the D20 Storage work is that OPG will have to bear certain additional costs to replace the contractor and move work forward. The velocity of cost increases and schedule perturbation for these Projects remains a significant concern, and the DR Team will need to have sufficient contingency plans and funds to ensure this work (particularly D20 Storage) will not adversely impact Refurbishment. Included in Release 4D is an additional program level contingency in the amount of \$73M to offset cost increases beyond the amount within approved estimates for Campus Plan projects.
- **Contingency and Risk Management:** Contingency is a significant component of the 4d estimate, representing ~20% of the total. Therefore, the development of RQE contingency should be given a high priority. The DR Team's approach to risk has evolved such that approximately half of the contingency in the 4d Cost Estimate has been deterministically derived based on monetizing specific risks identified by the DR Team. Further increase of the maturity of contingency must be a major goal for RQE. Doing so will likely require much more time than was allowed for 4d after the base estimate data freeze in order for the contingency to be properly developed. Work also remains to increase precision and reasonableness, and OPG could well benefit from a third party, cold eye assessment of contingency given the nature of the RQE. OPG is aware of this need and is planning accordingly. OPG has already commenced the process to hire a third party to perform a review of its RQE results.
- **4d Cost Estimate Identified Process Improvements for RQE:** The DR Team's process was sufficient to produce 4d and included significant challenge from within, though a high-confidence RQE will require a step-up in the level of vetting, analysis and an increase in the overall maturity of the cost elements. We have made several recommendations to the DR Team for improvements to the RQE process, the most important of which is that the DR Team must have a detailed schedule of all necessary RQE-related activities. Furthermore, the team should



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develop accountability metrics that will provide management with the visibility needed to ensure the components of RQE (including contingency targets for reductions to the 4d Cost Estimate) are being addressed. A detailed schedule will also ensure sufficient time for quality assurance efforts so that any potential errors, double counting and the like can be reduced to minimal levels. We also recommend that the estimates be consolidated in a more standardized format for ease of future analysis, including creation of an estimating database.

Overall, BMcD/Modus found the effort associated with the 4d Cost Estimate to be within reasonable expectations, though the greatest value OPG may have derived from this exercise is the identification of gaps that remain to be closed by the time of RQE. The 4d Cost Estimate effort should provide the DR Team with a robust action plan for RQE. Consistent with our recommendations, OPG's management is treating the transition from the 4d Cost estimate to RQE as a continuous exercise in order to achieve the goal of a high confidence cost and schedule estimate for the Project by this time next year.

## **II. BMcD/Modus Process for Review of 4d Cost Estimate**

As noted in our prior reports to NOC, BMcD/Modus referred to the 4d Cost Estimate effort as a "dress rehearsal" for RQE. OPG needed to increase the rigor in the processes used for developing the 4d estimate so that RQE be a further refinement that process. We viewed the 4d Cost Estimate as a way to evaluate the efficacy of the process the DR Team uses for developing cost estimates, and identify any upward cost pressure that might materially threaten the Project's viability. The advantage of identifying these gaps at 4d is to give the DR Team sufficient time to take the actions needed to lower costs, which in some cases may require the development of alternative strategies or changes to its base plans and assumptions. BMcD/Modus's approach to the 4d Cost Estimate was to evaluate the process the DR Team used for determining the base cost underlying the estimate as well as the method used for quantifying contingency, risks and opportunities.

At a high level, we sought to characterize the DR Team's methodology and effort applied to the 4d Cost Estimate and assess whether the current estimate is reflective of the Project's current level of maturity. In doing so, we examined the following aspects of the 4d Cost Estimate in detail:

- Reviewed the major variances from the 4c Cost Estimate to the 4d Cost Estimate and assessed the rationalization of those variances by the DR Team.
- Identified whether process gaps previously identified in our past reports (and most notably apparent in the 4c Cost Estimate effort) have been addressed by the team.
- Reviewed how the DR Team documented estimating results and key assumptions so that these can be revisited at the time of RQE.
- Reviewed the process for developing contingency including the treatment of cost and schedule uncertainty and discrete risks impact.
- Vetted the DR Team's characterization of the components of the estimate, including:
  - Sampling a reasonable amount of the underlying basis of the estimate; and
  - Reviewing whether costs and associated schedules for work components were developed on a bottoms-up or top-down basis.
- Vetted the DR Team's assumptions and judgment to measure whether these were well developed, including evaluating the overall reasonableness of management's direction to the DR Team to reduce cost and associated schedule and risk; and
- Measured effectiveness of the tools in place for developing the estimate and identified gaps in the team's use of those tools.





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As noted in our prior report to the NOC, we emphasized to the DR Team the importance of properly characterizing the basis of the cost estimates it was putting forward for Board approval. In the case of the 4d Cost Estimate, the DR Team has properly characterized the estimate as one that generally meets the AACE's definition for a Class 3 estimate for the majority of program costs for larger projects and Class 5/4 for the balance. Typical expected accuracy ranges for Class 3 estimates are (-10% to -20%) on the low side, and (+10% to +30%) on the high side. For Class 4 estimates (-15% to -30%) on the low side, and (+20% to +50%) on the high side. For Class 5 estimates (-20% to -50%) on the low side, and (+30% to +100%) on the high side.

As mentioned above, BMcD/Modus performed reasonable sampling of the 4d Cost Estimate including:

- Detailed vetting of the current SNC/Aecon Class 3 estimate for the RFR work;
- Review of three BOP projects that total \$77 M, or 19% of the projected Basis of Estimate ("BOE") cost;
- Review of three Fuel Handling projects that total \$17 M, or 14% of the projected BOE cost.
- Review of selected line items in the Turbine Generator estimate that total \$9 M, or 22% of the projected turbine BOE costs for Unit 2.

In all, we considered approximately 53% of the project bundle costs. In this review, we vetted the nature of the driving aspects of these cost estimates, including: work hour estimates, quantities, labor rates and productivity factors, allowances, and the like. Our purpose in doing so was to confirm the reasonableness of the cost estimating process and the level of maturity underlying the information. In addition, we reviewed the development of the OPG costs for project management and support, which are essentially drawn from head counts of staff and flowed-out over time. This analysis essentially confirmed that the DR Team has prepared and presented an estimate that generally conforms, process-wise, to the AACE Class 3/4/5 definitions. This characterization is generally confirmed by the DR Project's current overall status at this time.

As noted, our focus in preparing this report has been on the DR Team's process, not on the outcome of that process. In reviewing the 4d Cost Estimate, we have not prepared or opined on the monetization of the estimate or any of its component costs. We did not prepare a check estimate to determine whether any cost items individually or in total were reasonable or attempt to determine whether the Project can be accomplished for the defined goal of \$10 billion.

In summary, BMcD/Modus found that the processes the DR Team used to develop the 4d Cost Estimate were reasonably robust and followed frequently seen practices as related to an AACE Class 3-5 estimate. The DR Team has also reasonably characterized the nature of the estimate that it has advanced for approval.

### **III. Characterization of 4d Cost Estimate**

The following is a summary of the major cost components in the DR Project and how they are characterized in the 4d Cost Estimate. As noted, approximately 64% of the Project's bundle cost has matured to Class 3 (or better). In the sections below, we focus on the areas with the largest implications to the DR Project and the most significant challenges we see the DR Team facing, as related to cost and planning definition, over the next year.

In this summary, we refer to some of the initial estimates by the different project and functional groups that were then subjected to challenge by the Project Controls team, RPET and the Project's VPs. We have referred to the resultant estimates to highlight the nature of those challenges and their reasonableness. The Project's VPs have broadly challenged the DR Team to refine its estimates over the next year to incorporate the results of the DR Project's planning effort and to look for ways to re-engineer how it is doing business through improved process definition, reduction in duplicative effort and further incorporation of lessons learned into subsequent units. From our view, these challenges were appropriate and generally well received, though achieving the desired results will require a determined effort, if goals are to be reached.



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A. Major Projects

1. RFR Bundle

The RFR bundle's estimate is perhaps the most mature in the DR Project's overall 4d Cost Estimate. The estimate is largely based on SNC/Aecon's Class 3 estimate, which OPG approved on June 15, 2014. OPG's RFR team believed that SNC/Aecon's Class 3 estimate was conservative. SNC/Aecon's justification for its conservatism was to a large degree based on its view of the contract's terms and conditions, which require the use of predetermined values for tool testing and contain provisions SNC/Aecon interpreted as creating a major risk exposure for themselves. SNC/Aecon's estimate for the direct cost of the RFR work totalled \$2.02B, exclusive of contingency and fee, which according to the terms of the RFR contract will only be monetized as part the Class 2 Estimate SNC/Aecon is currently preparing. This estimate has matured significantly over the preceding Class 4 estimate utilized for 4c; specifically, it has evolved from an OPEX based estimate taken from the results of past refurbishments to a bottom-up, Darlington-specific estimate. In order to approximate the end-cost of the RFR work, OPG's team needed to provide its estimates for the contractor's fee, contingency, budget transfers and prospective change orders, and OPG-related costs, such as OPG's project management team. These portions of the estimate initially totalled an additional \$1.40B before the challenge process was initiated, resulting in an in-flight estimate of \$3.42B.

However, based on the OPG team's specific experience and in an attempt to rationalize the cost of the RFR work, OPG has embedded in the 4d Cost Estimate approximately \$700M in targeted reductions that it expects to realize over the next 6-8 months. These reductions emanate from OPG's view of the likely results of tooling performance guarantee testing in the reactor mock-up and its general reviews and challenges of the non-tooling items as part of the Class 2 estimate review, which may yield still further opportunities for reduction. With the reductions, the final value being carried in 4d for RFR is \$2.69B. Additionally, contract negotiations of the final target price as well as adjustments to existing terms and conditions will also be required. A further analysis of the ~\$700M in reductions is presented below and separated into three major categories:

- **Changes to SNC/Aecon's Staffing:** Based on its review of the Class 3 Estimate, the OPG team believes the estimated direct field labor ("DFL") and PMT costs are excessive. OPG seeks to reduce SNC/Aecon's DFL and the associated PMT supervision costs by changing the shift pattern from a 24 hour, 7 day per week critical path operation utilizing a 4 on/4 off, 12 hour per day shift pattern to two 10 hour per day, 6 day per week shifts. The change in the shift pattern should reduce the total number of people needed and as a result, reduce the staffing level of associated PMT personnel<sup>2</sup>. OPG also will request SNC/Aecon to further reduce its assumed PMT percentages to address redundant and unnecessary positions, which will most likely require a change to the impacting contractual language. These reductions amount to nearly \$289M of the ~\$700M total pool. These potential reductions have not been internalized in SNC/Aecon's estimate to date; thus the values contained in 4d are assumptions based upon the outcome of future negotiations. SNC/Aecon has asserted that its Class 3 Estimate PMT cost is a direct result of certain provisions in the contract that shift risk of potential claims from OPG to SNC/Aecon. Additional supervision is SNC/Aecon's method of mitigating that risk by staffing its team to catch any such issues. In this regard, it appears SNC/Aecon is using the PMT to charge OPG for an embedded risk premium that OPG may choose to manage differently. Resolution of this issue will likely require agreement on certain revisions to the contract or, at a minimum, a common understanding of the effect of the contractual provisions related to which party accepts certain risks within different threshold levels.
- **SNC/Aecon Recommended Changes:** SNC/Aecon has identified certain technical cost reduction opportunities that OPG must accept for the savings to be fully realized. These include: (1) elimination of the channel by channel draining, and (2) elimination of the calandria seal replacement. Upon OPG's agreement, SNC/Aecon can include specific estimate reductions in its Class 2 Estimate.

<sup>2</sup> This change has also been incorporated in OPG's supporting functions, who will work the same shift pattern.



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- **Contract Provisions:** As with the PMT, many of the other assumed 4d reductions will require changes to negotiated provisions of the contract with SNC/Aecon. These items include: (1) a reduction in the contractually allowed 3% rework, which SNC/Aecon has applied to every work hour in the project, including for non-craft workers; (2) offsite infrastructure changes; and (3) alignment of incentives and disincentives to meet with the Minister of Energy's Long Term Energy Plan ("LTEP").

On this last point, we had previously noted in prior NOC reports that the incentives and disincentives in the RFR contract were structured on a four unit, comprehensive performance basis, with the goal to drive the contractor to constant improvement and successively reduce the performance schedule for each of the four units by set targets. Taken to its extreme, these incentives could drive SNC/Aecon to be less aggressive in saving schedule and cost on Unit 2 which would not align with the goals of the LTEP. OPG's Project VPs agree that the contract must have appropriate alignment of incentives to drive SNC/Aecon to the best possible performance on Unit 2, and has directed that the commercial strategy incorporate unitized incentives and off-ramps and seek to remove any unit-over-unit automatic triggers that are currently terms of the contract.

The OPG senior management team has taken the initiative to jump-start what could be a lengthy and difficult negotiation over the final target price for the work. Importantly, the OPG team has sought a reconciliation of the concepts that are embedded in the 4d Cost Estimate for RFR so that SNC/Aecon can include them as part of the Class 2 estimate. This will reduce churn and center the discussion on the result OPG wants to achieve. There is certainly risk in presuming the outcome of this negotiation, particularly since these cost reductions will have a significant impact on SNC/Aecon's anticipated fee for the project. Both parties are likely to have strongly held positions, and the risk of prior refurbishments has clearly driven SNC/Aecon to the positions it has taken to date. In recognition of this, senior management has also requested the RFR team to consider a "Plan B" of OPG self-performing/directing the work. We see this as important, not just as a basis for negotiating leverage but as a realistic mitigation plan in the event the parties cannot come together, or SNC/Aecon is otherwise unable or unwilling to perform.

## **2. Turbine Generator Bundle**

As with RFR, the Turbine Generator ("TG") bundle's estimate has significantly matured since the 4c Cost Estimate. This estimate has three main components: (1) the Alstom engineering and procurement contract; (2) SNC/Aecon's construction estimate; and, (3) OPG's project management estimate. The Alstom portion of the total TG estimate is largely fixed-price and represents approximately half of the total TG estimate. SNC/Aecon's estimate for construction has, like RFR, evolved to a Class 3 level estimate which represents another ~30% of the total TG estimate. SNC/Aecon's estimate was developed in cooperation with OPG and Faithful + Gould, who leveraged a significant amount of existing OPG maintenance data to build and validate the estimate. The final ~20% piece of the TG estimate are OPG's expenses, such as project management. Senior management issued two challenges to the Turbine Generator team to reduce and otherwise rationalize its staff: (1) a directive to rationalize its staffing plan to the execution schedule and significant reductions for non-critical path downtime; and (2) further reduce the execution cost by \$15M across all four units based on OPEX integration. The Turbine Generator team is committed to these reductions and has developed a plan to achieve these savings. In addition, further opportunities exist for reducing SNC/Aecon's cost as its estimate matures to Class 2 as it was generally accepted that the current Class 3 estimate represents SNC/Aecon's reasonable maximum cost. In addition, opportunities to achieve efficiencies in project management and support functions in conjunction with the RFR team have not been incorporated into the Class 3 estimate and will be addressed in Class 2. It should be noted that the future units will include the TG control work as part of Refurbishment, so there is a higher burn rate reserved for post-Unit 2 work.

## **3. Balance of Plant**

Over the last year, BOP work has matured though not at the pace expected due late released packages, and the scope of BOP work has been further rationalized. The BOP scope originally included 323 Darlington Scope Requests ("DSRs"). Between the Blue Ribbon Panel initiatives for 4c and reassigning SIOs to P&M (12 DSRs), the current BOP scope is comprised of 101 DSRs. Approximately \$343M of the 4d work items have defined scope, EPC bids and F&G estimates, and



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are supported by Class 4 estimates. The remaining BOP work constituting \$38M has an estimated value in 4d that is at a Class 5 level estimate.

BOP went through the challenge meeting process and identified few additional reductions and shifts to contingent scope. In addition, management challenged the BOP team to realize an additional \$34M in cost reductions (\$4M in engineering and \$30M in execution). Currently, the BOP team can support \$22.5M of these reductions through specific cost cutting initiatives, though the remainder has been identified as risk. The most significant potential cost risk for RQE is the lack of engineering and planning definition for this work which we believe is relatively limited. The DR Team has established a stretch goal of May 2015 for engineering completion, with a final milestone of August 2015. There is a strong likelihood that BOP (and Shut-Down/Lay-up) will miss the stretch target, the consequence of which would be to increase the uncertainty bands around those select projects. We see this having a very limited impact on RQE, as discussed in 4Q report.

#### **4. Defueling/Fuel Handling/Specialized Projects**

These projects have increased by a total of \$77.8M (39 %) from 4c to 4d, and these increases are largely due to the following:

- Defueling: increase in FTE's transferred from Fuel Handling Refurbishment and new scope;
- Fuel Handling Refurbishment: increased EPC estimate for power track, a new execution strategy that added extra OBUs, and additional labor/core matrix resources;
- Specialized Projects: the SDS computer replacement estimate increased due to added labor costs and scope changes based on a better understanding of the project's requirements.

Similar to Turbine Generator, these projects have been challenged to reduce and rationalize staffing to match the performance period of the actual work.

#### **5. Shut-Down/Lay-up**

These various projects have increased in aggregate by 73% due to maturation of scope, improved estimates based on vendor bids, increases in project management/overhead, and higher than anticipated engineering costs. It appears the velocity of these increases is due to a severe understatement of costs in the 4c Cost Estimate basis of estimate. Even with these increases, the Shutdown/Layup team reports it saved significant time and cost due to implementation of the collaborative scoping process and integrating engineering and estimating into the scope definition process at an early stage. Shut-Down/Lay-up is subject to many of the same risks as BOP, as discussed.

#### **6. Campus Plan Projects**

The Campus Plan Projects including D2O Storage have increased by \$285M, a 52% increase over the \$552M carried in the 4c Cost Estimate, for a current total of \$836M<sup>3</sup>. Excluding \$376M for the D2O Storage Facility, which has a different trajectory, and some small projects not started that will be cancelled, and D2O, the aggregated increase during this period for all remaining P&M projects is 23% (\$375M at 4c to \$460M at 4d). Recent history shows the cost velocity of these projects is generally upward, particularly as seen when engineering nears completion and/or field execution begins. The remaining P&M projects are still showing the effects of poor initial scope definition and cost estimates, though are not generating the same amount of overrun as D2O Storage because these projects are smaller in size. In the past quarter, P&M has started forecasting the estimate at completion ("EAC") of its projects and incorporating this into the overall DRP EAC. BMCD/Modus will continue to monitor the effectiveness of this forecasting and we recommend that P&M take a greater examination of the cost underpinnings, including enhanced trend analysis, greater detail in the change control process and more effective vetting of information from vendors.

We refer in our main report this quarter to the initiatives that P&M's management is undertaking to bring better predictability to these projects. Nonetheless, a series of trends has been established for these projects that will be difficult

<sup>3</sup> All figures include interest and contingency for this comparison.



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to arrest, in large part because of unrealistic initial estimates. We have recommended that the Project retain sufficient funds to allow for likely cost increases; thus, OPG has included \$73M in contingency at the program level based on these trends.

With respect to the D2O project, OPG is still considering what direction to take in light of Black & McDonald's termination; thus, it is too early to foresee the end cost of the project at this time. However, the risks to the Refurbishment Project's breaker open date are foreseeable. It is our recommendation that the DR Team have a robust mitigation plan in place for draining the water from Unit 2 that reduces or eliminates that cost and schedule impact. It is our understanding that the DR Team is readying this alternate plan and the accompanying business case in once it has the necessary information.

**B. Functional Costs**

The functional costs on the project comprise \$2.3B or ~30% of the overall DR Project before contingency. There are many opportunities in these areas for OPG to streamline and reduce its costs as the DR Team develops specific project management plans through execution. There is a significant amount of work that will need to be done prior to RQE in order for the various groups to align themselves as to the best and most effective way to manage execution of the Project. Additionally, the challenges made by senior management need to be internalized by the functional groups and incorporated into their estimates by making reasonable changes to their base plans that will support these reductions; we understand that these actions are underway and will be tracked to completion, as noted previously in this report.

**1. Operations & Maintenance**

Operations & Maintenance's 4d estimate represented perhaps the greatest overall growth in maturity between 4c and 4d. The Operations & Maintenance team's cost back-up and analysis was detailed, straightforward and verifiable, and a considerable portion of its estimates are based on a combination of past experience with similar work and vendor-supplied bids.

However, the results of Operations & Maintenance's effort showed an increase over 4c of \$103M, or 11%. Overall, the estimate represents a more mature picture of Operations & Maintenance's staffing levels and functions than was presented in the 4c Cost Estimate. The largest of the increases from 4c are as following noting that some of these increases were offset by reductions elsewhere in Operations and Maintenance:

- **Radiation Protection: (total \$264M; variance from 4c of \$97M)** – increase due to (1) additional scope and better understanding of requirements; (2) normalizing FTE's and unit pay rates.
- **Maintenance: (total \$347M, variance from 4c of \$28M)** - this line item includes \$138M of cyclical outage maintenance cost that the Station would have incurred regardless of Refurbishment.
- **Operations & Maintenance Training: (\$39M, variance from 4c of \$7M)** – this line item has been underspent though with the directional change in Fuel Handling, Operations & Maintenance will now have to qualify an additional 40 more personnel.

The information Operations & Maintenance provided is sufficient for senior management to review, vet and make decisions regarding Operations & Maintenance's utilization for the DR Project. Senior management challenged Operations & Maintenance to reduce its overall staffing by 5% or \$50M and to look at achieving economies of scale and elimination of duplication of effort between the Project and the operating Darlington units. The work in support of the major projects needs to be further rationalized based on a more mature execution schedule and division of work responsibilities. In addition, Operations & Maintenance was directed to reduce its effort to straight time shifts and optimize staffing where possible to reduce overtime and weekend work whenever possible. It is our understanding that the Operations and Maintenance organization has already embraced these cost reductions as part of its overall plan going forward.

**2. Engineering**

Engineering and each of its subsidiary functions, including Nuclear Safety, exhibited considerable growth from the 4c Cost Estimate to 4d. The primary driver for this growth was altering the duration of engineering activities, adding key functions



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and assuming a different business model (i.e. Active Management). However, Engineering has another role to play in the cost picture for the DR Project. Engineering is also the leading indicator of project maturity for the purpose of classifying the individual components of cost. As we have previously stated, having reliable and verifiable metrics showing the pace and completion of engineering is an essential element to underpin a high confidence RQE. The DR Team understands this, though the velocity of engineering progress is difficult to assess based on the current maturity of the metrics. For this reason, we have recommended that the engineering schedule needs re-prioritization and more development so that more emphasis is placed on the engineering product with the highest value targets for RQE. Since the goal for the milestone is to improve confidence at RQE, it may be the case that certain of the BOP and Shut-Down/Lay-up packages that are lagging behind are tilting the metrics in a manner such that the more important, higher value work is not being addressed in the right order.

From a functional cost perspective for 4d, Engineering's most notable issues and risks are as follows:

- **Performance and Deadlines:** The current velocity of detailed design work needed to complete Engineering Change packages shows that there will be considerable stress on the DR Project as a whole to meet the stretch goal of May 15, 2015 for completion of detail design, though these metrics show the major work underpinning the Project's cost estimate will complete on time. Thus, it is very likely that the costs will rise due to acceleration of the effort, and the costs will extend beyond current amounts due to late completion of the work. The impact to the budget could be particularly acute if the acceleration effort is spent on lower-valued engineering work, as noted above.
- **Processes and Procedures:** The DR Project's engineering leadership has committed to reducing the overall cost and taken the challenge to "lean out" its processes, which its team believes can net ~15% savings. We agree that Engineering needs to make its processes more efficient and have seen the benefits in other companies, but this is a goal that will take time and concentrated effort to achieve. The tendency when work is behind is to accelerate the effort utilizing additional resources and overtime, both resulting in additional costs. If Engineering is to achieve these significant savings, it must go after this immediately with a plan, targeted areas for reduction and appropriate metrics tracking the results. The initiative of Collaborative Front End Planning should be yielding cost savings, in that speeding the process means fewer people churning away hours. However, while there have been some anecdotal evidence of cost reduction, it is not being visibly measured. The cost savings from process efficiency improvements and any future initiatives also need to have visibility.
- **Changes to Core Business:** Challenged reductions in Nuclear Safety and Component Engineering will require OPG doing business differently, and our experience is this takes considerable time and often meets with resistance from outside stakeholders. If these challenges are to be achieved, the DR Team will need to move forward with tangible strategies and get internal agreement quickly or these projected cost savings will prove difficult to realize.

As with Operations & Maintenance, the Engineering team's overall estimate quality increased since the 4c Cost Estimate so the basis for measuring cost performance (and initiating any more specific cuts) should be readily apparent.

### 3. Other Functional Areas

4d's development provided the DR Team with the opportunity to further develop and refine functional support organizations that were short of details in the 4c Cost Estimate. Some of this increase in maturity is reflective of the DR Team leadership's movement toward an organization that is set-up for active management of the Execution Phase. In this sense, the 4d Cost Estimate represented the first attempt by the DR Team to evaluate and monetize the level of effort needed to support execution. Thus, while the overall effort to develop the plan was necessary, the integration of these support functions is still in its relative early stages. The larger increases in Functional cost were as follows:

- **Execution Organization:** The 4d value of \$178M is \$35M over 4c. At the time of the 4c Cost Estimate, the development of the Execution Organization was in its early stages. Since 4c, the new Project VP (Mike Allen) has





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developed a much more formative and realistic plan for actively managing the execution of the work. This organization includes the personnel needed to clear process barriers in the field and verify installed work quantities, both of which are needed to assure that OPG is receiving proper value for money.

- **Outage Execution:** The Outage Execution organization is responsible for planning and coordinating all of the activities leading up to, throughout and closing out assigned unit outages. Outage execution must integrate and coordinate the effort of individual project teams with cyclic maintenance, operation and layup requirements. As with the Execution Organization, at the time of the 4c Cost Estimate, the Outage Execution plan was not fully developed, and subsequent changes in the management team have brought greater focus to its function and accountabilities. The final, post-challenge increase from 4c to 4d for this function is \$0.3M.
- **Supply Chain and Contract Management:** Since 4c, costs have increased by 9.4%. These organizations are small in the grand scheme of the Project, though there was some initial confusion within the team regarding cross-over roles and responsibilities that should continue to be resolved prior to RQE.

Increases in bundle costs from 4c to 4d put pressure on the functional groups to hold the line, if possible. The challenges from senior management were for the functions to reduce and rationalize staffing in smart ways that take advantage of the Project's extensive planning effort; reduce unnecessary work; and, maximize the costs attributable to the direct work. This is balanced against the need for Unit 2 to be the collection point of OPEX for the remaining units, and as the first unit, it will certainly require more staff and overall effort; as shown in the overall staffing plan. Management has further challenged all functions to reduce their staff for the subsequent units. For these various challenges to materialize, the DR Team must be subjected to a rigorous, continuous improvement effort, as we discuss below.

### C. Contingency

At the outset of 4d, the Risk Team developed a "white paper" that articulated its plan for developing and monetizing contingency. The 4d effort is generally compliant with the process laid out in the white paper, but for the involvement of estimating subject matter experts ("SME's") in determining refined 3-pt estimates for discrete risk impacts and burn rate determinations. The Risk Team's effort was compressed because the development of the Project's base costs took up so much time that little was left for the estimating team to get involved in the contingency development process. Because contingency cannot be effectively calculated on a base estimate that is still changing, the Risk Team had only one week to perform the 4d contingency calculations where, ideally about three weeks or more are necessary. While some limited contingency work was performed in parallel with the estimate development before it was locked down, the majority of the effort had to wait for the 4d "data freeze," when the base estimate was finalized and subsequently the inputs to the contingency process were finalized.

#### 1. Uncertainty Modeling

Estimating uncertainty accounts for potential variability of that portion of an estimate that is undefined. Estimating uncertainty was included for the project bundles but not for the functional groups in the 4c Cost Estimate, though such was included in 4d. However, because of time constraints, estimating uncertainty in 4c was largely based on judgement of the Project Controls leads rather than stochastic modeling.

For 4d, fifty-eight activities on the Project's critical path were analyzed by the DR Team and a three point distribution was developed for each activity.<sup>4</sup> The Unit 2 schedule was evaluated assuming that the same three-point estimates applied to each of the subsequent units. No efficiency gains were included because in consultation with the project managers as there was no real basis to apply efficiencies to the three-point estimates at this time. This resulted in an 8 week schedule impact per unit for contingency purposes, which was monetized on an assumed \$500K/day basis. Probability ranges were then assumed to be the same for all four units. Additionally, the daily burn rate was assumed to apply from start to finish and did not consider variations in burn rate over the life of the project.

<sup>4</sup> The assumed critical path was for a 36 month outage, not the potential 39 month schedule that emerged as a potential planning assumption during the RFR 4d challenge meetings



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## 2. Discrete Risks

For discrete risks, the project managers provided input regarding which risks should have specific contingency amounts applied and which should not (e.g. if the risk was low or was likely to go away). This resulted in 96 discrete risks analyzed for contingency. Post mitigation scores were used as the starting point of the analysis and anything with a low risk score that was not already eliminated by the project managers was not included. A high level review for double counting was then conducted with limited identification of such duplication. Schedule and cost three-point ranges were developed based on ranges associated with the risk register entries. Some rationalization was performed if the high or low end of the range was considered inappropriate. Correlation among the risks was not addressed. Bundle-level critical path activities (i.e. the critical path for each project when looked at individually, not the program-level critical path that runs through the RFR work) that had a schedule impact used an assumed rate of \$50K/day. This assumes that only the individual non-critical path project would be delayed, and while this carries some additional costs, it would be significantly lower than if the entire project was delayed. As indicated above, the primary critical path impacts (primarily the RFR risks) were monetized at \$500K/day. The project managers were asked to review the contingency after the analysis and some minor adjustments were made by the teams.

We believe the above contingency analysis performed for 4d is appropriate for a Class 3/4 level estimate. Additionally, the processes used to determine the contingency were a good start for the processes that will need to be employed for RQE. However, the rigor and comprehensiveness of the contingency analysis will need to be significantly increased to support RQE. In addition, an earlier data freeze date is necessary to allow the Risk Team enough time for a robust contingency analysis.

## IV. Major Observations and Recommendations

BMCD/Modus has the following observations regarding the 4d Cost Estimate process and associated recommendations for advancing the estimate to RQE. It should be noted that as part of our ongoing oversight of the 4d Cost Estimate process, we have provided our input to senior management and a high percentage of the recommendations we discuss herein have already been recognized and/or assimilated by the DR Team.

### A. Risks and Opportunities for Cost Reductions

The following summarize certain cost reductions made during the 4d Cost Estimate process that will require additional follow-through and actions in order for the Project to ultimately realize the projected savings for RQE.

- **Savings Achieved through Commercial Negotiations:** The DR Team made significant assumptions regarding the desired/expected outcome of commercial negotiations with its prime vendors which will occur in the coming months. As noted, the DR Team has embedded critical assumptions in 4d Cost Estimate regarding cost reductions and other concessions it will seek from SNC/Aecon in negotiating the final terms of the RFR and Turbine Generator upgrade contracts. These reductions account for over \$700M reduction from SNC/Aecon's Class 3 estimates. These various cost reduction proposals identified by the DR Team have reasonable basis, and some reductions involve OPG invoking conditions on SNC/Aecon must accept without negotiation. Nonetheless, wrapping these reductions into SNC/Aecon's Class 2 estimate and the ultimate target price that emanates forth will require the full agreement of SNC/Aecon. Both OPG and SNC have almost equally strong negotiating profiles for various reasons and this may translate into unfavorable contract value movements for either side.

The DR Team's senior management has begun exploration of these opportunities with SNC/Aecon. We agree with the timing and substance of these efforts and see a meeting of the minds between OPG and SNC/Aecon as essential to ensuring the viability of the Project at RQE. Senior management has made it clear to SNC/Aecon's executives that the approval process alone will require multiple stages, thus the need to jump start the discussions. SNC/Aecon's senior management team initially balked, though now appears to be aligned with the DR Team's view. Nonetheless, the parties need to work together on many core issues as soon as practicable, given the strong likelihood that this negotiation will require internal and external alignment of goals, significant effort and senior management attention from OPG and each of SNC/Aecon's partners. Senior management has also





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asked the commercial team to accelerate its development of a negotiating strategy to support these efforts. We have also recommended that the DR Team identify the risk of not achieving an optimal result from these negotiations and develop a contingency plan in the case of failure.

- **Reductions in OPG Functional Cost:** ~30% of the line items in the 4d Cost Estimate are costs associated with OPG's functional management of the work. Senior management has challenged the functional groups to reduce staffing levels by: "projectizing" costs where possible, thus allowing costs to be based upon actual project needs and reducing redundancy; changing processes where current methods create unnecessary churn; reducing estimates over the life of the Project based on achieving subsequent unit savings; and looking for economies of scale with the operating unit and other center-led OPG functions. Each of the functional groups was issued an across-the-board challenge to reduce cost by 5%, which given the size of the functional groups does not appear to be unreasonable, at least at a high level. However, the functional groups must internalize the cost reduction and incorporate it into their base plans rather than seeing it as purely as a management directive; OPG is tracking the completion of each of the adjustments and many of these cost challenges have already been firmed up into the base plans. The major challenges ahead as discussed herein include:
  - Operations & Maintenance – \$50M or 5% reduction in all areas excluding Radiation Protection;
  - Engineering - 5% across the board reduction (on top of a \$50M reduction it previously acknowledged), which Engineering has committed to achieve via reducing unnecessary processes, realizing the benefits from collaborative front end planning and rationalizing staffing for replication efforts on future units;
  - Execution Organization – reduction of \$25M (9%) to account for the benefit of the Project's Definition Phase planning; and
  - Nuclear Safety - \$20M challenge to halve the increase from 4c Cost Estimate.

It is our understanding many of the above cuts have been incorporated into these functional budgets, which is a good start. Such initiatives necessary to make these cuts will require consistent effort and transparency which bear management attention and wide visibility. Critical to both will be a needed ramping-up of the analytics needed to assess planning the work that each group is performing. We have previously recommended to Engineering that it ramp up the development and use of meaningful progress metrics and capture cost and schedule trend data; without this information, assessing the possibility of cost reductions within engineering disciplines is problematic. To date this has not been achieved. In addition, OPG still must consider whether it should carry costs for staff and work that would have been incurred regardless of Refurbishment, such as the cyclical outage work.

The 4d Cost Estimate includes significantly more robust functional definitions and associated estimates for the Execution and Outage Management organizations. The estimates and plans included in the 4c Cost Estimate were lacking such definition and the team has addressed this significant gap. Now that these and other functions are better-defined, management can further refine the basis of these costs and make decisions regarding the effort necessary for these costs. The senior management team has given the directive to the functional groups to re-engineer aspects of its business, find new ways of doing business that are less cumbersome and recognize the benefits of the Definition Phase planning effort.

- **Project Bundle Reductions:** Senior management similarly challenged the Project Managers to reduce their PMT costs for managing the major project work. These challenges were based largely on the recognizing benefits from the planning effort during the Definition Phase. Our team interviewed the Project Managers for each of the bundles to pulse their respective plans to achieve these savings and found general acceptance of the premise, though the size of certain reductions (particularly for BOP) may be difficult to achieve without reductions in scope. Potential opportunities for reduction in cost via the continued maturation of the planning effort also exist. As noted, other than RFR, Turbine Generator and Fuel Handling, the majority of the remaining project bundle costs are in the Class 4/5 level at this time.



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- **Campus Plan Risks:** The Campus Plan Projects provide a significant and distinct risk for the Project and the 4d Cost Estimate. The upward velocity of cost has continued as these projects advance. Moreover, there is low confidence in the quality of the estimates for the remaining work. The DR Team has taken action to make ES Fox's estimating standards more transparent, but much more effort is required before there can be the needed levels of confidence in the Campus Plan Project's cost estimates. The team has also set forth goals to continue improving the quality of the Campus Plan Projects' schedules.

While these negative performance trends continue, the overall cost growth (except for D2O Storage) should not be a major threat to RQE, because these are mostly smaller projects. Nonetheless, the potential adverse impacts from the Campus Plan Projects may evidence themselves in the following ways: (1) additional increases in direct cost of the projects will drain contingency and management reserve from Refurbishment; (2) the schedule risk many of these projects carry (particularly D2O Storage) could impact the start of Unit 2's Refurbishment; and (3) the ongoing distraction from reworking the execution of D2O Storage. As a result, we recommend that the DR Team carry sufficient allowances at the program level to compensate for the strong likelihood of future cost overruns. In addition, the DR Team should advance the preparation of mitigation plans in the event the Campus Plan Projects cannot be executed in time. Included in 4d is an additional program level contingency in the amount of \$73M to account for potential cost increases beyond the amount within approved estimates for Campus Plan projects.

- **Contingency and Management Reserve:** We have noted ongoing improvements in the development of the Project's risk management system, though because of the size and importance of contingency to the Project, more improvements are in order for RQE. The team has improved the internal challenge process related to the risk register and the reporting metrics produced by the Risk Team have increased in quality. The DR Team's focus on risk management must continue advancing, as the Project's increase in maturity to RQE should translate to contingency based on deterministic risk analyses and the development of robust mitigation plans. Moreover, the quality of estimates for mitigation plans and monetized risks must increase above the current Class 5 level.

For RQE, contingency should be based increasingly on determined values and less on percentages of cost and other less specific stochastic modeling. The Project has the benefit of OPEX from prior CANDU refurbishments and other energy industry megaprojects that should allow for a focused approach to contingency. We believe the risk management effort for RQE could be further enhanced by a cold-eye challenge from an experienced external party, which would be fully justified given the size of the Project's contingency. We also recommend the DR Team track the puts and takes from contingency and management reserve in a visible manner through the next year as project estimates continue to mature.

B. Recommended Process Improvements for RQE

BMCD/Modus offers the following recommendations for the DR Team regarding improvement of the cost estimating process for RQE based on the 4d Cost Estimate OPEX.

- **RQE Needs a Detailed Schedule of Activities:** The effort to develop the underpinnings of the 4d Cost Estimate was inconsistent and was too often distracted by ongoing work on the Project, resulting in significant activity occurring late in the process. Prerequisite estimate work was also late and would have benefitted from a schedule reflecting estimate integration for both OPG and the contractors. As a result, senior leadership challenges and input to 4d Cost Estimate occurred in a condensed period of time. OPEX from the 4c Cost Estimate effort indicates much the same occurred last year. In addition to the challenges, time available to properly develop contingency was compressed to a point where some contingency elements had to be created by an abbreviated process that likely resulted in a compromise of quality and reasonableness. Developing a high-confidence RQE will require a continued and consistent effort, and having a detailed P6 schedule of activities with appropriate definition of accountabilities, deliverables and senior management weigh points is essential to map out the time between now and RQE. Sufficient time and energy must be devoted to developing such a schedule, and such requires full buy-in from all of the Project's stakeholders. The DR Team agrees that this is needed. The DR Team's leadership is prepared to initiate the development of a schedule as well as define its detailed expectations for the broader DR



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Team, and will attempt to utilize the momentum from 4d Cost Estimate to maintain this effort though RQE. However, we caution the DR Team not to overly complicate this exercise, as development of the Schedule needs to occur with expediency and urgency. We will continue to monitor their progress over the coming weeks.

- **Quality Assurance Should Be Increased and Embedded:** The 4d Cost Estimate lacked a focused program of quality assurance checks. As an example, the effort to vet the 4d Cost Estimate's development was impaired by inconsistent adherence to the standards the Project Controls team promulgated at the beginning of the process. As a result, the challenge process was bogged down by repeated internal checks of information. Within the industry, owners of mega-projects have invested considerable sums in quality assurance in the development of estimates to combat potential double-counting, errors in spreadsheets and ensuring the documentation backing-up the estimate is complete; OPG should follow suit. Based on the OPEX from the 4d Cost Estimate, the aforementioned schedule should allow for proper windows of time for quality assurance. In addition, the RQE estimating effort would be strengthened by full implementation of the US Cost system, which OPG is currently pursuing.
- **Documentation of Assumptions for the Basis of Estimates Needs Attention for RQE:** The process issued by the Project Controls team to the DR Team at the outset of the 4d Cost Estimate development included detailed guidance and templates for developing all of the documentation needed for vetting of the individual estimates. The project teams followed this guidance for purposes of developing their monetized inputs to 4d. However, the different groups used varying ways to develop the collateral information (i.e. analysis, management plans, organization charts) supporting the cost estimate. Management is now undertaking an activity to have all assumptions documented into the ADA database by November 13, 2014. For RQE, we recommend the team employ a more standardized approach for developing the documents that explain the elements of their cost estimates, and utilize those as a guideline the best of the submissions from 4d, including:
  - Functional and program management plans which incorporate all major position descriptions and accountabilities, and a fully developed staffing plan;
  - Project management plans which clearly identify and qualify vendors' pricing, project risks and opportunities, and management plans that are right-sized for Execution Phase; and
  - Clear requirements on the process for documenting assumptions and decisions.
- **RQE will Require More Timely and Determined Vetting of Underlying Assumptions:** Building confidence in the final characterization of RQE will rely on senior management gaining a full understanding of the underpinnings of the Project's costs so that reasonable and principled decisions can be made. As we have observed, senior management has had to issue cost reduction and other challenges to the Team in order to bring cost estimates in line to reign in project costs, which for RQE would not be optimal.

To address this, the RQE effort needs to be organized so that there are multiple weigh points for senior management to test the development and maturation of the Project's costs. We recommend that the schedule of RQE events include such weigh points so that senior management can stay informed of the RQE build-up, make interim decisions that impact cost and issue challenges in a timely manner so that they can be principally answered long in advance of RQE's conclusion. The schedule should also be reflective of the needs for senior management to appropriately and adequately inform the Board, the Shareholder and other key external stakeholders.

- **Characterizing the RQE Result:** The DR Team has committed to providing an estimate for RQE in the Class 2/3 range, which is appropriate for establishing the Project's control budget against which the Project will be measured until completion. However, even a Class 2 (let alone a Class 3) estimate still has an expected range of variability, and in the industry at large, a control budget is not considered a locked-down, never-to-change prediction of final cost. This is especially true for projects as long and complex as the Refurbishment, and which is likely to be executed in the face of a challenged labor market. OPG should consider expressing the RQE as a point number within a reasonable range of cost outcomes a Class 2/3 estimate would presuppose. By doing so,



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OPG would provide its confidence level in the RQE in the context of the reasonable outcomes that such an estimate could predict at this stage.

Overall, the DR Team has shown signs of enhanced performance in the year between 4c and 4d, and the resultant 4d Cost Estimate reasonably reflects the current nature of the Project's maturity when it comes to cost. This effort has also yielded significant lessons learned that the DR Team must internalize for the sake of RQE's success. Most importantly, the RQE effort will be significantly more involved and must capture the current focus and momentum gained from 4d in order to be successful.



# **Report to Nuclear Oversight Committee**

## **1<sup>st</sup> Quarter 2015**

### **Darlington Nuclear Refurbishment Project**



**Burns & McDonnell**  
**Modus Strategic Solutions**

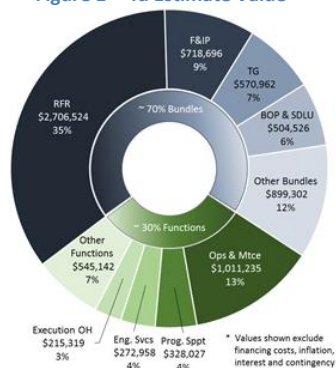
**March 12, 2015**

## I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company (“BMcD/Modus”) provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors (“NOC”) regarding the status of the Darlington Nuclear Generating Station’s Refurbishment Project (“Project” or “DR Project”) as of February 25, 2015. Our main focus for this report is the status of the DR Team’s preparation of the Release Quality Estimate (“RQE”) that will be submitted to the Board in November 2015. We also provide an update on the larger Campus Plan Projects.

### A. DR Project Cost and Estimate Overview

Figure 1 – 4d Estimate Value\*



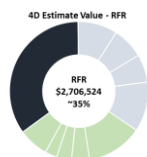
For purposes of evaluating the DR Team’s progress in preparation for RQE, we have provided the adjacent Figure 1, which summarizes the current 4d Cost Estimate into its component parts. The following are the most notable cost elements of the DR Project at this time:

- ❖ **RFR** constitutes approximately 35% or \$2.7B of the DR Project’s estimated costs;
- ❖ **Turbine Generator** constitutes approximately 7% of the DR Project’s estimated costs;
- ❖ **Balance of Plant and Shut Down/Lay-up** constitute 6% of the estimated costs; and
- ❖ **All Functional Groups** constitute approximately 30% of the current cost estimate including: Operations and Maintenance (13%); Engineering (4%); and Execution (3%).

As the inputs to RQE progress, the DR Team will be comparing its revisions to the breakdown presented here from the 4d estimate.

Over the last Quarter, the DR Team has spent a significant amount of time evaluating its plan and processes for developing the components of RQE, including improving the data the team and management will need for analysis and establishing confidence. The following is a brief summary of the status of the major inputs to RQE:

#### Retube and Feeder Replacement:



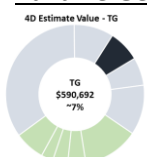
SNC/Aecon’s Class 2 Estimate is the single largest input to RQE. OPG’s Project Team recognizes the importance of this estimate and had requested SNC/Aecon to advance the delivery date to April 10, 2015 (from its original plan May 15, 2015).

OPG has granted a 2-week extension to April 24, 2015

The OPG team is preparing for this review period and intends to vet the various estimate components to ensure they meet the DR Project’s needs. Also,

OPG’s Project Team is mindful of the Campus Plan Projects lessons learned and thus rejected SNC/Aecon’s estimate. The OPG team has a clear understanding of the issues that need to be resolved to arrive at final target price with SNC/Aecon, though significant work remains, thus the current risk level.

#### Turbine Generator:



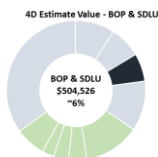
SNC/Aecon is on pace to complete its Class 2 Estimate by late 1Q for Unit 2. Some commercial issues related to the phasing of the turbine generator work over the four units will need to be resolved.

#### Steam Generator:

No issues are apparent at this time; these estimates should be sufficient for RQE.

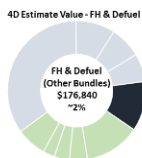


## Balance of Plant/Shut Down-Lay-up:



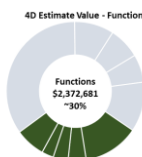
Detailed engineering for these bundles will not be fully complete by the May 15, 2015 target date; thus, development of Class 3 estimates for this work will be challenged to meet the RQE milestone. However, as we previously noted, from a cost standpoint, these estimates in total constitute approximately 6% of the direct costs of RQE, and the non-modification work (approximately half of Balance of Plant) is not engineering dependent and should have mature estimates for RQE. Balance of Plant and Shut Down/Lay-up project teams are proceeding with developing estimates based on the best possible information. The team is committed to carrying appropriate contingency for remaining uncertainties within RQE.

## Fuel Handling/Defueling:



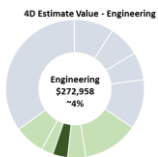
The DR Team is targeting Class 3 level estimates for RQE, and this appears to be an achievable goal, though some challenges remain with vendor submissions for non-critical path work. Defueling constitutes only about 2% of the direct costs of RQE, but it has a much higher risk profile due the reactor's defueling which occurs on the critical path. Therefore, careful planning, risk mitigation and adequate contingency are essential. Execution of the Fuel Handling Equipment Reliability plan is underway to ensure uninterrupted defueling operation.

## Functional Groups:



Currently the DR Team is placing adequate focus on development of the functional group (indirect) costs. The DR Team has addressed a gap from 4d and is committed to developing detailed functional management plans that will allow management to fully vet all critical planning bases for the DR Project's management team. The functional groups must also follow-through on commitments for cost reductions included in the 4d Estimate by incorporating those reductions into their management plans.

## Detailed Engineering:



The majority of the Project's detailed engineering should complete by May 15, 2015. While there are certain to be outliers to this milestone, the Project Team should be in substantial compliance with its goal to define engineering and scope sufficiently to support RQE.

## B. Campus Plan Highlights

- D20 Storage:** As of this writing, the team is in continued negotiation with the ESMSA vendors over the D20 Storage Building's mechanical/electrical/plumbing ("MEP") completion package, and is evaluating the risks associated with this award. Construction of the foundation is ongoing though with some impacts from weather, and P&M is attempting to mitigate future delays by directly purchasing over 600 valves needed for construction.
- ES Fox Resources and Capacity:** ES Fox's field construction was impacted by two separate High MRPH safety incidents; these events plus ES Fox's overall support of the P&M and Refurbishment projects contributes to existing concerns regarding ES Fox's capability to support the volume of its Project work. OPG senior management has raised these concerns with ES Fox, and corrective actions are underway. ES Fox has committed to adding resources in key areas, including project management and project controls.
- P&M Staffing:** P&M has added resources at the Director level and is embarking on additional training and instruction for its management team, including inserting lessons learned to date from the Campus Plan Projects.
- P&M's Project Controls:** P&M's Project Controls will consolidate under Refurbishment. This means that common processes and procedures, including using work-hours for schedule performance tracking, should be employed for future work, including D20 Storage's completion. However, many of P&M's projects will not be fully standardized. P&M has several initiatives underway with the Project Controls team to track these projects, as discussed below.

## II. Refurbishment – Areas of Focus

### A. RQE Processes, Procedures and Team Alignment



The DR Team has formalized its RQE processes in conjunction with the RQE Roadmap presented to NOC in the January Meeting. These processes include a full re-examination of the requirements for each sub-project's Gate 3 submissions and Functional Management Plan ("FMP") submissions. In developing and finalizing these processes, the DR Team has addressed many process gaps BMCD/Modus identified in the 4d Cost Estimate regarding underlying documentation, quality checks, and assuring proper time and opportunity for management vetting of the results.

- ❖ **Schedule:** The RQE Roadmap has well defined milestones that have been fully vetted within the DR Team, and who is being held accountable to meet deadlines. The RQE Roadmap provides sufficient margin for developing program-level reviews for quality and contingency development. The DR Team has set goals for multiple RQE deliverables, including project playbooks, execution plans and improved functional management plans that are due in 1Q 2015. The detailed RQE working level schedule remains under development and will be completed in early March. The RQE team will conduct weekly meetings to review the schedule for adherence with dates and quality of the products.
- ❖ **Estimating:** The team has rolled out new processes that will be applied to estimates for the projects and functions. The largest projects (RFR, Turbine Generator) are currently following estimating processes that conform to the new standards. This process moves the DR Team from parallel independent estimating used for validating bid proposals, which sometimes created confusion, to increasing focus on vetting of the estimates the contractors and work groups provide. This should provide greater confidence in the estimates underlying RQE. Moreover, previous quality concerns are being addressed with new processes.
- ❖ **Documentation of RQE:** The DR Team is preparing the following for RQE that will, when complete, provide a solid basis for vetting and a baseline for future comparison to actual project performance:
  - Data alignment to allow for transparency in support of project and regulatory reporting
  - Functional Groups are required to submit Functional Management Plans in advance of and in support of staffing estimates;
  - Project Teams are preparing "playbooks" that document execution method and other estimating considerations;
  - Project Teams and Contractors are engaged in "Day-in-the-Life" reviews to fully vet execution planning details, mitigate potential gaps, and consolidate similar common work scopes.

We have additionally recommended the DR Team develop a formal division of responsibility ("DOR") matrix that clarifies goals, highlights potential gaps in performance and memorializes accountabilities.

- ❖ **Gate 3 Process:** The RQE team has re-evaluated and re-issued the process for the coming Gate 3 reviews, which are the individual projects' primary RQE inputs. The process has established clear rules for developing the documentation for Gate 3s, as well as a typical sequence of events so that both the Project Team and the reviewers can be adequately prepared. In addition, Finance is prepared to provide "Black Hat" reviews of the Project Team's gate packages to provide appropriate challenges to the information presented. The Gate 3 reviews are scheduled for 2Q and will be a leading indicator of the overall progress to RQE.

### B. Engineering Status for RQE



As of February 1, detailed engineering for the DR Project was 79% complete. The most significant design packages – RFR (~69% complete) and Turbine Generator (~90% complete) – have produced sufficient engineering product for their respective Class 2 estimates. Lagging behind are BOP and Shut-Down/Lay-up (~30% complete), and completion of the BOP engineering is a concern. However, the DR Team's overall engineering effort should produce sufficient output to adequately support RQE and reduce the risk that late engineering work presents. The engineering process has been



significantly aided by:

- ❖ **Front End Planning:** The DR Team and the vendors are working together, increasing the efficiency of engineering and providing a more complete product. In turn, the improved engineering product allows for better assessment for the purposes of developing RQE estimates.
- ❖ **Active Management:** OPG's leadership as design authority and proactive management of the engineering phase is driving more timely and appropriate decision making.
- ❖ **Collaborative Approach:** The placement of resident engineers in the offices of the engineering service providers is expediting the engineering process.

However, Projects & Modifications, who adopted these initiatives after the Campus Plan Projects were underway, continues to struggle with delayed engineering and problems masked by a lack of vendor transparency.

After considerable effort, the DR Project's engineering schedules are now almost completely integrated at level 3, many of these are also resource loaded. Consequently, the DR team now has insight into the resource demands created by the Project's design effort. The availability of the detailed design information is allowing for very tight monitoring of the completion of the detailed engineering design, and identification and resolution of remaining delays. This same approach now needs to be applied to downstream activities in order to forecast future critical resource needs in advance of the peak demand. The schedule and performance metrics and the quality dashboard deployed by Engineering allow the DR Team the opportunity to plan around and mitigate delays and issues with resources and the quality of the engineering product. With the possible exception of the pre-requisite projects (discussed herein), the slippage in the engineering schedules is not likely to affect the breaker open milestone, as more than adequate float exists for performance of most project work.

Other ongoing Engineering initiatives include the following:

- ❖ **Benchmarking:** A recent benchmarking exercise with Exelon, while validating the rigor of OPG's engineering change process, identified some areas worthy of further consideration including the benefits from self-performing procurement. Whereas the planned benchmarking with Bruce Power will support collaboration in the CANDU industry in Ontario, we also encourage OPG to pursue their involvement in INPO's planned nuclear engineering benchmarking exercise.
- ❖ **LEAN Process:** From an engineering efficiency perspective, we endorse OPG's LEAN evaluation of the engineering change process in order to identify areas where value can be enhanced. This goes hand-in-hand with Engineering's commitment in 4d to reduce its functional cost by 15%.
- ❖ **Quality Dashboard:** Project Engineering has created a quality dashboard, focusing attention on nine aspects of engineering quality. Data validity issues with these metrics continue to be addressed along with several process shortfalls that were brought to light by the creation of this dashboard. We view this quality dashboard as a proactive and innovative initiative by the DR team. The SCR process continues to be the vehicle of choice for identifying specific quality issues.

### C. Areas of Focus - RQE Quality

*RFR Project-Class 2 Estimate*



RFR represents approximately 35% of the total estimated DR Project cost. SNC/Aecon's progression to its Class 2 Estimate and the parties' ultimate agreement to a target price for performance of the work represents the largest portion, thus the largest risk to RQE. Moreover OPG is motivated to close the approximate \$700M gap between SNC/Aecon's Class 3

Estimate and the amount OPG carried in its 4d Cost Estimate for RFR. This gap was due to OPG's well-founded determination that SNC/Aecon's Class 3 estimate was very conservative and there were multiple opportunities that SNC/Aecon needed to realize and take into account in the Class 2 estimate and its planning for RFR's execution.

As noted, SNC/Aecon's work on the estimate is behind an agreed target of April 10, 2015, resulting in its request for a 2 week extension of time to complete its work. At present, based on the multiple deliverables that SNC/Aecon is required to provide OPG, SNC/Aecon claims its overall completion is **57%** at this time. The following are concerns that are indicative of this effort to date:

- ❖ Construction Work Packages ("CWP's") form the basis of the detailed estimate and schedule, and are a key tool in establishing the direct field labor component of the Class 2 estimate. To date, SNC/Aecon reports being 70% complete with CWPs, though OPG only recently received the majority of these for review.
- ❖ The Tool Performance Guarantee ("TPG") testing is ongoing at the DEC's Mock-up Facility, and these tests have produced good-to-excellent results that should reduce the estimated direct field labour from the Class 3 estimate. However, the OPG team has observed SNC/Aecon's attempts to re-introduce risk and uncertainty into the estimate that negates these results. The OPG team has strongly objected to SNC/Aecon's attempts to do so.
- ❖ SNC/Aecon intends to assemble the Class 2 estimate into "chapters" to allow for OPG and other stakeholders vetting. SNC/Aecon is 4-6 weeks behind its schedule for producing these chapters and other key material OPG needs to properly consider the quality of SNC/Aecon's estimate.
- ❖ We have observed that SNC/Aecon's earned value trend for the tasks associated with developing the Class 2 estimate is growing increasingly negative. SNC/Aecon has expended 50% to 75% more hours than planned each of the last 3 months in estimating; nonetheless, its deliverables are not meeting the schedule target. We have challenged whether SNC/Aecon has recognized that its original work estimates are under-estimated and whether they have appropriately staffed the work to finish the work on the Class 2 estimate.

The result of SNC/Aecon's delays is that the OPG team will likely receive a much larger quantity of material from the SNC/Aecon to review and vet at the completion milestone than it expected when the process began. This happened with last year's Class 3 estimate, though the consequences around approving that estimate were much less severe than this time. In a recent Executive Oversight meeting with the CEOs of each company present, Tom Mitchell asserted OPG's expectations for SNC/Aecon to submit a transparent estimate with high quality, and that the parties may need to have a discussion at the appropriate time to discuss apportioning risk in order to disposition the likely gap between SNC/Aecon's estimate and OPG's assessment of it.

BMCD/Modus will continue to monitor the development of the Class 2 estimate. We have recommended that whatever reasonable time is given to SNC/Aecon for its preparation of the estimate components should not be absorbed by OPG accelerating its review period. If current trends continue, RFR is unlikely to meet the current RQE milestones for its Gate 3 submission, at a minimum.

#### *Refurbishment Waste Processing Building (RWPB)*

#### Overall Risk Perspective



SNC/Aecon submitted a proposal for the RWPB, which is where SNC/Aecon's waste processing and volume reduction machines for disposing of removed contaminated reactor parts will reside. This proposal was rejected by OPG due to its lack of detail and inadequate schedule, which showed this building completing in the 2Q of 2017, well after breaker open of Unit 2. Moreover, this proposal for \$93M is approximately \$11M more than what OPG carried in 4d, which was a red flag to the OPG team.

Recognizing lessons learned from the Campus Plan Projects, OPG's RFR team has engaged SNC/Aecon in a series of challenge meetings intended make SNC/Aecon produce a more detailed schedule and cost estimate that is properly supported. This should be achievable largely because this building is not very complicated, though it represents a

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March 12, 2015

distraction to the RFR team at a critical time. The OPG team is seeking to avoid the kind of cost creep that has impacted many of the Campus Plan Projects by having a solid cost estimate and schedule in place for RWPB at the work's outset, and have transparency to SNC/Aecon's subcontractors' work. OPG's VP of Execution initiated a weekly focus meeting on RWPB's challenges with SNC/Aecon leadership, which has increased the visibility of the issues. In order to reverse prior trends established by the Campus Plan Projects, it is critical for OPG to obtain and vet a detailed, well-formulated estimate from SNC/Aecon for RWPB and hold SNC/Aecon accountable for performing to that estimate. In addition, OPG is considering potential work shifting and award of other ESMSA work to SNC/Aecon that could benefit the overall program, particularly if SNC/Aecon can establish economies of scale with similar projects to RWPB.

### *BOP / Shut-Down/Lay-up*



As we have noted in prior reports, the BOP and Shut-Down/Lay-up projects will be challenged to produce Class 2/3 estimates for their modification work projects in time for RQE. The BOP and Shut-Down/Lay-up project managers are mitigating these delays to the extent possible by monitoring the completion of engineering and assessing and advancing development of estimates for this work. The result for RQE should be estimates for this work in the Class 3-4 range with more refined Class 2 estimates available for the Project's planned 2016 Unit 2 check estimate. Assuming the engineering and planning work proceeds as planned, the impact to RQE will be minimal – essentially the difference in holding contingency for a Class 4 v. Class 3 estimate for a relatively small (~6%) portion of the Project's cost. BMcD/Modus is more concerned over ES Fox's capability for planning and executing this work, which we discuss in more detail below.

### *Functional Groups*



The functional groups (essentially what make up the "DR Team" and include Engineering, Operations & Maintenance Project Controls and the Execution Team) constitute approximately 30% of the DR Project's total cost. The RQE team has been working to develop processes needed to increase the amount of detail the functional groups develop for their RQE estimates, and as noted, we see significant progress in this regard. Each functional group was challenged by the Project's VPs to reduce or otherwise rationalize their estimated costs for the Execution Phase, resulting in commitments from each to do so. It is important that those commitments are tracked to completion to avoid re-hashing old ground for RQE, and so management does not have to issue across-the-board directives to reduce cost.

## **II. Campus Plan**

### **A. P&M Management**



P&M's management has initiated changes to its project team to address issues that have been raised regarding P&M's performance. P&M has added experienced resources with construction backgrounds and management is focused on training programs to improve the team's approach to the Campus Plan Projects. In addition, Project Controls management will be consolidated with Refurbishment, and the Project Controls organization is adding resources so that better controls may be employed for tracking future P&M work (most notably the new D20 Storage contract). For the "in-flight" projects that are either too far along or too small to rebaseline, we have recommended, and the team has agreed, to make the specific bases for tracking of this work more visible and increase accountability for adhering to the current schedules. Project Controls is in the process of assessing each Campus Plan Project's estimate to complete and identify the major deliverables and implement, to the extent feasible, earned value metrics that account for major commodities. The projects' schedules are better aligned with the cost reporting tools which will provide more reliable indicators on the status of these projects. All of these measures should improve P&M's ability to manage and track the ongoing work.

## 1. Vendor Performance Issues



We have ongoing concerns, shared by the DR Team, regarding ES Fox's bandwidth to support the volume of the upcoming work on the DR Project. These issues are acute at this time as ES Fox has a number of "in-flight" P&M projects while also being required to support planning efforts for multiple Refurbishment projects. Our comments regarding ES Fox's scheduling and cost estimating capability have been discussed in prior reports, [REDACTED]

In addition, ES Fox must prepare approximately 45 separate project estimates for BOP and Shut-Down/Lay-up Refurbishment projects prior to RQE and oversee the final development of the associated detailed engineering packages from its engineering subcontractors. The Refurbishment BOP and Shut-Down/Lay-up directors have tasked ES Fox with developing estimates and schedule pilots that will be used as a template for the remaining estimates; these pilot estimates and schedules are under review.

The OPG executive team has escalated these issues to ES Fox's senior management, from whom OPG has received assurances that ES Fox intends to strengthen its capability by adding core team members for project management, project controls and other needed positions. ES Fox's actions bear watching, as their ability to complete these critical Campus Plan Projects while simultaneously supporting the planning of BOP and Shut-Down/Lay-up work for Refurbishment is a growing risk to the Project. The DR Team should continue its efforts to evaluate its needs from ES Fox and continue to hold them accountable for making necessary changes to support this work, and consider if there is an opportunity to balance work amongst the other ESMSA contractors.

## 2. Major Campus Plan Projects

### *D20 Storage Facility*



The DR Team has prepared a Superseding Business Case Summary ("BCS") recommending an additional release of \$270.9M, including [REDACTED] of contingency, with a projected total cost of \$381.1M. The BCS examined four alternatives, including slowing down construction at different points and abandoning D20 Storage entirely. The BCS also considered and established the basis for an alternative plan to draining water from Unit 2 in the event that D20 Storage construction is further delayed, and the DR Team has established trigger dates for proceeding with the alternate plan in sufficient time to procure temporary tanks and other material if needed. BMcD/Modus believes the BCS has appropriately considered the reasonable options at this time and provides a basis for justifying the decision to proceed with the best available option, completing D20 Storage based on the original design in time for Refurbishment.

With \$123.1M spent to date, the remaining cost to complete is estimated at \$258M, of which approximately \$140M is estimated for the new completion contract. As of this time, the award for the MEP completion of D20 Storage had not been made, as the OPG team is considering which of the ESMSA contractors should be awarded the completion of the work. In any event, the contract needs to be awarded and progressed by mid-March so that the selected contractor can begin piping prefabrication, procurement and further development of its execution schedule. The P&M team has committed to following Refurbishment's earned value and project controls processes for D20 Storage, which will provide a good proving ground for these processes for Refurbishment as well as significantly improved controls over P&M's past practices. In addition, P&M has added management resources and has established weekly progress meetings to focus on P&M's management of the work.

Based on the current D20 Storage schedule, the revised plan appears achievable, though with all of the issues to date,



## Report to Nuclear Oversight Committee – 1Q 2015 Darlington Nuclear Refurbishment Project



completion of the building will require close attention by the DR Team. Once the contract award is made, we recommend the P&M team: (1) re-evaluate the project risks based on the revised execution model; (2) fully vet the schedule and earned value set-up; (3) apply the project controls strategy to the completion of the foundation work.

### Auxiliary Heat

#### Overall Risk Perspective



As noted, the work on the Auxiliary Heat System Building (“AHS”) was impacted by ES Fox’s safety stand-down following two separate safety incidents. AHS is also impacted by the change to the Vacuum Building Outage (“VBO”). AHS was initially planned to be commissioned before the VBO in the spring of 2015, though its completion was later relaxed because it was determined that the building was not needed for the spring VBO. However, AHS now must be available for service for VBO in the fall. The AHS schedule had slipped by 2 months to October 2015 due to the Steam and Condensate tie-in window changing. This completion date is too close to the start of VBO, and will require ES Fox to resequence its work to recover this slippage. OPG is working with ES Fox to improve its schedule in consideration of the shift in the VBO date.

The current EAC of \$85.14M is being challenged by ES Fox, who has over \$6M in change orders (\$5M for engineering) that it has submitted to OPG. Construction was reported by P&M to be 45% complete, which needs to be verified, in particular because ES Fox has spent 78% of its EPC contract value through February 1, 2015 and ES Fox’s SPI continues to deteriorate. P&M needs to validate these figures, and needs to ensure that ES Fox is motivated to expend the needed direct field labour to complete this project.

AHS also represents the first major Campus Plan Project to be commissioned with cooperation from Operations & Maintenance. We would advise the P&M team insist ES Fox provide as much float as possible before VBO to allow for any slips in commissioning.

### Emergency Power Generator 3

#### Overall Risk Perspective



EPG 3’s current performance trends are also a concern, and the Project Team is reporting the planned September 2015 in-service date is at risk by as much as 2 months. ES Fox’s performance indicators continue to deteriorate and the Project’s EAC is \$96M, an increase of \$8M since 4d. Engineering completion has been delayed to May 2015 due to vendors’ performance challenges. The P&M project team was readying EPG 3 for its final Gate 3, though these trends and ES Fox’s additional cost submissions and delayed schedule development have pushed this gate meeting. The Project Team is also carrying the commissioning of EPG 3 as a significant risk due to the complexity of commissioning and configuration of this equipment.

P&M’s management has requested a full recovery plan from ES Fox, and the SVP of Projects has requested a focused, weekly update to examine ES Fox’s performance. Given the short timeline to complete this SIO project, ES Fox will need to increase its effort and improve its performance.

## III. Other Focus Areas

### A. Corporate Support

BMcD/Modus remains encouraged by the ongoing efforts by OPG’s corporate units to support the DR Project. Among the Project Team’s recent issues is highlighting its software needs for IT to implement needed changes, particularly for change project controls systems needed for project. Large capital projects often struggle using enterprise level business systems to support project needs, and recognition of the shortcomings of the current systems is timely. A similar approach should be pursued with other corporate policies; as previously discussed, tailoring hiring and talent retention processes for short-



**Report to Nuclear Oversight Committee – 1Q 2015**  
**Darlington Nuclear Refurbishment Project**



term project needs often requires flexibility that is not advisable for normal operations.

**B. Project/Station Integration**

Integration between the Project and the Darlington Station needs to be addressed. P&M projects have missed or are projected to miss tie-in dates to the plant, in part due to vendor performance but also due to the Station demanding a level of precision from the Projects that is difficult to achieve from a project environment. BMCD/Modus will be advancing our timeline for a more detailed assessment of this integration and will identify any process or procedural gaps.

In addition, with the shifting of the VBO, the DR Team and the Station will need to re-assess their mutual priorities and assess any impacts to either cost or schedule.





# **Report to Nuclear Oversight Committee**

## **2<sup>nd</sup> Quarter 2015**

### **Darlington Nuclear Refurbishment Project**

# **ONTARIO POWER GENERATION**

**DRAFT**

Burns & McDonnell  
Modus Strategic Solutions

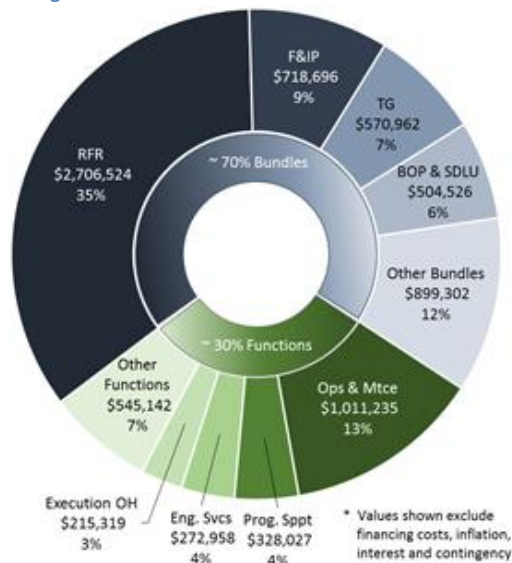
May 21, 2015

## I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company (“BMcD/Modus”) provide the following Quarterly Report to the Nuclear Oversight Committee of the OPG Board of Directors (“NOC”) regarding the status of the Darlington Nuclear Generating Station’s Refurbishment Project (“Project” or “DR Project”) as of May 8, 2015. Our main focus continues to be assessing the status of the DR Team’s preparation of the Release Quality Estimate (“RQE”) that will be submitted to the Board in November 2015. We also provide an update on the larger Campus Plan Projects.

### A. DR Project Cost and Estimate Overview

Figure 1 – 4d Estimate Value\*



As with our 1Q Report, we provide the adjacent Figure 1, which summarizes the current 4d Cost Estimate into its component parts, as a basis for gauging the Project Team’s RQE progress. The following are the most notable cost elements of the DR Project at this time:

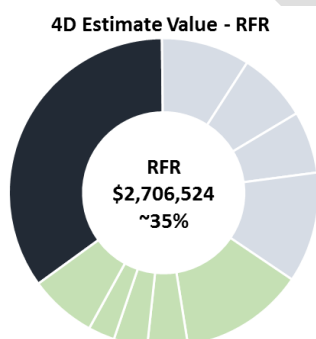
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- ❖ **All Functional Groups** constitute approximately 30% of the current cost estimate including: Operations and Maintenance (13%); Engineering (4%); and Execution (3%).

As the development of the inputs to RQE progress, the DR Team will be comparing variances based upon the breakdown presented here from the 4d estimate. Over the last Quarter, the metrics and the processes the DR Team

has put in place to track its RQE progress have accurately depicted areas where the team is meeting its plan and other areas that have fallen behind. The largest components to RQE – the Retube and Feeder Replacement (“RFR”), Turbine Generator (“TG”) and project functional costs - are capable of meeting their end milestones, as are Steam Generators, Islanding, and Fuel Handling/Defueling. However, Balance of Plant (“BOP”) and Shutdown/Layup, which are an aggregation of smaller projects, are well behind, prompting the Project Team to reprioritize its efforts and approach with both the vendors and the basis for RQE.

The following is a brief summary of the status of the major inputs to RQE:

#### ● Retube and Feeder Replacement:



SNC/Aecon’s Class 2 Estimate for RFR is the single largest input to RQE. Over the last quarter, SNC/Aecon and OPG have made significant progress in the development of the Class 2 Estimate, identifying the major areas where the parties agree and distinguishing the issues that will need to be resolved prior to negotiating a Target Price for the execution phase. Significantly, the parties have agreed on the basic parameters of RFR’s critical path schedule duration, and agreed to eliminate schedule contingency that had been built into SNC/Aecon’s Class 3 Estimate. Thus, the agreed schedule that is at the heart of the Class 2 Estimate represents an aggressive, but reasonably achievable plan for Unit 2.

Nonetheless, considerable vetting work remains ahead over the next 4-6 weeks to confirm that the quality of SNC/Aecon’s estimate is sufficient to qualify it as a Class 2 Estimate. On May 8, SNC/Aecon delivered its first full project estimate report for OPG’s review. While the OPG team has been vetting the discrete sections of the estimate as it has been assembled, the team needs to now carefully consider how the various parts fit together.





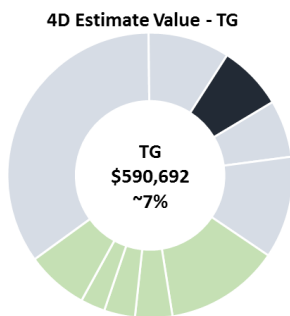
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Simultaneous to the estimate development, the parties have commenced some high-level commercial discussions at the project executive and CEO levels in an attempt to identify any major contract or commercial issues that will need to be resolved before the Execution Phase contract can be awarded to SNC/Aecon. Primarily, there remains a sizeable pricing gap between the parties that needs to be narrowed to the extent possible. OPG has identified specific areas for possible negotiation and is planning to discuss these items with SNC/Aecon in stages through June 15<sup>th</sup>. We have urged OPG to take whatever reasonable time is necessary to properly vet the Class 2 Estimate and associated schedule, most notably the near critical path work, to ensure that the estimate represents an achievable plan and comports with Class 2 parameters.

OPG's Project Team is mindful of the Campus Plan Projects' lessons learned and thus continues to challenge SNC/Aecon's estimate. Limited field work has been started in parallel with SNC/Aecon's further attempts to bolster its estimate. RWPB has a separate Gate 3 from RFR in early June by which SNC/Aecon must complete its estimate.

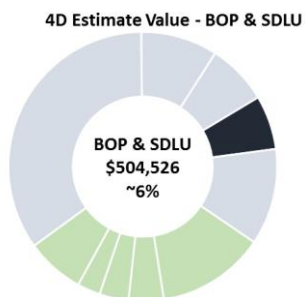
### **Turbine Generator:**



SNC/Aecon issued its Class 2 Estimate for the Turbine Generator for Unit 2 on May [REDACTED], and Alstom has completed its detailed design. SNC/Aecon still must complete its estimate for the TG control work for the subsequent units, and reports it is on track to meet its July 31, 2015 deadline. OPG used the TG estimate as a proving ground for its new estimate vetting process, and this was a significant success. The OPG estimating team sampled approximately 3,000 line items of cost, or over 50% of the estimate, and issued hundreds of comments that SNC/Aecon had to disposition. We believe this process should be repeated for each of the major units of cost on the project. In addition, the parties resolved the commercial issues related to the phasing of the turbine

generator work over the four units. SNC/Aecon needs to meet its commitment to identify economies of scale across its entire portfolio of work (RFR, TG, D20 Storage) that should reduce Project overhead cost.

### **Balance of Plant/Shut Down-Lay-up:**



Detailed engineering for the projects will not be completed by the May 15, 2015 target date. Based on current performance trends, BOP and Shut-Down/Lay-up will be challenged to meet the August detailed design complete milestone. Moreover, [REDACTED]

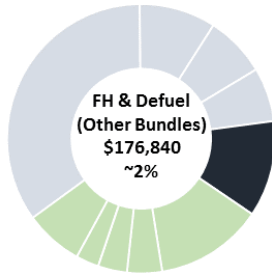
[REDACTED] This inability poses a significant risk to Refurbishment that the team is attempting to mitigate.

The BOP and Shut Down/Lay-up project teams are injecting collaboration into the estimating process to reduce potential gaps and misses that have been evident in the Campus Plan Projects. These bundles are attempting to overcome the lack of mature, detailed design to the extent possible and have directed the Contractor to develop estimates based on the best possible information at this time, though it is unlikely that these bundles will obtain estimates above Class 5 for the majority of this work prior to RQE. In addition, the team is taking appropriate action to re-prioritize those work packages based on the Execution Phase schedule's needs. OPG senior management has significantly ramped up project executive-level attention to the vendors' difficulties. The team is committed to rejecting work product of insufficient quality and intends to carry appropriate contingency within RQE. Refurbishment also needs to ensure that it is carrying program level contingency sufficient to account for the ESMSA vendors' known deficiencies in engineering progress, estimating and scheduling. In addition, [REDACTED]

[REDACTED] While from a cost standpoint, the BOP and Shut-Down/Lay-up estimates constitute approximately 6% of the direct costs of RQE, our concern is that the vendors' issues will drain a disproportionate amount of management attention and divert focus from the more significant scopes of work, which continue to be a risk to Refurbishment through the Execution Phase.

### **Fuel Handling/Defueling:**

4D Estimate Value - FH & Defuel



The DR Team is targeting Class 3 level estimates for RQE, and the team's work over the last quarter has improved the overall outlook for both the estimate and the technical basis for the work. While defueling constitutes only about 2% of the direct costs of RQE, it has a much higher risk profile due to the reactor's defueling which occurs on the critical path. Prior challenges with the vendor's supply of fuel handling equipment appear to be resolved, and the team is working to a more aggressive commissioning schedule to increase schedule float and reduce overall risk. The team has also worked to distinguish differences between Bruce Unit 1's defueling performance and its own planning for Darlington, and is focused on realistic opportunities for shaving time off the current

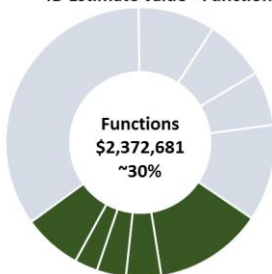
estimated 113-day defueling cycle.

### **Steam Generator:**

No issues are apparent at this time; these estimates should be sufficient for RQE. The team has addressed prior quality issues and its recovery plan has been successful.

### **Functional Groups:**

4D Estimate Value - Functions

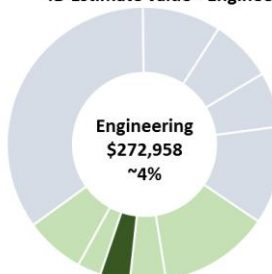


The RQE Roadmap milestone for the DR Team's functional groups to complete their management plans and estimates by May 15<sup>th</sup> will not be met. The functions have developed initial management plans and related estimates which in aggregate are showing the potential to exceed the amounts provided in the 4d Cost Estimate. While it is still early in the vetting process and no firm conclusions should be drawn from this initial review, it is evident that management will need to devote significant attention to right-sizing the team, developing clear roles and responsibilities and locking down appropriate assumptions for RQE. We have recommended the team develop a detailed division of responsibility ("DOR") matrix to ensure there is no unnecessary cross-over or

large gaps in the functional responsibilities within the Project. We have also provided some input to the team to increase the level and effectiveness of the vetting of these costs. Our team will be included in the "black hat" reviews led by Finance of the RQE estimates for the functional groups.

### **Detailed Engineering:**

4D Estimate Value - Engineering



The Project's Detailed Design is 86% complete which means the Project is in substantial compliance with its goal to define engineering and scope sufficient to support RQE. However, BOP and Shut-Down/Lay-up engineering is delayed which is partially driving these bundles' cost estimates to miss current and downstream milestones.

these will require monitoring. The Engineering team's quality metrics highlighted some early warning signs, prompting the engineering VP to hold a brief stand-down of the vendors to examine quality and corrective actions. Thus, OPG management has visibility to the remaining engineering

work and is timely managing those problems that manifest themselves.

## **B. Campus Plan Highlights**

**D20 Storage:** P&M has issued a letter of intent ("LOI") to SNC/Aecon to perform the mechanical and electrical portion of the work for D20 Storage. The LOI's terms provide for \$5M in funding and a 6-week time period for SNC/Aecon to refine its detailed estimate and schedule for the work, upon acceptance of which a final, conformed contract will be issued. P&M believes that the cost associated with the SNC/Aecon contract will be less than the \$140M in 4d and will provide greater confidence in the overall cost and schedule. OPG is managing Ellis Don in the construction of the foundation, which is attempting to recover weather impacts. Ellis Don is currently working on its baseline schedule



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for the remaining civil work. P&M is working with SNC/Aecon to mitigate delays in purchasing over 600 valves needed for construction.

- **ES Fox Resources and Capacity:** [REDACTED]  
[REDACTED] OPG's senior management has escalated its concerns to ES Fox's executives, and secured Fox's commitment to add resources in key areas, including project management and project controls, [REDACTED]  
[REDACTED] ES Fox has projected that it will exceed its baseline estimates on key P&M projects (Auxiliary Heat Building, EPG 3, RPO and RFRISA) and [REDACTED]  
[REDACTED]  
[REDACTED] In any event, OPG needs to perform adequate due diligence in vetting these cost increases and [REDACTED]
- **P&M Organization:** The focus on P&M's staffing, structure and capabilities for managing work for both the DR Project and the ASIC project portfolio is still under review. The additional senior resources that have been added to the team have had a positive impact on P&M's performance.
- **P&M's Project Controls:** P&M's Project Controls will continue to consolidate under Refurbishment and share processes and resources. The schedule for D20 Storage will be a transition point and allow for the team to establish appropriate metrics for tracking the work. In addition, the EPG 3 schedule for execution and cost estimate for completion is the next in line for detailed vetting, and should take into account the lessons learned from AHS.

## II. Refurbishment – Areas of Focus

### A. RQE Status Summary



In our 1Q 2015 report, BMCD/Modus noted that the team had put in place a processes for tracking RQE deliverables including a schedule and tracking metrics. The early milestones supporting RQE were generally met, though the underlying metrics are forecasting that a significant number of upcoming milestones will be missed.

The RQE Roadmap that provides all of the high-level RQE milestones has been augmented by a weekly report called the "Playbook #1 Weekly Execution Report". This Report measures the DR Team's progress against its plan for the Project-level cost estimates and schedules needed for RQE. The team has identified a total of 341 sub-project estimates and 226 sub-project schedules that are needed to support RQE. Of the estimates, 165 of the 341 (48%) and 156 of the 226 (69%) of the schedules are for numerous smaller projects under two project bundles – BOP and Shut-Down/Lay-up. Both of these project bundles' primary vendor is ES Fox. By comparison, the projects that represent the majority of the cost – RFR and TG – constitute only 10% of the number of individual estimates and schedules. Thus, these metrics are not intended to portray the weight of these deliverables to RQE but do provide a "bean count" of the remaining work and visibility to work that is falling behind schedule.

As of May 1, these metrics show that the smaller BOP and Shut-Down/Lay-up projects are lagging well behind the RQE Roadmap schedule. BOP estimating is 6% complete and 66% of its estimates are tracking behind schedule. The Shut-Down/Lay-up estimates are 11% complete, and 84% of these estimates are behind schedule. These delays mean that the estimates and schedules provided by these bundles in support of their upcoming Gate 3 meetings will be substantially below Class 3 quality. By contrast, the largest projects – RFR and TG – are generally on pace to meet the RQE milestones with Class 2 Estimates by the end of June.

Engineering maturity remains a leading indicator of the team's overall RQE development. The Project will miss the May 15, 2015 goal for completing detailed design, though its achievement of 86% complete at this relatively early stage is a nonetheless a major achievement. The larger packages – RFR and TG – are substantially complete and capable of supporting Class 2/3 project estimates. The remaining engineering work is predominantly in the BOP and Shut-Down/Lay-up bundles. The RQE metrics have highlighted the specific areas that are lagging behind, and using these metrics, the team has revised the engineering priorities for the Contractor to progress the more urgent packages to meet the August



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engineering milestone. The Contractor's performance to date has been inadequate in managing its work and providing reliable cost estimates and schedules. This is causing the DR Team to devote considerable attention to the recovery effort.

The RQE team has re-evaluated and re-issued its process for the upcoming Gate 3 reviews, which are the individual projects' primary RQE inputs. The process has rules for developing the documentation for vetting the Project's Gate 3s. Each Project sub-bundle will be required to advance to Gate 3, even if that sub-bundle's maturity level is at a Class 4/5 level. The Gate 3 reviews are scheduled for 2Q and will be a leading indicator of the overall progress to RQE. In addition, the DR Team's functional groups have submitted initial estimates and revised functional management plans which will also be vetted during 2Q 2015.

In summary, the major projects and functions, which comprise approximately 92% of the overall Project cost, are tracking on time to 2-3 weeks late with their RQE inputs while the BOP and Shut-Down/Lay-up bundles will struggle to complete Gate 3 with estimates more robust than Class 5 level. The DR Team will have to properly characterize the packages that are late and unlikely to mature beyond Class 4/5 level prior to RQE. A risk the DR Team needs to manage, among others, is devoting a disproportionate amount of attention to the BOP and Shut-Down/Lay-up bundles for the purpose of refining many of these estimates to a level not feasible prior to RQE.

### B. Engineering Status for RQE



As of May 1, detailed design for the DR Project was 86% complete. While this falls slightly short of the 90% goal set by the Project Team, it is sufficient to support the estimating accuracy range for RQE. The most significant design packages – RFR (~86% complete) and Turbine Generator (~86% complete) – are enough to support their respective Class 2 estimates. BOP and Shut-Down/Lay-up engineering maturity (~86% complete) remains the primary outlier, and the team has reprioritized the work based on need.

The engineering team's schedule and quality metrics have matured and are being used to monitor vendor performance. These metrics have highlighted signs of certain adverse trends that the team is working to reverse:

- ❖ **Quality:** Project Engineering's Quality Dashboard has highlighted potentially adverse trends including: human performance errors; vendors employing under-qualified resources; over-specification of engineered materials and unique components; and other short-cuts that could result in downstream changes. To address these issues, the Project's Engineering VP initiated a quality "stand down" during which the results of multiple reviews and audits were shared and discussed with the vendors and OPG team. Each engineering vendor was challenged to provide an action plan to eliminate errors, rework and increase the quality of their work product.
- ❖ **Resourcing:** The metrics have highlighted the specific areas of focus for the remaining detailed design effort, and provide a basis for projecting the resources needed to complete this effort. In addition, these metrics have highlighted potential downstream gaps that require OPG resources, including the drawing office and TSSA registration.

Thus, the metrics tracking engineering are providing management with information it needs to actively manage the work. As engineering transitions to the next phase of supporting procurement and construction work package ("CWP") development, the tools developed during the design phase will need to shift focus.

The current Weekly Project meeting continues to focus on engineering, and remains a good forum for the team to work through issues and focus on the Project's schedule. The team is working to highlight gaps and develop management plans to resolve them. Over time, the team intends to expand this forum to include procurement tracking and construction readiness. The team is currently finalizing metrics for tracking procurement, and intends to introduce those metrics in June 2015.





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Two issues that the DR Team needs to resolve in the upcoming examination of the Engineering functional cost include: (1) the level of support needed for replication engineering for the units subsequent to Unit 2; (2) the roles, responsibilities and level of effort needed from OPG Engineering and vendors in support of the field work and commissioning. There is valuable OPEX from Pickering Unit 1 RTS that should be reviewed in making these decisions.

### C. Documentation and Data Alignment

The DR Team's data management group is working to align the Project's RQE and schedule data so that costs can be properly viewed and assessed over the entire Project's lifecycle at the work package/scope level. A key aspect of this work is properly mapping data so that the planned and actual cost of performing each element of scope can be baselined and then traced over time. The data management team is currently correcting flaws in data mapping present from the Project's inception. This work is essential to establish and maintain a proper Control Budget going forward from RQE. In addition, this data mapping is integral for future plant configuration control, and will be necessary for OPG to support rate recovery of its investment. If these issues are not resolved in the near term, the DR Team will risk struggling with data alignment issues throughout the entire Project. We have provided management with an assessment of current challenges in the Project's Cost Management system that provides further explanation of these problems in comparison with best practices. We recommend the DR Team make data alignment a priority for RQE so that further rework of these systems can be avoided and RQE has the data integrity necessary.

### D. Areas of Focus - RQE Quality

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*RFR Project-Class 2 Estimate*

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RFR represents approximately 35% of the total estimated DR Project cost, and thus the largest single risk to RQE. Since receiving SNC/Aecon's Class 3 estimate for RFR in June 2014, OPG's challenge has been to vet SNC/Aecon's plan and pricing of this work to ensure it is achievable, accounts for the OPEX from past refurbishments, improvements to the tool set and the value of the planning effort to date, including the full-scale mock-up at the DEC.

Moreover, OPG is motivated to close the approximate \$700M gap between SNC/Aecon's Class 3 Estimate and the amount OPG carried in its 4d Cost Estimate for RFR. OPG believes that SNC/Aecon's Class 3 estimate was conservative and included opportunities for SNC/Aecon to realize in the Class 2 estimate and its planning for RFR's execution. OPG has made SNC/Aecon fully aware of its position relative to these opportunities.

SNC/Aecon's Class 2 estimate was initially targeted for delivery by April 10, 2015, though SNC/Aecon was unable to meet this deadline. OPG provided SNC/Aecon with an extension to May 8, 2015 to ensure SNC/Aecon was providing an estimate package of requisite quality<sup>1</sup>. The OPG team also recognized that while monitoring and vetting the SNC/Aecon's incremental progress was necessary and beneficial, the OPG team now needs to review and vet the estimate as a whole.

SNC/Aecon and OPG have agreed on a number of key areas that will ease the vetting of the Class 2 Estimate, including:

- The critical path duration of 1084 days, including OPG's responsibility of 186 days from breaker open to defueling and 223 days after RFR is completed to breaker closed. SNC/Aecon's schedule and estimate are premised on it controlling the critical path in the vault for the 676 days in the middle (the "RFR Duration"). SNC/Aecon's RFR Duration was determined on the basis of its Tool Performance Guarantee ("TPG") durations that were tested in the mock-up and modified by assumptions gained from OPEX of prior CANDU refurbishments. Importantly, SNC/Aecon's RFR Duration is shorter than the actual duration of Wolsong, which was the previous best

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<sup>1</sup> SNC/Aecon's Class 2 Estimate was received concurrent with the preparation of this report; thus, we cannot comment on its content at this time.



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refurbishment.

- A major sticking point in the Class 2 Estimate development was SNC/Aecon's conservatism toward potential owner-caused delays. By accepting the critical path in the RFR Duration, SNC/Aecon has agreed to remove contingency time in the schedule, which is a significant concession.
- While still higher than OPG's expectations, SNC/Aecon's initial Class 2 Estimate reflects modest reductions from the Class 3 estimate.
- SNC/Aecon has identified approximately \$40M of additional opportunities to reduce the base cost that are different from those OPG had identified. OPG needs to consider whether these opportunities can be realized. In addition, there is a list of approximately 50 items that OPG has developed that are additional opportunities of varying size that can be worked down.
- The parties have agreed to revisit current assumptions around project risk allocation once the base cost is determined.

The OPG team's vetting process for the Class 2 Estimate is geared toward identifying any areas in the estimate that remain suspect from a cost perspective. While the vetting process will review all aspects of the Class 2 Estimate, the particular areas of focus for the team include: (1) right-sizing of SNC/Aecon's project management team ("PMT"); (2) right-sizing of SNC/Aecon's Support Services; (3) review of non-critical path direct field labor; (4) unit-over-unit resource leveling; and (5) productivity rates utilized for direct field labor. In addition, the parties will work to finalize the risk register and develop contingency.

Assuming there is agreement on the Class 2 Estimate, the parties will finalize target price parameters and seek resolution of any remaining commercial issues. The DR Team has been preparing options for performing the RFR project without SNC/Aecon in the event there is no agreement. However, coming to mutually agreeable terms with SNC/Aecon is clearly the best possible option for performing RFR, given the time investment the parties have made to date and the difficulties inherent with starting over with a new vendor.

BMCD/Modus will continue to monitor the development of the Class 2 estimate. We have recommended that whatever reasonable time is given to SNC/Aecon for its preparation of the estimate components should not be absorbed by OPG through acceleration of its review period. OPG should weigh the risks of rushing the review and vetting process versus missing the RQE milestone.

### *Refurbishment Waste Processing Building (RWPB)*



SNC/Aecon is continuing to develop its cost estimate for the RWPB. SNC/Aecon has submitted different iterations of the estimate and schedule that the OPG team rejected as having insufficient detail. OPG has made clear to SNC/Aecon that the schedule must provide adequate detail to ensure that sufficient float is maintained prior to the mid-2017 need date for this facility. SNC/Aecon has developed a schedule, which still requires full vetting, that pulls the completion date back to December 2016.

With respect to the cost estimate, SNC/Aecon and OPG have agreed on key aspects of the basis of estimate regarding the ability of the RWPB to withstand a seismic event. This agreement may have some additional cost impacts, but these changes will be necessary to support the nuclear safety case. The team has set-up a separate Gate 3 for RWPB from the RFR work with a deadline of June 6<sup>th</sup>. The OPG team has challenged SNC/Aecon to produce the cost and schedule based on final resolution of the design basis and benefits from the Campus Plan Projects' lessons learned in the planning of this work. In the meantime, SNC/Aecon continues to perform caisson work and site preparation to mitigate any further schedule issues. The project executive-level meetings will continue until such time that OPG has confidence in SNC/Aecon's plan for the work, and weekly construction progress meetings will continue through completion.



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*BOP / Shut-Down/Lay-up*

Overall Risk Perspective



The DR Team has acknowledged that the BOP and Shut-Down/Lay-up modification work projects will be no better than Class 4/5 in time for RQE. However, the relative impact to RQE will be minimal – essentially the difference in holding contingency for a Class 4/5 v. Class 3 estimate for a relatively small (~6%) portion of the Project's cost. The BOP and Shut-Down/Lay-up teams continue to press the Contractor to develop the highest quality estimates based on the best information possible for RQE. ES Fox has set-up an estimating "war room" at its offices, and the OPG teams are actively collaborating with ES Fox to guide the process, provide answers to questions and highlight assumptions. OPG has established for ES Fox a seven-step vetting process and is tracking throughput. The team is committed to carrying sufficient contingency in RQE to compensate for the expected bandwidth around these estimates. BMCD/Modus recommends that these teams increase the level of documentation that is kept so that the actual basis of these estimates can be fully understood and vetted, and so that appropriate classification of these estimates can be applied.

[REDACTED]. Refurbishment's answer is to ensure that it properly characterizes the nature and maturity level of the estimates at the outset. [REDACTED]

[REDACTED] We have recommended to the team to consider this history because it is the most relevant information OPG needs to establish truly appropriate contingency levels for these Refurbishment projects.

In addition, based on the experience to date, the DR Team should be examining other options for delivering this work where practicable. If the schedule allows, [REDACTED]

[REDACTED] The BOP and Shut-Down/Lay-up teams are already taking extraordinary measures [REDACTED] The team should evaluate whether it would really be taking on additional risk by directing the effort. From our team's experience, the risk posed to execution by BOP has to be managed or this typically non-critical path work can have a significant impact on both cost and schedule.

Based on what we have observed of this process, the DR Team is actively managing and attempting to mitigate the deficiencies in these estimates. The DR Team now has metrics in place that should provide early warning signs for management to take mitigating actions. The DR Team's Gate 3 process requires that these projects proceed to their respective gates and visibly report all deficiencies that erode the quality of these estimates.

*Fuel Handling/Defueling*

Overall Risk Perspective



The Fuel Handling/Defueling team, which is integrated between Refurbishment and the station, appears on pace to deliver its Class 3 estimates and has shown the results of good overall cooperation and vendor collaboration. These projects are not significant in terms of overall cost but represent OPG's most significant critical path risk to the Project.

In the ongoing collaboration with Bruce Power, the Project Team received more granular information regarding the success of Bruce Unit 1's defueling for its refurbishment. Bruce Unit 1 achieved defueling 63 total days compared to the

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Project's assumption of 113 days. However, the additional details the team received allowed for more detailed analysis, and the team determined that Darlington's more complex and less efficient base design and related processes accounted for 30 of the 48 day difference, and those areas are not ripe for improvement. However, the analysis did net an opportunity to vet the 18 day difference between the stations in assumed Trolley Duty Cycle, which OPG executive management expects to be challenged.

With respect to Fuel Handling, the main challenge remains to improve the fueling machine reliability to increase the potential success for the fueling system's ability to simultaneously support Refurbishment and ongoing station operations. Over the last quarter, the team has made good progress in working through key issues, and OPG and vendor, GE-Hitachi, agreed to move forward by three months the schedule for commissioning the equipment to provide the Project with greater schedule float. While there have been challenges, it appears the schedule is achievable; that cooperation with the OPG team (including the station) and GEH has been good; GEH's engineering product has been of high quality; and the team has accepted and mitigated challenges along the way. While the risk of actual performance will remain until the reliability of the enhanced fuel handling equipment is proven, the actions taken by the team appear to have increased the overall probability of success.

### Functional Groups

#### Overall Risk Perspective



The functional groups (essentially what make up the "DR Team" and include Engineering, Operations & Maintenance Project Controls and the Execution Team) constitute approximately 30% of the DR Project's total cost. The RQE Roadmap milestone for RQE Functional Estimates Complete by May 15 will not be met, though progress toward defining the functions' purpose and related estimates has matured over 4d. Unfortunately, this maturation has resulted in the functional cost estimates for virtually each group increasing over their 4d levels.

These increases require extensive vetting, which as of this writing, has only recently started. Key areas for this vetting process should include:

- Assuring that the functions are properly supporting the Projects, and not duplicating effort the performing contractors are expected to provide;
- Ability to meet all of the true oversight needs an owner's management group should provide, including validation of field execution, timely decision-making when issues arise and management of risks;
- Examining how the functions mesh together so that there is no duplication of effort, excess cost or confusion over roles and responsibilities;
- Identifying whether the functional groups have met 4d goals for right-sizing their teams.

In our view, these goals can be met through: (1) detailed vetting of the functional management plans in comparison to the functional cost estimates to assure that all assumptions for staffing are fully identified; (2) development of a division of responsibility ("DOR") matrix that shows both ownership of functional areas and potential rub points; and (3) detailed vetting of the cost estimates themselves. While considerable work remains before these estimates can be considered to be complete, the progress made thus far allows management to view the functions in a consolidated manner and make appropriate decisions on right-sizing the effort for RQE.

## II. Campus Plan

### 1. P&M Management

#### Overall Risk Perspective



P&M's management has initiated changes to its project team to address issues that have been raised regarding P&M's performance. P&M has added experienced resources with construction backgrounds and management is focused on

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training programs to improve the team's approach to the Campus Plan Projects. In addition, Project Controls management will be consolidated with Refurbishment, and the Project Controls organization is adding resources so that better controls may be employed for tracking future P&M work (most notably the new D20 Storage contract). For the "in-flight" projects that are either too far along or too small to rebaseline, we have recommended, and the team has agreed, to make the specific bases for tracking of this work more visible and increase accountability for adhering to the current schedules. Project Controls is in the process of assessing each Campus Plan Project's estimate to complete and identify the major deliverables and implement, to the extent feasible, earned value metrics that account for major commodities. The projects' schedules are better aligned with the cost reporting tools which will provide more reliable indicators on the status of these projects. All of these measures should improve P&M's ability to manage and track the ongoing work.

### 2. Vendor Performance Issues

ES Fox's bandwidth to support the both the ongoing P&M work and its current work load for Refurbishment has received considerable attention from OPG's management. [REDACTED]

The OPG executive team has escalated these issues to ES Fox's senior management, from whom OPG has received assurances that ES Fox intends to strengthen its capability by adding core team members for project management, project controls and other needed positions. In addition, the Sr. VP of Nuclear Projects has requested ES Fox to take immediate action to reconcile its cost and schedule positions on the Campus Plan Projects and utilize lessons learned from recent projects to help properly characterize the nature of their project estimates.

The DR Team should continue its efforts to evaluate its needs from ES Fox and continue to hold them accountable for making necessary changes to support this work, and consider if there is an opportunity to balance work amongst the other ESMSA contractors. The team is taking measures to do so and must measure how ES Fox responds.

### 3. Major Campus Plan Projects

#### *D20 Storage Facility*



The DR Team has awarded the mechanical and electrical package to SNC/Aecon via a LOI, with the full conformed contract to follow once SNC/Aecon presents its full, detailed execution budget and schedule. SNC/Aecon was given a short but reasonable time frame to complete its work. Based on the multiple iterations SNC/Aecon's RWPB team has produced for that building, we have advised OPG to request ongoing updates during this period to ensure SNC/Aecon prepares its budget and schedule. SNC/Aecon is currently working with OPG to prepare for its mobilization and work through procurement issues. On April 30<sup>th</sup>, RCMT completed its design work and provided SNC/Aecon with the engineering packages it will need to plan and execute the work. SNC/Aecon will provide field engineering through the completion of the work.

Ellis Don continues to work at OPG's direction on the foundation work, which is currently running on or near schedule. The OPG team reported the end date for foundation work had slipped 2-3 weeks, though the teams are working together to look at different shift patterns and work calendars to pull the dates back into early December 2015, if not earlier.

The P&M team has committed to following Refurbishment's earned value and project controls processes for D20 Storage, which will provide a good proving ground for these processes for Refurbishment as well as significantly improved controls over P&M's past practices. In addition, P&M has added management resources and has established weekly progress meetings to focus on P&M's management of the work.



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Based on the current D20 Storage schedule, the revised plan appears achievable to meet the needs of Refurbishment, though with all of the issues to date, completion of the building will require close attention by the DR Team. With the contract award to SNC/Aecon, the P&M team should re-evaluate the project risks based on the revised execution model and implement and report on the revised project controls strategy to the completion of the foundation work.

### Auxiliary Heat



The Auxiliary Heat System Building (“AHS”) schedule and cost estimate continues to be a concern. ES Fox’s current date for construction completion is September 1, 2015, and AFS is scheduled for October 27<sup>th</sup>. These dates have been challenged by OPG’s team. The schedule pushes that are causing these dates to slip appear to be from issues that could be mitigated. This completion date is too close to the start of VBO, and will require ES Fox to resequence its work to recover this slippage. OPG is working with ES Fox to improve its schedule in consideration of the shift in the VBO date.

The current EAC of \$85.14M is being challenged by ES Fox, who has over \$6M in change orders (\$5M for engineering) that it has submitted to OPG. Construction was reported by P&M to be 45% complete, which needs to be verified, [REDACTED]

AHS also represents the first major Campus Plan Project to be commissioned with cooperation from Operations & Maintenance. We would advise the P&M team insist ES Fox provide as much float as possible before VBO to allow for any slips in commissioning.

### Emergency Power Generator 3



EPG 3’s current performance trends are also a concern, and the Project Team is reporting the planned September 2015 in-service date has slipped to April 7, 2016. [REDACTED] and the Project’s EAC is \$\_\_\_\_, an increase of \$\_\_\_\_ since 4d. Engineering completion has been delayed to May 2015 due to vendors’ performance challenges, though ES Fox reported this date will be met. The P&M project team was readying EPG 3 for its final Gate 3, though these trends and ES Fox’s additional cost submissions and delayed schedule development have pushed this gate meeting. The Project Team is also carrying the commissioning of EPG 3 as a significant risk due to the complexity of commissioning and configuration of this equipment.

P&M’s management has requested a full recovery plan from ES Fox, and the SVP of Projects has requested a focused, weekly update to examine ES Fox’s performance. Given the short timeline to complete this SIO project, [REDACTED]

## III. Other Focus Areas

### A. Corporate Support

BMcD/Modus remains encouraged by the ongoing efforts by OPG’s corporate units to support the DR Project. Finance is embracing its role in the vetting and challenging of the various elements of RQE, and continues to provide its full support to the Project. The Project Team and the CIO are working together to implement needed changes that are tailored to the needs of the Project. This collaboration has resulted in the CIO supporting upgrades to software and necessary attention to the Project’s hardware needs. In addition, we are encouraged by the increased focus People and Culture’s senior



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leadership is providing to develop flexible plans to address the personnel and succession issues that have been highlighted as major risks.

## **B. Risk Management**

An effective risk management program is integral to the success of the Project. The Darlington Risk Management Program continues to evolve. Overall guidance, process and tools have matured and visibility of senior management support has improved. From a process standpoint, the DR Risk Management Program has matured into an excellent vehicle for identifying and facilitating the management of risks. The recent launch of the Risk Management and Oversight (“RMO”) tool has greatly facilitated the review, analysis, tracking, and management of refurbishment risks across bundles, functions, and “Key Risk Areas”.

The concept of “Key Risk Areas” (“KRAs”) has been introduced to consolidate program and project risks by common themes or drivers (e. g. “Regulatory Approval”, “Cost & Estimating Management”). A senior management sponsor is assigned to each of the Key Risk Areas for the purpose of ensuring that project managers and functional team leaders, along with the risk owners focus proper attention on identifying and managing the risks. We have observed a tendency for the project team to focus only on “urgent” issues. The KRA assignments are very critical because managing risks seems to fall into the “Important, but Not Urgent” category of priorities that managers face every day. In fact, the purpose of a risk management program is to identify the important issues before they become urgent—and so they can be effectively mitigated. Once an issue becomes urgent, the possible resolutions are inevitably limited and more costly. The KRA sponsor concept in theory is a good one—however, it will only be effective if it is given a priority and managed daily. That effectiveness has yet to be realized. We have made several recommendations for the improvement of the Risk Management Program and will continue to monitor its progress.



**ONTARIO POWER**  
**GENERATION**

## I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMCD/Modus") provide the following Quarterly Report to the Darlington Refurbishment Committee of the OPG Board of Directors ("DRC") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of August 7, 2015. Our main focus continues to be assessing the development of the Release Quality Estimate ("RQE") that the team intends to provide the Board of Directors at the October 1-2, 2015 retreat.

Specifically, this report focuses on the DR Team's current status with its RQE preparation, a summary of the processes used for deriving the estimate, remaining gaps in the RQE effort that the DR Team will need to close, and recommendations for the DR Team to take into account as it evaluates risk and contingency. As we have previously observed, the DR Team's RQE effort has followed an appropriate process for deriving the Project's estimate, though there have been some unexpected challenges that have impacted the planned pace of RQE's completion. Most notably, while some of RQE's work is significantly advanced, the date for OPG's acceptance of the estimate for the Retube and Feeder Replacement ("RFR") project with the SNC Lavalin/Aecon joint venture ("SNC/Aecon"), has slipped from June 15 to at least August 31. The additional time for vetting the RFR Class 2 Estimate has been extremely valuable, as the end result of the DR Team's efforts should be a very robust and defensible basis of cost estimate and schedule for the most significant scope of work in the DR Project. In addition, the team has encountered issues with assembling, verifying and validating the amount of cost data that is inherent with an effort of the magnitude of RQE. Thus, the DR Team's ability to assess the Project as a whole, including the full schedule, resource allocation, contingency and other such considerations, has been delayed and compressed. As a result, we believe the DR Team will be challenged to meet the current schedule for presenting a RQE that can serve as the Project's control budget by October 1-2.

Following the Recommended Practices provided by the Association for the Advancement of Cost Engineering International ("AACEi"), the DR Team has committed to provide a full, four unit Project "Class 3" estimate with an intended accuracy range of +10% to +30% (on the high end) to -10% to -20% (on the low end).<sup>1</sup> Per the AACEi recommended practices and OPG's own procedures, the RQE would be based on a sufficient level of maturity to form the Project's control budget, against which the overall Project's progress will be compared to completion. The DR Team intends to prepare unit-specific check estimates immediately prior to the start of execution for each unit that will leverage additional maturation of the planning effort and account for any lessons learned from prior units' performance. The check estimate for Unit 2, the first unit to reach the execution phase, is scheduled for August 2016 and the goal is to further mature the Unit 2 estimate and schedule for optimal management of the Execution Phase.

The total RQE amount will include the \$2.547 billion OPG plans to spend during the current Definition Phase through October 2016. OPG engaged in this extensive planning and preparatory effort in order to mitigate issues that have severely impacted prior CANDU refurbishments and other nuclear megaprojects. This includes a commitment to complete engineering by August 15, 2015, more than one year before opening the breaker of the first refurbished unit, Unit 2. The Definition Phase has also included hard construction costs for:

- Completion of \$1.2B of pre-requisite Campus Plan Projects needed for Refurbishment and ongoing operations;
- Purchase of all specialized tools required for the units' refurbishment;
- Procurement of Unit 2 pressure tubes, feeders, end fittings needed for refurbishing the units' reactors;
- Fees to vendors for development of detailed engineering, project estimates, execution schedules and construction work packages ("CWPs") needed for execution.

<sup>1</sup> For purposes of characterizing RQE and its component parts, OPG has utilized AACEi Recommended Practice No. 18R-97 COST ESTIMATE CLASSIFICATION SYSTEM – AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION FOR THE PROCESS INDUSTRIES



## Report to Darlington Refurbishment Committee 3Q 2015 Darlington Nuclear Refurbishment Project



In addition, OPG has already negotiated the terms and conditions of the most significant execution contracts with EPC contractors, many of which include provisions for establishing target pricing and incentives based on acceptance of detailed vendor estimates.

BMcD/Modus recognizes OPG's commitment to plan the work in advance and the DR Team's many accomplishments to date in the Definition Phase. However, the DR Team's RQE effort has been substantially compressed. The original schedule for RQE was to complete the estimate integration and analysis by October 15<sup>th</sup> and then present to the Board in November 2015. RQE preparation for that November delivery included a planned 3 ½ months of detailed integration and vetting of the amassed data; that work under the current schedule has been compressed to 1 ½ months, with much of the work being done in parallel. Significant work remains for the DR Team to meet its commitments with respect to the submission of RQE, as discussed below.

As noted, the DR Team intends to use the period from RQE to Unit 2 breaker open in October 2016 to further mature its planning, estimates and schedules, and present a Class 2 check estimate and detailed execution-ready schedule in 2Q 2016. The team has developed a "Readiness to Execute" regime through which it plans to test multiple processes and improvement initiatives with smaller BOP and Shut-Down/Lay-up packages that need to be performed prior to Unit 2's breaker open.

### II. DR Project RQE Overview—Status



On January 20, 2015, the DR Team presented its RQE Roadmap to the NOC. That initial Roadmap anticipated the DR Team would produce RQE for Board approval at the November 12, 2015 meeting. This schedule was premised on a number of key milestones being met, most notably:

- Completion of Functional Estimates – May 15, 2015
- Acceptance of SNC/Aecon's RFR estimate – June 15, 2015
- All Execution Phase project Gate 3's complete (except for BOP and Shut-Down/Lay-up) and Project Data Frozen – June 30, 2015
- Presentation of RFR target price to NOC – August 20, 2015
- A six week review and validation period of the estimate and schedule date (July 1 to August 20)
- From August 21 to October 15, the senior team planned vetting and rationalization of changes;
- Finance had 3 weeks to provide a final review and approval before the October 15, 2015 planned completion;
- One month (October 15 to November 12) to prepare and route the materials before the November BOD meeting.

The DR Team's time to finalize RQE has been significantly compressed, and the once planned 3 ½ month period (July 1<sup>st</sup> to October 15<sup>th</sup>) for vetting of the integrated cost and schedule has been reduced in its current plan to 1 ½ months (July 31<sup>st</sup> to September 15<sup>th</sup>). The current schedule is premised on the DR Team completing the RQE base cost and contingency and associated unit by unit cash flows and consolidated business case by September 15<sup>th</sup> for presentation to the DRC 10 days later. To meet these challenging dates over the next month, the DR Team must complete:

- A thorough vetting of the Project's cost components through a series of "Program Integrated Scope and Reasonability Reviews" with the Project Managers leveraging the work completed to date;
- The receipt and review of an acceptable estimate and schedule submission from SNC/Aecon, which is currently expected on August 31, 2015, though which will still require verification, vetting and reconciliation with the rest of the RQE files;
- Concluding the negotiations with SNC/Aecon on the RFR target price;

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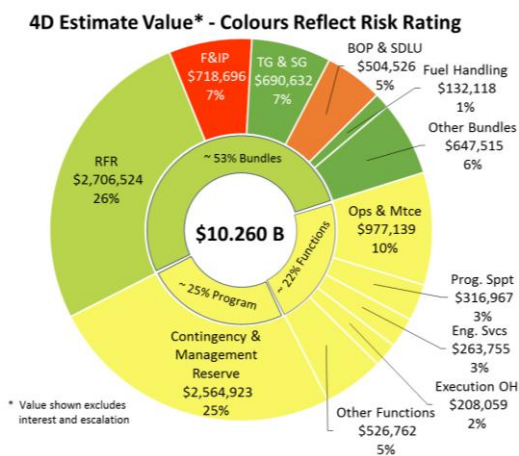




- Finalizing the documentation for the basis of estimates for each of the Project's "bundles" or sub-projects;
- Final vetting of the DR Team's Functional groups, functional management plans, and associated cost estimates
- Senior management vetting and challenge of the program and its constituent parts to validate the overall schedule, resourcing, roles and responsibilities and confidence level in performing the work;
- Finalizing development of the DR Project's contingency, including reviewing all of the discrete risks for each bundle and the program as a whole, and capturing and properly modeling risk of performance for all four units;
- Integrating the cost and schedule data for each of the Program's component parts so that an integrated review can be performed to ensure proper alignment for future cost and schedule control; and
- Addressing potential quality control and quality assurance concerns in order to provide the confidence in the reliability and accuracy range RQE as the control budget for the Project.

This represents a tremendous amount of work in a short period of time and assumes that work feeding RQE outside of OPG's direct control will finish on time and with requisite quality. Moreover, for this effort to be successful, the data produced for developing RQE must be free of error and understandable, as there is no margin for rework. As discussed below, the team is currently integrating the data for these reviews to begin, and this effort has also proven to be more time consuming than initially thought, and currently lacks the final and most important part, the RFR estimate. BMcD/Modus is concerned that the remaining time to October will not be sufficient for the DR Team to finalize RQE commensurate with the necessary quality to establish the Project's control budget.

## A. Status of the Components of RQE



As with our prior reports, Figure 1 shows the 4d cost estimate values for each of the major sub-projects, or bundles, as well as the OPG Functional costs and contingency. Once RQE is finalized, we will update this figure to reflect the current values and percentages of the Project's cost.

Figure 1 also provides context for the size and percentage of each component of RQE. The three largest parts of RQE are: RFR (26%); OPG Functions (22%); and Contingency and Management Reserve (25%). BOP and Shut-Down/Lay-up (5%), the Turbine Generator project (6%) and Campus Plan Projects (7%) are next largest slices of the budget. Below, we provide a brief update regarding the status of each of the major inputs to RQE, and in Section IV below, we provide additional details regarding key areas – RFR, Functions, and Contingency.

## B. Major Inputs to RQE

### Detailed Engineering:

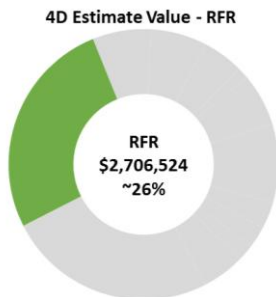
One of the lessons learned from other refurbishment and other nuclear megaprojects is that the control budget should be based upon completed engineering in order to mitigate the risk of unreliable and uncertain initial cost estimates. As a result, OPG has made a commitment to complete as much engineering as reasonably possible for the basis of the RQE control budget, and to ensure that engineering is sufficiently complete for each unit to prepare a Class 2 cost estimate prior to field execution. As of June 30, the Project's Detailed Design was 92% complete which means the Project is in substantial compliance with its goal to define engineering and scope sufficient to support RQE.

As the BOP and Shut-Down/Lay-up projects proceed with their development of detailed Class 3 estimates for their upcoming Gate 3s and prior to the check estimate, the DR Team should account for a risk that has manifested itself in

the Campus Plan Projects, that the definition of “design complete” needs to include in the engineering package all of the vendor/supplier procurement information. P&M projects have also had cost impact and scope creep due to the later incorporation of these details by the EPC contractor’s revised “Issued for Construction” drawings, and this additional effort was not estimated at the outset of the work. The DR Team’s Engineering VP has highlighted this risk which now must be monetized and carried in RQE.

### Retube and Feeder Replacement:

SNC/Aecon’s Class 2 Estimate for RFR is the single largest input to RQE. Some notable highlights since our 2Q Report:

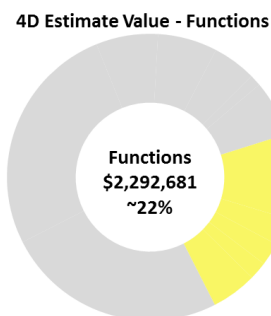


- SNC/Aecon’s initial Rev 0 submission dated 5/8/15 was rejected by OPG for quality deficiencies and omissions. SNC/Aecon’s submitted schedule was significantly longer (1086 critical path days with 396 days of contingency time) and higher in cost (in excess of \$3.3B) than acceptable to OPG.
- From 5/8/15 to 7/20/15, OPG led a series of challenge meetings with SNC/Aecon’s VPs to identify gaps in schedule, cost and quality. On a parallel path, the project teams have engaged in “bottom-up” vetting of the estimate and schedule.

- These initial efforts resulted in OPG and SNC/Aecon agreeing to target a schedule duration of 1110 days and an associated cost of \$2.6B (at P50 contingency level).

The teams are currently working to these goals with a target of mid-August for completing the analysis and August 31<sup>st</sup> for SNC/Aecon’s “Rev. 1” submission, approximately 2 ½ months later than the DR Team anticipated. Because of RFR’s importance to the Project, this delay threatened to impact the DR Team’s ability to complete key elements of RQE. There has been increased cooperation between the teams to optimize the work flow to the extent possible. However, due to the enormity of the effort at both the project and executive levels, concluding this estimate is taking significantly longer than OPG anticipated. The DR Team has engaged in some work-arounds to keep the rest of the RQE process moving in parallel. Moreover, the DR Team and our team are concerned that SNC/Aecon will have a large amount of work in a short time to meet the August 31<sup>st</sup> date for the Rev. 1 submission, and this could impact the quality of the revised submission. OPG is attempting to mitigate this with near-constant contact with SNC/Aecon until the submission is delivered.

### Functional Groups:



The DR Team’s intention for RQE with the Functions is to develop a bounding estimate that incorporates all necessary roles and responsibilities, and then examine the organization in the Readiness-to-Execute roll-out after RQE.

Early in the RQE process, the initial functional estimates had shown 9% growth over what was presented in the 4d Estimate. The SVP commissioned a team drawn from multiple areas within the Project and the centre-led functions to examine the DR Team’s functional estimates and provide recommendations for reducing redundancy and overall staffing size. The recommendations from this review have been accepted and are now being integrated into the various staffing plans. Once complete, the DR Team will need to vet the results to

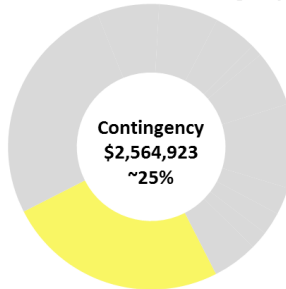
confirm that the current estimates are bounding in nature.

Management will still need to devote significant attention to right-sizing the team, defining clear roles and responsibilities and locking down appropriate assumptions prior to the Unit 2 check estimate. Past attempts to make top-down adjustments to the functional estimates have not been effective at holding down cost estimates, and this remains a risk. More importantly, the DR Team needs to be arrayed in a manner that is capable of effectively managing the execution phase. The DR Team’s leadership is committed to doing so.



## **Risk and Contingency:**

4D Estimate Value - Contingency



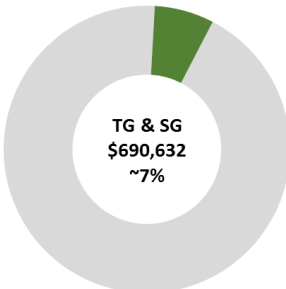
Contingency is the third largest category of costs in RQE behind RFR and the Functional Groups. The DR Team has developed and matured risk registers over the life of the project to date. The Risk team held workshops with each of the project and functional teams to review the current state of the risk registers to establish estimating uncertainty, clearly identify risks and fine-tune risk scoring so that contingency can be calculated and analyzed using Monte Carlo analysis methods. Once the data establishing the Project's base cost is fully available, the project teams will need to vet the results, and the DR Team's leadership intends to follow with full project reviews which are intended to challenge and affirm the variability in the estimates and approximate the level of estimate uncertainty.

We find the process for developing contingency to be robust, and the team has received help and advice from OPG's Enterprise Risk Management and OPG's vendor. However, the overall quality of the contingency development will be dependent on the quality of the data inputs. Due to the compressed RQE schedule, we remain concerned that the time for developing the base costs, understanding the estimate classifications and analysis of the residual impacts of discrete risks will compress the proper formation of contingency.

## **C. Status of Remaining RQE Inputs:**

### **Turbine Generator and Steam Generator:**

4D Estimate Value - TG & SG



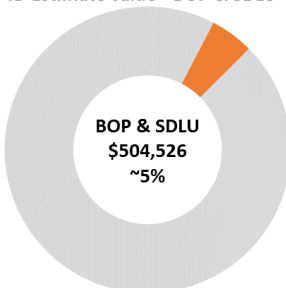
OPG has accepted SNC/Aecon's Class 2 Estimate for the Turbine Generator for Unit 2, and Alstom has completed its detailed design. SNC/Aecon and Alstom have submitted their full estimates for the subsequent units, which are characterized as Class 3 in nature. OPG's approval of those detail estimates is pending final review, though is expected shortly.

As with RFR, the OPG and the SNC/Aecon project teams are integrated and working well together. The remaining risks at this time appear to center on completing the CWP's for execution and finalizing the Unit 3, 1 and 4 detailed schedule. In addition, the risk profile for the Project changes significantly with Unit 3, which will be the first of three units that will have a full replacement of the original TG controls during Refurbishment. This will be a first time evolution for OPG and will require significantly more planning than the limited scope for Unit 2.

The OPG Steam Generator Team has done a good job in managing its activities in order to meet its milestone dates and this project is currently on-track. No issues are apparent at this time; these estimates are expected to support RQE.

### **Balance of Plant/Shut Down-Lay-up:**

4D Estimate Value - BOP & SDLU



At this time, the focus for BOP and Shut-Down/Lay-up has been Phase I/II engineering and planning work. The DR Team projects that detailed engineering for these projects will be substantially completed by the August 15, 2015 milestone. The DR Team has provided guidance to ES Fox to improve the development and quality of its related project estimates, and is in the process of characterizing the estimates it has received at this time. Approximately 35% of the BOP and Shut-Down/Lay-up work estimates will be in the Class 4/5 range, which increases the risk of estimating uncertainty and accuracy bandwidth for these projects. The OPG Estimating Team has taken a reasonable approach in characterizing the estimates on the basis of differences in their maturity level. Prior to RQE, the DR Team

needs to devote significant time in finalizing the risk registers for these projects so that contingency can be properly attributed.

In addition, ES Fox must continue its planning work with more detailed and mature estimates, execution schedules and



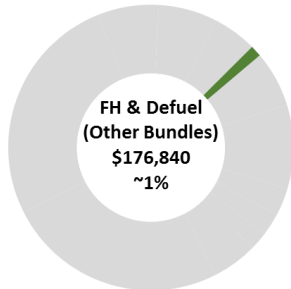
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development of CWP's. The DR Team has placed a goal of having BOP projects proceed to their Gate 3 between late November 2015 and January 2016. To do so, ES Fox will need to complete the detailed level 3 execution schedules, Class 2/3 estimates and Construction Work Packages to support these gates. To meet these goals, the BOP team has set interim milestone dates with ES Fox for these deliverables which will be regularly pulsed by the team.

### Fuel Handling/Defueling:

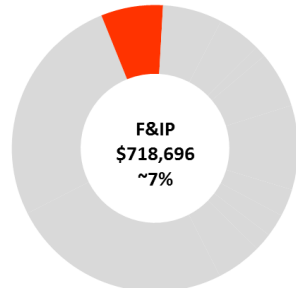
4D Estimate Value - FH & Defuel



The DR Team has received and accepted vendor Class 3 level estimates for RQE based on completed engineering from GE/Hitachi. Cold commissioning is ongoing for Fuel Handling system modifications, and while performance indicators had been lagging, recent progress has dramatically improved overall schedule performance. The recovery plan has also allowed the team to advance plans for testing and training. These recent improvements should allow for a better understanding of the critical path project durations and performance risks

### Campus Plan Projects:

4D Estimate Value - F&IP



The overall performance of the most significant Campus Plan Projects – D20 Storage, Auxiliary Heat System (“AHS”) Building, and Emergency Power Generator 3 (“EPG3”) - has continued to be impacted by ongoing issues with poor initial estimates and scope definition, site conditions, contractor performance and OPG oversight.

- **D20 Storage** – OPG issued a purchase order to SNC/Aecon on July 31, 2015 that covers the mechanical, electrical and civil/structural work from grade. SNC/Aecon has provided an estimate and schedule for the work that still needs continued development. SNC/Aecon initially submitted its cost and schedule proposal on April 9, 2015 though it was rejected by OPG due to a number of unacceptable commercial and scope exclusions.

SNC/Aecon revised its submission on July 8, 2015 including an estimate proposal of \$148M, an increase of \$8M from the prior submission, with a Class 3 bandwidth. OPG’s estimating team issued approximately one hundred comments to which SNC/Aecon agreed to respond; to date, these have not been fully addressed. While it was necessary for P&M to release this work to SNC/Aecon, it is important SNC/Aecon complete and fully submit its estimate for RQE so that OPG can properly assess risks of performance and potential costs. The Refurbishment Estimating team is supporting P&M in completing the vetting of the details of SNC/Aecon’s estimate to determine whether it is of sufficient quality to meet contractual requirements and allow for OPG’s assessment of risk and contingency. This is needed to support RQE.

Ellis Don continues to perform the underground civil work, including foundations, dyke walls and closure slab at grade. Currently, the schedule (dated August 4) shows Ellis Don is 57 work days (82 calendar days) behind in meeting the key milestone for setting of the D20 tanks. On August 6, the D20 Storage team identified a partial recovery of approximately 15 days (to January 13<sup>th</sup>) of this milestone through resequencing of the work. However, at Ellis Don’s current pace (SPI is 0.58), it is likely that these dates will continue to slip. If this work cannot be recovered, it will significantly compress SNC/Aecon’s work and could impact Unit 2’s need to use the D20 Storage tanks for moderator and primary heat transport drain after breaker open. OPG needs an execution schedule for D20 Storage that can be executed by the performing contractors based on the current understanding of the work, realistic projections based on field productivity to date, and which accounts for the limiting factors in the construction of the building.

We have recommended that P&M assess these risks using SNC/Aecon’s estimate and schedule and revisit the business case to confirm whether the path chosen for execution is the most prudent course, and whether the team should revisit options for temporary storage of Unit 2’s heavy water. It is notable that SNC/Aecon

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currently classifies its estimate at Class 3, as the business case was premised on a Class 2 estimate, meaning that additional contingency may be needed to cover the risks. P&M is also pursuing options with SNC/Aecon to further improve the schedule and sequence of the work. In any event, this analysis must proceed so that the risks of performance are adequately captured and monetized in RQE.

- **AHS** – The AHS project, which has been subject to schedule delays and cost increases, is nearing completion. The current schedule shows the work is 92% complete and construction testing of the systems has begun. The target for completion is October 2015 based on a full understanding of the commissioning effort. OPG and ES Fox have executed a fixed price amendment to cover the outstanding costs that had been pending for several months. The current projected final cost is \$99.5M, which has required a contingency draw of \$15M over the approved \$84.52M budget in 4d. AHS has provided multiple lessons learned that Refurbishment is taking into account in planning of BOP and Shut-Down/Lay-up work with ES Fox.
- **EPG 3** – This project must be completed prior to Unit 2's breaker open. Construction has been impacted by issues with plant tie-ins and unforeseen underground conditions. Engineering of modifications to the EPG unit are complete, and ES Fox has provided OPG with an estimate at completion of \$115M (increased from \$88M in 4d). The Refurbishment Estimating team needs to fully vet the details of the estimate to determine whether it is of sufficient quality and represents a sound plan. In addition, the schedule for construction requires additional vetting to confirm the constructability and sequence of ES Fox's plan. These details need to be addressed before the project advances to its upcoming Gate 3.

In prior reports, we have commented extensively on the P&M team's structure and capabilities for managing the work. P&M had previously committed to making improvements in areas of project management, project controls and risk management through additional training and adopting Refurbishment processes, where necessary. These improvements need to be accelerated to properly manage the remaining Campus Plan Projects to completion within the RQE control budget. In addition, we have raised the risk of ESMSA contractors' performance deficiencies. The step-up in collaboration between the Refurbishment team and the ESMSA contractors has resulted in higher quality engineering packages and project estimates. The vetting effort described above with SNC/Aecon's D20 Storage proposal provides an example of the benefits that P&M has achieved. These same efforts need to be applied to all remaining Campus Plan Projects, as necessary, to reduce risk of remaining performance and attempt to properly characterize the risks of these Projects to the Refurbishment program.

### III. Areas of Focus - RQE Quality

#### Estimate Characterization



The process of validating and vetting EPC cost estimates for the Project's bundles has followed the approved DR Project RQE Cost Estimate Plan. The vendors presented the cost estimate packages to the OPG Project team in a multi-stage progressive review process for comments and disposition. Among the issues covered at each review stage were scope, COMS, schedule, identification of key cost drivers, estimate basis, benchmark ratios, exclusions and assumptions, as well as cost challenges on a number of issues, such as vendor PMT, indirect costs and productivity factors. Once the EPC vendor completed the comments and disposition phases, and a final revised estimate was received, OPG's estimating team then loaded the estimates into the US Cost estimating platform for analysis.

Once loaded into OPG's US Cost database, OPG's estimating team then vetted and validated the estimate data to determine if the estimate was accurate, reasonable and competitive to the desired classification; as well as, identified any gaps in the documentation or methodology that may negatively impact the quality of the final estimate. The team then performed a technical review of the estimate from a scope point of view and proposed an AACE classification for further review. The process is documented with review checklists. Another member of the estimating team performed



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a peer review of the estimate checklists. The estimating manager then conducted a final challenge of the proposed classification of the estimate. Upon completion of the review process, the estimating team issued an estimate declaration of appropriate AACE estimate class.

The estimating team is in the process of performing a reasonability review to obtain buy-in of the vetting process. The focus was to ensure the estimate and its classification is transparent and justifiable. A final estimate review report is then issued memorializing and summarizing the AACE classification, scope review, estimate review, and reasonability review for approval by the Project Manager. This report is targeted for the end of August 2015.

Over the coming weeks, BMcD/Modus will be reviewing and sampling the process to test whether the OPG estimating team has consistently applied its standards and accurately assessed the estimates.

### RFR Project-Class 2 Estimate



RFR represents approximately 26% of the total estimated DR Project cost (per the 4d estimate, including contingency), and thus, remains the single largest risk to RQE and the DR Project as a whole. To provide context for the RFR estimate's current status, the following is a summary of the events over the past year.

After receiving SNC/Aecon's Class 3 estimate in June 2014, OPG worked collaboratively with SNC/Aecon to ensure that its Class 2 estimate plan and pricing of the work would be, when delivered, reasonable and achievable. This collaborative review process was intended to ensure that SNC/Aecon's estimate accounted for OPEX from past refurbishments, improvements to the tool set for Darlington and the value of the planning effort to date, including the full-scale mock-up at the Darlington Energy Centre ("DEC"). The collaborative review process spanned much of the year between the delivery of the Class 3 estimate in June 2014 to mid-April 2015, though SNC/Aecon was consistently behind in its preparation. In April, OPG paused its review to allow SNC/Aecon to complete the estimate documentation on its own. It was clear to the OPG team at that time that proper vetting of the estimate required SNC/Aecon to deliver the entire Rev. 0 submission, as piecemeal reviews of the estimate's components were of increasingly limited value. On May 8<sup>th</sup>, 2015, after several changes to the agreed to delivery date<sup>2</sup>, SNC/Aecon presented its first draft of the Class 2 estimate to OPG.

From an initial reading, it was immediately apparent that SNC/Aecon's Class 2 submission was based on a substantially longer duration and higher cost than OPG anticipated, considering the results from testing in the mock-up were very favorable. In fact, the base duration in Rev. 0 exceeded the scaled-up duration of Wolsong (which is a smaller unit), and the reasonably achievable duration was in excess of Bruce Unit 1, both of which had problems during execution that SNC/Aecon and OPG had strived to eliminate for the DR Project.

Following SNC/Aecon's delivery of its Rev. 0 Class 2 estimate, OPG's project management team (including members of the Estimating, Scheduling, and RFR organizations) commenced detailed reviews, ultimately producing over 2,000 comments regarding various noted deficiencies. OPG began bottom-up estimate vetting exercises consisting of "deep dives" and "vertical slices" through the estimate documentation. The deep dives generally addressed specific items of cost such as tool management, support services, direct field labor, performance adjustment factors, and the like. The "vertical slices" evaluated SNC/Aecon's estimate at different key points in time, testing the veracity of SNC/Aecon's planning, resourcing, and constructability; in particular, areas of high complexity such as peak man-power staffing, unit over unit overlaps, and waste processing logistics were carefully analyzed. The results of the early vetting revealed problems with SNC/Aecon's submission that needed to be corrected for OPG to accept the estimate and utilize it as the

<sup>2</sup> The SNC/Aecon contract specifies that the Class 2 Estimate would be delivered by May 15<sup>th</sup>, 2015. By mutual agreement, SNC/Aecon's Class 2 estimate was accelerated for delivery by April 10<sup>th</sup>, 2015, though SNC/Aecon was unable to meet this deadline. OPG ultimately provided SNC/Aecon with an extension to May 8<sup>th</sup>, 2015 to ensure SNC/Aecon was providing an estimate package of requisite quality.



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basis of the Project's target price.

Simultaneous to OPG's review, the parties jointly engaged an expert panel (including individuals selected by OPG and SNC/Aecon) who have played significant roles in virtually every CANDU refurbishment to date. The expert panel reviewed SNC/Aecon's submission and generally agreed with OPG's conclusions regarding the excessive schedule, cost, size of the labour force and risk monetization. BMcD/Modus also provided input from our review of the submission, focusing largely on inconsistencies in the information presented and areas lacking in appropriate back-up and rigor. Areas we highlighted to OPG were as follows:

- Overall quality is insufficient to support a Class 2 submission
- Contingency is built into the base estimate and schedule
- Subsequent unit estimates are assumed to be a replication of Unit 2, with overlapping schedules, and did not consider distinct risks from the overlaps and changes in the execution model
- OPEX is not utilized in a meaningful manner for establishing the basis of the estimate or testing reasonability
- Resource leveling is questionable and resultant resource curves are not achievable
- Based on comparable metrics, the PMT is oversized and is not presented as a well-integrated organization
- SNC/Aecon's inaccurate understanding of conformance to AACEi recommended practices for estimate preparation

Overall, the expert panel and BMcD/Modus produced over 300 comments regarding the Rev. 0 estimate's quality.

Based on the DR Team's initial reviews and input from third parties, it was clear to OPG that SNC/Aecon's Rev. 0 submission was insufficient, and resolving the multitude of issues would require substantially more time and effort than originally planned. The resultant estimate vetting process has run well past the initial mid-June 2015 target date for approving SNC/Aecon's Class 2 estimate. Starting in June, OPG and SNC/Aecon proceeded down parallel paths to resolve the current estimate issues:

- Project executive-level working sessions, intent on establishing a set of baseline cost and schedule objectives and addressing potential risks and barriers to performance that caused SNC/Aecon to take an excessively conservative approach to the estimate;
- Continued bottoms-up vetting of the detailed estimate and schedule, with subject matter experts ("SMEs") from OPG and SNC/Aecon working shoulder-to-shoulder to resolve OPG's comments and challenges.

Based on the agreement reached at the project executive-level, the combined OPG and SNC/Aecon teams have been given targets for what OPG deems an acceptable schedule and cost (a P50 schedule of 1,100 days and a target cost of ~\$2.6B including contingency). These targets were provided for context only, as the direction given by both management teams was to focus on coming to agreement on what is realistic and achievable, supported by workable plans, concrete data, and OPEX, rather than meeting top-down targets. This process has netted excellent progress towards reaching closure on many of OPG's challenges and developing a principled basis for SNC/Aecon's estimate.

The current target date for delivery of the revised estimate is August 31<sup>th</sup>. Meeting this target will require completing the following:

- Finalize review of schedule critical path and sub-critical path durations from "bottoms-up"
- Rationalize risk register and reach agreement on nature, severity and ownership of risk
- Complete monetizing Unit 2 estimate based on outcome of SME examination
- Review all accepted changes to schedule and monetize differences in overhead/Project Management Team ("PMT") costs





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- Provide analysis of discrete risks for Units 3/1/4 and monetization of same
- Complete all steps in pre-negotiated term sheet including finalizing incentive/disincentive approach
- Dispositioning all items in expert panel and BMCD/Modus list
- RWPB estimate which needs to be fully vetted.

From the outset, we have recommended that OPG take a reasonable amount of time to vet the Class 2 estimate given its importance. Completing all of this work by August 31<sup>st</sup> will be a significant challenge, and ensuring that the resultant SNC/Aecon Rev. 1 submission is of the quality capable of being approved will also take time. However, the work done to date in vetting the estimate has had tangible results and greatly improved the price, schedule and risk profile for the overall Project.

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### *Functional Groups*

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The Project's functional groups (essentially what make up the "DR Team" and include Engineering, Operations & Maintenance, Project Controls and the Execution Team) constitute approximately 22% of the DR Project's total cost. The RQE Roadmap milestone for completing functional estimates by May 15<sup>th</sup> was not met, and the initial functional cost estimates for virtually every group increased over their 4d levels.

The SVP of Nuclear Projects challenged the functional team managers to both reduce their overall cost and right-size their staffing plans, and investigate ways to leverage other parts of OPG's business to reduce staffing burdens. To assist in this regard, the SVP requested formation of a senior review panel that included a broad spectrum of knowledge within the company. This panel provided the following observations from this review:

- Many of the panel's recommendations related to removing overlapping responsibilities between different functions;
- Future staffing reductions, based on Lessons Learned from the first unit, should be possible for the subsequent units included in RQE;
- Approximately 50% of the reductions contained in the report have been agreed to by the Functions. A 'top down' instruction will be required to achieve the balance of the reductions recommended. In addition, a single leader must be assigned to ensure the reductions are implemented and that a Divisional Self-Assessment or audit be performed prior to the 'Check Estimate' to ensure the reductions have remained in the estimate; and,
- Going forward, the project philosophy must be that if something is to be added to the estimate an equivalent reduction must be taken.

The panel made a number of recommendations regarding clarifying roles and responsibilities and resource allocation. From a cost estimate perspective, the panel essentially reversed much of the cost growth that the functions had estimated post 4d. These recommendations were presented to the SVP, who directed the functions to follow suit and revise their staffing plans.

In our view, the results of the senior panel still need to be vetted to ensure that the recommendations have been incorporated into both the teams' management plans and cost/staffing estimates. The SVP has directed top down adjustments in prior cost forecasts that have not been realized; thus, ensuring full buy-in of the panel's recommendations is necessary at this time. Moreover, once these changes are made, we would advocate vetting of the result to see whether the revised plans truly represent a bounding estimate. At a minimum, the functional management plans from the team must reflect that the panel's recommendations have been embraced and the staffing plan needs to reflect those assumptions.

Ultimately, the DR Team's leadership intends to "live test" the organization through the Readiness to Execute plan,

leading to potential refinements of the organization needed for the full Execution Phase. We have recommended that management also look at the division of responsibility (once available) to confirm the roles are well defined and duplication is eliminated, and examine the work itself and right-size the staff in accordance. The senior leadership is committed to doing so prior to the Unit 2 check estimate. There is considerable value in re-assessing the DR organization's structure considering the current transition to execution phase work and the ways in which the Project's planning has matured.

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### *Risk and Contingency*

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Contingency for RQE will be comprised of seven (7) major "buckets", each of which require separate and unique inputs. These buckets include:

- Cost estimating uncertainty (determined based upon the class of estimate of the base costs and the opinion of OPG estimators and subject matter experts);
- Schedule estimating uncertainty;
- Discrete risks (both for the individual project bundles and the entire program);
- High impact/low probability risks
- Contingent work;
- Campus Plan/F&IP life cycle contingency estimates; and
- Insurance uncertainty

OPG has taken a scalable approach to calculating contingency for project bundles and functions. The rigor applied and method used (stochastic or deterministic) will depend on the state of the project bundle or function at the time the RQE package is assembled. Where the base plan cost and schedule estimate is mature enough to allow it, certain buckets will be run through a Monte Carlo simulation using the @RISK program. Other buckets (such as the high impact/low probability risks, Campus Plan life cycle contingency risks and insurance uncertainty) are derived deterministically using expert analysis and will be added to the outcome of the Monte Carlo simulations to comprise the total RQE contingency estimate.

OPG has retained the PALISADE Corporation to provide third-party expertise in supporting RQE and to ensure integrity of the modelling process. This third party expert will review the inputs generated by the risk management process, design the risk model, define the detailed modeling feed stock and execute and oversee the contingency modeling processes. PALISADE is the developer of the @RISK program and has performed this function for many capital projects.

During the week of July 20, 2015, the DR Risk Management team conducted contingency workshops with the project bundle and function teams. The purpose of these brief (1-2 hour) workshops was to guide the teams on the expectations regarding the data inputs needed for RQE contingency development. In these workshops, the discussions focused primarily on discrete risks and the scoring of those risks (probability of occurrence, cost and schedule impact if realized). These assumptions were then challenged by a panel that also reviewed the scoring, 3-point ranges and recurrence frequencies in the templates.

The Project and function teams were to take the comments from the workshop and update their contingency inputs for final submittal on July 27<sup>th</sup>. The Risk team has entered the input data and run a preliminary Monte Carlo analysis to arrive at preliminary contingency numbers for the DR Project. These amounts will need to be further analyzed to determine if the contingency is appropriate and reasonable. Once these inputs are adjusted, another Monte Carlo analysis will be run. The following are some of our key observations from these risk workshops:



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- The workshop concept is good and leverages the work ongoing with risk identification since the start of the Project. However, the key to success is how the projects/functions develop appropriate contingency inputs. This is no small task considering the available time and the amount of effort involved. Individuals from the Risk Management Group will work with the project and functional groups to facilitate acceptable input for RQE. However, project and functional personnel must develop the justifiable content.
- When BMCD/Modus began work on the Project, risk was a very low priority for the managers. Over the last year, additional management focus has been placed on developing and rationalizing risks, and management's goals are well known to the project managers. Some groups have embraced risk analysis, but others pockets within the team have produced contingency input merely to meet the RQE deadline; despite effective Risk Management tools, infrastructure and a support organization. RQE will be the test of how deeply the DR Team understands the risk aspect of their work.
- Some of the estimates of the impact costs were not derived using accepted estimating practices—but were based upon the project manager or functional group representative's "gut feel". The calculations for the cost impacts of discrete risks should be estimated and vetted by the Estimating team with the same rigor as the base cost estimates.
- The Risk Management Team will also review all registers to identify and resolve duplicate and overlapping entries. Clarity and precision in the risk descriptions will influence how efficiently this review can be conducted. Eliminating such redundancy only increases confidence.
- The BOP team has a significant challenge. Its major contractor has noted performance issues on Campus Plan projects, necessitating significant BOP schedule and cost contingency in order to have sufficient funds budgeted. That creates problems developing firm estimates and schedules. Nonetheless, absent detailed Construction Work Packages, fairly accurate OPEX for executing some of the BOP work, such as valve repair/replacement, can be employed. To develop the best input for RQE contingency, the BOP team has to rely on creative approaches such as existing DNGS OPEX, SME input and appropriate risk analysis. BOP (and, where necessary, other groups) are working closely with the Risk Team to timely develop acceptable contingency inputs.

The Project Controls team managing RQE is intent on issuing a number of key questions for the team to consider in looking at their contingency. In developing the global, program level contingency, the DR Team should fully consider the following risk areas as part of that exercise:

- **Address vendors' concerns regarding OPG's role as overseer and integrator of the work:** Each of the vendors have voiced their concern that OPG's history is to provide multiple points of contact during a work cycle, who often provide conflicting information and direction and otherwise interfere with the field work. For the Project to be successful, the DR Team needs to dispel these fears with an optimized Execution Phase organization with clear accountabilities, and ensure that the Station and the Project are fully integrated. To address this, the DR Team has identified a plan to test its Readiness to Execute the work using actual work scheduled in 2015-16 prior to Breaker Open. This plan should be finalized and fully vetted for RQE and tracked with appropriate metrics and targets during the coming year. Nonetheless, for purposes of RQE, these risks need to be fully addressed.
- **Fully analyze and account for the distinct risks inherent with the performance of Units 3, 1 and 4:** RQE is establishing a control budget for measuring OPG's performance on all four units. While this is sufficient for establishing the control budget's base cost, the full DR Project as it currently is planned actually consists of four separate and distinct execution models: Unit 2 is intended as a stand-alone project; Unit 3 will be completed while Unit 1 is started; Unit 1 will be started simultaneous to Unit 3's completion and completed at the same time Unit 4 is started; and Unit 4 will be "lapped" at its start by Unit 1. The DR Team has embedded certain risks regarding the subsequent units; these should be vetted for consistency and whether they cover the impact, needed resources, and other key factors that could make the execution of the subsequent units different, if not



more difficult. Thus, full consideration needs to be given to contingency and other cost factors associated with future unit performance.

- **Developing appropriate succession plans for both OPG and vendors:** OPG is carrying as its most prominent enterprise risk the availability of qualified staff and craft resources over the 12-year lifecycle of the DR Project. Mitigating this risk will require increased flexibility in hiring of staff and potentially additional cost for incentivizing workers. The risk of losing key staff over time will manifest itself in multiple ways, including losing the learning curve and “tribal knowledge” provided by the performance of prior units. Thus, unless this risk is properly addressed (as well as the aforementioned risk of multiple unit performance), assumptions regarding unit-over-unit performance improvement could prove to be overstated.
- **Scope definition for subsequent units:** Our understanding is the Darlington units are as close to alike as any multi-unit station in the world. This assumption has been tested through inspections and operational performance. However, the methods for replicating engineering and scoping effort for the remaining units presents an opportunity to reduce cost. These assumptions also could impact the direct work, as the cost for “design once, build four times” needs to be confirmed.
- **Re-Assess utilization of the ESMSA agreement:** The Campus Plan Projects have provided OPG with an initial opportunity to assess its vendors under the ESMSA, and the record shows significant evidence of poor performance in both cost and schedule. Most of the ESMSA work in Refurbishment in the Balance of Plant and Shut Down/Lay-up bundles has not yet advanced to construction phase purchase orders. The DR Team has committed to finalizing the estimates for this work by next year’s Unit 2 Check Estimate. The DR Team is aware of the track record established to date, and is committed to holding appropriate contingency for Refurbishment work. However, the team should consider whether the current contracting arrangement is also contributing to these problems, and whether there is a reasonable mitigation strategy available before finalizing the work plan for Balance of Plant and Shut Down/Lay-up.

#### Documentation and Data Alignment



Assembly of the massive amount of data that underpins RQE would be a challenge by itself; adding the compressed time for integration and quality assurance makes the integration effort much more difficult. The Project Controls team leading the effort is currently tasked with integrating the multiple estimate submissions from the vendors, OPG functions and other costs into a Master Consolidated File (“MCF”) for purposes of analyzing the individual estimates as well as the sum of the multiple parts. As of this writing, Project Controls reports being substantially complete with compiling the data, though that is the first step.

For full vetting of the DR Project as a whole to be effective, the DR Team will need to have the MCF fully populated and QC checked so that the team can analyze issues such as whether:

- The project management team (both OPG and contractors) is right-sized;
- Work windows are available for non-critical path work;
- Resource profiles for craft workers are properly leveled so that the work can be supported, and so that troughs in the work flow are smoothed out and the contractors know when and whom to hire and train;
- Productivity factors and assumptions used in the estimates are consistent and properly characterized;
- Unit-over-unit direct work costs have been properly considered;
- Resources identified in the vendors’ cost estimates match the resources in their P6 schedules;
- Ratios of direct field labour to supervision are appropriate for the work and consistent across the program;

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- Other such considerations.

Vetting the MCF once assembled will take considerable effort and likely will run longer than anticipated.



**Report to**

**Darlington Refurbishment Committee**

**Board of Directors**

**November 12, 2015**

**Darlington Nuclear Refurbishment Project**



Burns & McDonnell  
Modus Strategic Solutions



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## I. Executive Summary

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company (“BMcD/Modus”) provide the following Report to the OPG Board of Directors (“BOD”) regarding the status of the Darlington Nuclear Generating Station’s Refurbishment Project (“Project” or “DR Project”) as of October 30, 2015. This report provides the summary of our team’s assessment of the DR Team’s development of the Release Quality Estimate (“RQE”). This report also summarizes the DR Team’s current status of “post-RQE” work that will be its focus going forward, assuming the Board of Directors’ approval of RQE at the November 2015 meeting and subsequent shareholder approval, as well as the status of work that is currently being executed on the Prerequisite (“Campus Plan”) work and the DR Project.

### A. RQE

OPG and the DR Team have been working toward developing a realistic RQE for the DR Project since 2009. The major focus of the DR Team over this time period has been the development of detailed cost estimates of sufficient quality and basis in order to establish a four-unit, program level **control budget** for the DR Project. In order to develop the control budget, the DR Team needed to mature the planning to the point where the cost estimates were substantively based. While the DR Team will continue to refine the unitized estimates for each of the four units in order to make specific funding requests, the control budget, if accepted by the Board, will be the baseline against which both the stakeholder confidence and public trust will be measured.

Megaprojects (\$1 billion or more in cost) are often adversely impacted by overly optimistic initial cost estimates that do not fully consider the risks and complexities inherent in such undertakings. The DR Team is aware of the industry track record and has taken reasonable steps to account for the particular risks of CANDU refurbishments and develop its cost estimates accordingly. In order to properly communicate the nature of the DR Project’s estimate and approximate appropriate contingency, OPG has chosen to utilize the guidance of the Association for the Advancement of Cost Engineering International (“AACE International”). OPG’s strategy in this regard is aligned with reasonable and acceptable industry practice for a multi-year, multi-phase megaproject.

In our last report (October 2015) we noted that the month leading up to the November Board Meeting would be challenging given the amount of work the DR Team had left to complete. The DR Team met each of its goals, including:

- Finalizing the target price negotiations with SNC/Aecon on the RFR contract;
- Completing outstanding actions regarding all of the sub-projects from the initial round of senior management-level reviews and revising cost projections accordingly, and vetting the results of those changes;
- Firming up and vetting direct cost estimates and associated critical path schedule basis; and
- Performing integrated reviews of contingency and developing recommendations for amounts of contingency “buckets” and which entity (i.e. project, executive management, BOD) should control those buckets.

With these activities accomplished, the DR Team has completed the work necessary for establishing its control budget, and as an additional benefit, the team has an improved understanding of the Project. Based on our nearly three years of oversight of the DR Project’s planning, BMcD/Modus believes the process used for developing the control budget and critical path schedule that form the basis for RQE meets or exceeds industry thresholds. The control budget is based, most notably, on well-defined scope and detailed engineering, which has sufficiently matured to allow classification using the AACE International guidelines in the manner OPG intended for RQE. In addition, the level of detail in the RQE control budget is in line with our experience for projects of this nature and should form the basis for a robust project controls regime that will be used to track progress.

Given the complexity and length of the DR Project, it is impossible for OPG to predict all of the issues that the DR Team may confront during execution. In order to reasonably incorporate the risk of these unknown issues, it is important to build a deterministic-based contingency augmented by a strong risk-management process and stochastic Monte Carlo model. Over the course of the Definition Phase, the DR Team’s risk management approach has matured and the team has



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put into place a robust process for modeling and monetizing contingency that considered the issues experience on prior CANDU refurbishments as well as issues previously encountered by OPG. In the course of developing the RQE contingency, all project and function managers increased their focus on risk matters to ensure that risks were reasonably identified; response plans were established; and occurrence probabilities and impact quantification were developed. The DR Team performed a reasonable amount of challenge and review of the risks. While risk management and contingency development has many subjective aspects, the DR Team's process is well constructed and executed. It is in the upper percentile of comparable project practices. As with any complex megaproject, contingency values can never be perfect, though OPG has developed contingency at an appropriate level of maturity for establishing the Project's control budget.

While there is still considerable work ahead for the DR Team to further refine its estimates, schedule and execution planning for each of the Project's units, the DR Team has substantially met the goals it set in 2009 at the DR Project's inception for its Definition Phase. With RQE's completion, the DR Team is focusing on ensuring the documentation needed to substantiate its decisions is properly archived and available for future needs, including the unit-specific estimates and future regulatory proceedings. The team has set a goal of completing the RQE document archive by the end of 4Q 2015. We discuss the process used to derive RQE's control budget and recommendations for further refinement in the Unit 2 Estimate<sup>1</sup> that will be issued prior to the Execution Phase in 2016.

## **B. Status of Prerequisite Projects**

We have noted the need for Projects & Modifications ("P&M") to provide greater confidence that the remaining key Campus Plan Projects, most notably D20 Storage and EPG 3, can be completed in time to support Refurbishment and meet current cost estimates. Providing such confidence depends as much on progress in the field as it does on P&M providing requisite metrics and progress reports so that this work can be accurately forecasted and managed. P&M has made good progress over the past month with D20 Storage. The Project Controls team is now tracking quantities of installed concrete by Ellis Don, the civil contractor, which will allow for better forecasting. Ellis Don has also added a second shift to increase its production. All of these efforts have improved the outlook for the foundation work, though P&M must continue to track Ellis Don's progress in order to confirm that it can meet its recovery schedule dates for turnover to SNC/Aecon of November 30, 2015 for the south side of the D20 West Annex Basement and December 22, 2015 for the seismic dyke.

As P&M's attention begins to shift to SNC/Aecon, P&M is closely monitoring the SNC/Aecon's recovery of initial delays in its preparatory activities, including procurement and prefabrication of process piping. P&M has assigned key staff [REDACTED] P&M's ability to manage this transition should be further enhanced by performance metrics SNC/Aecon is providing for its critical path activities. The other key prerequisite project being performed by SNC/Aecon is the Reactor Waste Processing Building ("RWPB"). Site work is ongoing while SNC/Aecon continues to develop its full execution cost estimate and schedule.

Another key project, the Emergency Power Generator 3 ("EPG 3"), is being performed by ES Fox. Based on ES Fox's assessment, the civil construction of this project is currently approximately 20% complete, though ES Fox and P&M must still agree to a cost estimate and full performance schedule to progress the work. SNC/Aecon's performance with D20 Storage and RWPB and ES Fox's performance with EPG 3 should be a leading indicator of OPG's ability to open breaker on time in October 2016 for Refurbishment and provide important lessons learned going forward.

## **C. Readiness for Execution**

With the completion of RQE, the Definition Phase also completes, and assuming BOD approval, the Execution Phase of the Project will formally begin. As we have noted, the key work ahead before Unit 2's Breaker Open in October 2016 will be focused on its "Readiness to Execute" plan ("RTE") in which the DR Team intends to live-test its plans for unit execution using pre-requisite work. During this time, the DR Team intends to, among other things: complete all execution processes and procedures; finalize its execution schedule and confirm the schedule's critical path and sub-critical paths for Unit 2; develop and test all of its tracking metrics for execution work; finalize tracking methods for vendor performance and

<sup>1</sup> The Unit 2 Estimate has also been referred to as the "Unit 2 Check Estimate". However, because the term "check estimate" has a particular meaning within the industry, we prefer use of the term Unit 2 Estimate.



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procurement, and; finalize the Division of Responsibility (“DOR”) and staffing for the execution organization. The Readiness to Execute is an aggressive plan that has multiple deliverables and will involve effort from the entire DR Team, and will leverage the work the DR Team has already accomplished with the vendors to prepare for execution. We have recommended that the DR Team schedule as many of the activities as possible in a resource-loaded, logic-based schedule and track its progress in the same manner as any project. The DR Team has initiated its Readiness to Execute planning in earnest and should be prepared to provide the BOD and senior management with meaningful progress reporting.

## **II. DR Project RQE – Summary of BMcD/Modus Assessment**

### **A. Overview**

RQE represents the culmination of the DR Team’s efforts in the Definition Phase. In order to formulate our opinions regarding RQE, BMcD/Modus have performed two in-depth assessments:

- Assessment of the DR Team’s Process for Developing RQE (“RQE Assessment”);
- Assessment of OPG’s Critical Path Schedule, on which RQE is based (“Critical Path Assessment”).

This report summarizes these detailed assessments which provide the DR Team with our view of RQE and identify certain issues and challenges the Team should consider in its continued preparation for Unit 2’s Execution Phase and beyond. In summary, the RQE Assessment and Critical Path Assessment conclude that:

- The estimates developed for the multiple sub-projects have the requisite basis to establish a meaningful control budget;
- OPG met the broad goals for RQE it established at the outset of the Definition Phase and in doing so followed acceptable industry practice, including its use of the guidance of AACE International that OPG chose for specific guidance in its estimating, risk and schedule development;
- RQE is based upon sufficiently mature scope and engineering definition, as well as an understanding of necessary operational experience (“OPEX”) and lessons learned from prior refurbishments and other similar megaprojects, and reasonable alignment with the vendors who are performing the work;
- The DR Team and OPG as a company have adequately assessed the DR Project’s risks and have reasonably approximated contingency necessary to offset those risks over time;
- The critical path for the Project was developed using a deterministic approach that considered past similar evolutions, simulated work in the Mock-Up reactor and reasonable assessments of potential improvements in key work series;
- The critical path has been captured using acceptable scheduling practices and resource curves have been sufficiently analyzed and incorporated into the estimate for the current phase of planning;
- The DR Team has a comprehensive plan to prepare for the Execution Phase of the Project; and
- The areas of RQE that are less mature – namely that Balance of Plant (“BOP”) and Shut-down/Lay-up (“SDLU”)– have adequate contingency for the known risks and uncertainties.

### **1. OPG’s Goals and Adherence to AACE International Guidance**

In order to aid OPG in its development and characterization of the RQE estimate, OPG appropriately chose to utilize AACE International’s Cost Estimate Classification System<sup>2</sup>, which explains the importance of these guidelines and the intent of their general use:

<sup>2</sup> See AACE’s Recommended Practice No. 17R-97, Cost Estimate Classification System (November 29, 2011) and Recommended Practice No. 18R-97 Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries (November 29, 2011)





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*An intent of the guidelines is to improve communication among all of the stakeholders involved with preparing, evaluating, and using project cost estimates. The various parties that use project cost estimates often misinterpret the quality and value of the information available to prepare cost estimates, the various methods employed during the estimating process, the accuracy level expected from estimates, and the level of risk associated with estimates,... improving communications about estimate classifications reduces business costs and project cycle times by avoiding inappropriate business and financial decisions, actions, delays or disputes caused by misunderstandings of cost estimates and what they are expected to represent.*

AACE recommends that cost estimates be categorized into five different “Classes” based on the project’s level of maturity and definition. Class 5 estimates are based upon a low-level of project scope definition and therefore these estimates have the highest amount of uncertainty and the lowest level of accuracy. In contrast, a Class 1 estimate should have little uncertainty and very high accuracy. As noted in our past assessments of the DR Team’s cost estimates (4c and 4d), this approach was appropriate and allowed for better understanding of the nature of RQE.

Pursuant to the Nuclear Refurbishment Project RQE Cost Estimate Plan (NK38-PLAN-09701-10235):

*The target classification of the RQE cost submission is AACE Class 3 with an expected 50% level of confidence on the point estimate and accuracy range, exclusive of applying escalation, interest and management reserve, within:*

<i>Class 3</i>	<i>Level of Project Definition: 10% to 40%</i>	<i>Budget authorization or control</i>	<i>Accuracy Range: L: -10% to -20% H: +10% to +30%</i>
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*An assessment of the class of estimate achieved by each project bundle will be performed by the NR Estimating Team based upon AACE Recommended Practices and the nature of the project scope of work.*

As stated above, AACE International’s guidelines use maturity level of project definition deliverables as the primary characteristic for classifying estimates. In its procedure, OPG listed the specific deliverables that would need to be developed in order to sufficiently advance the Project to support an RQE within the target Class 3 classification.

Based on our RQE Assessment, we concur that the DR Team has sufficiently matured the work in these areas in order to support RQE as a Class 3 estimate and establish a control budget. We do note that some bundles lack Class 3-level maturity (i.e. BOP and SDLU) while others have been deemed Class 2 (RFR). These differences in maturity are not unusual for projects of this complexity, and the DR Team has a full understanding of those parts of the work that need greater definition.

During the Definition Phase, the DR Project’s scope was substantially developed and supported with detailed engineering packages. With some exceptions, the detailed engineering packages were prepared in sufficient time for that scope to be adequately assessed and estimated by the DR Project’s EPC vendors. Additionally, as we noted in our 3Q 2015 report to the DRC, the process the DR Team used for validating and vetting the cost estimates for the Project’s bundles has followed the approved DR Project RQE Cost Estimate Plan, and the result of this process was as intended – the vendors’ estimates for project cost have been classified so that management understands the underlying quality, accuracy and reasonableness. This knowledge aided management in identifying potential risks in performance, gaps in the vendors’ planned approaches, and areas to shore up for the future unit-specific cost estimates.

Moreover, with this effort complete for the control budget, the DR Team is better positioned for all of its remaining cost estimating work, which will be considerable during the Project’s lifecycle. The Unit 2 Estimate the DR Team intends to deliver in the 3Q of 2016 to the Board of Directors will support that unit’s execution. The team is committed to performing a similar estimate prior to each unit’s execution. In addition, projects of this type must have ongoing cost estimate support for evaluating potential change orders, claims and cost overruns. The process the DR Team has used for RQE should be adaptable for each of these future needs.

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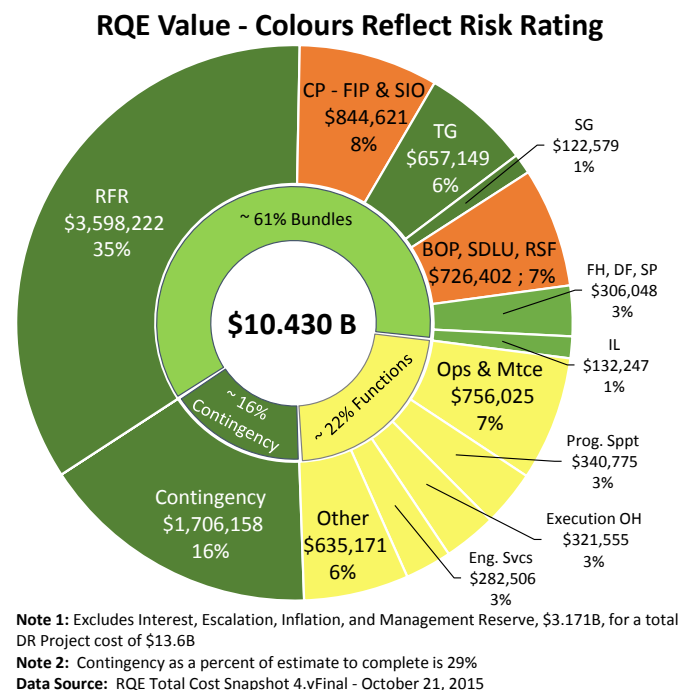




In addition, with the development of the control budget, the DR Team has advanced its understanding of the Project's estimated costs such that it should no longer need to depend upon AACE International's cost estimate classification. The DR Team has now established its own measuring stick. With the exception of those projects (BOP and Shut-Down/Lay-up) that have not advanced to Class 2/3 designation and which still need to reach appropriate maturity, OPG should henceforth measure its progress against the control budget without further regard to AACE International classification.

## 2. Summary of RQE Elements

In the following sections, we discuss in summary fashion: the basis for each of the DR Project's major cost elements; how these estimates were developed and characterized; the risks identified for each bundle, and; recommendations for further maturation of the estimates.

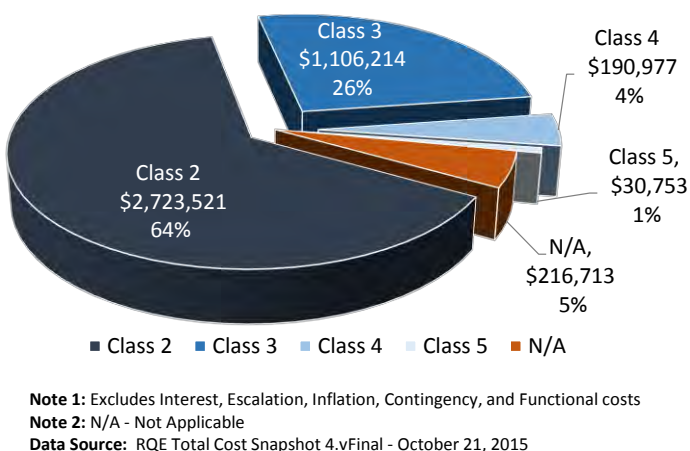


**Figure 1**

The adjacent **Figure 1** shows the updated RQE control budget values for each of the major sub-projects, or bundles, as well as the OPG Functional costs and contingency (in 2015\$). Figure 1 shows the entire control budget including Definition Phase costs of \$2.3B.

**Figure 1** also provides context for the relative size and percentage of each component of RQE. The three largest parts of RQE are: RFR (35%); OPG Functions (22%); and Project and Program Contingency (16% of the total control budget and 29% of the estimated cost to complete). The Turbine Generator and Steam Generator projects (7%), Campus Plan Projects (8%), and BOP, Shut-Down/Lay-Up, and Retube Support Facilities (7%) are the next largest slices of the budget.

## AACE Classification of RQE Estimate to Complete



**Figure 2**

**Figure 2** provides a depiction of the estimate class applied to each sub-project (or "bundle") per AACE International guidance and OPG's governance for RQE.

Below, we provide a brief update regarding the status of each of the major inputs to RQE in which we summarize the basis of the estimates that are being included in the control budget; the method and depth of vetting the DR Team applied to those estimates; a summary of the basis of the control budget's contingency, and; a summary of the current issues each project should address during the Ready to Execute period leading to breaker open.



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**B. Schedule Basis for RQE**

Establishing a control budget for a construction project requires an understanding of the project's planned schedule. In particular, setting the control budget requires the ability to identify the execution critical path and the resources necessary to support it, as the critical path influences a large portion of the project's costs and the risks on which contingency is based. As a result, we performed a Critical Path Schedule Assessment as a part of our RQE evaluation to determine whether the DR Project's schedule provides sufficient underpinning to the RQE control budget.

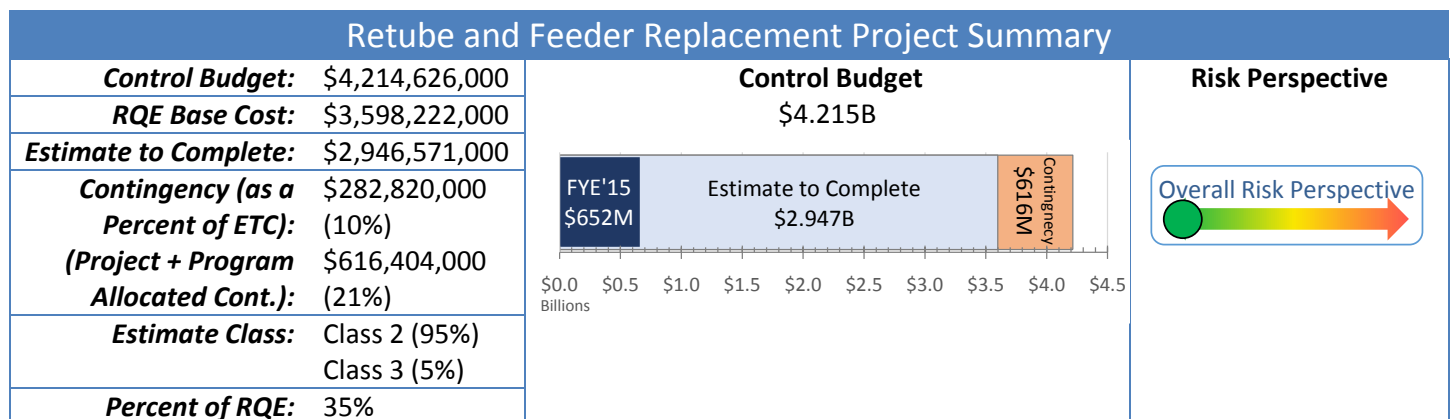
Our Schedule Assessment is based upon our review of four main phases of the schedule: Pre-requisite projects to breaker open; defuel and drain with system shutdown / layup; re-tube and feeder replacement; and system commissioning / return-to-service. Due to the current maturity of the integrated schedule, we have focused on the critical path work and schedule only, covering primarily the following questions:

- Does the process used to develop the schedule conform with the DR Project's contracts and approved scheduling plans and procedures;
- Is the basis for the critical path well defined and documented;
- Does the resulting schedule match the documented critical path basis utilized in monetizing the cost estimates; and
- What work remains to complete the schedule and increase quality (i.e. Does the schedule reflect an executable plan for the DR Unit 2 Outage?).

As part of RQE, the DR Team has developed the integrated schedule's critical path at a level consistent with the overall project status. Due to several issues, including delays in issuing purchase orders, the projects have varying stages of schedule maturity. As a result, many of them (particularly those for Balance of Plant) are not detailed enough to be execution-ready schedules. For a large number of DR Project's bundles, implementation planning and work order development are in the early stages and overall integration between OPG Operations and outside vendors is not yet complete. These details are the subject of the next phase of schedule maturity that will occur during the Readiness to Execute period. However, we have determined that the schedule is sufficient for purposes of supporting RQE and is adequate as a baseline for the critical path durations. The DR Team recognizes that much work needs to be done over the next several months in order to have a fully integrated executable schedule.

**C. Project Summaries**

**RETUBE AND FEEDER REPLACEMENT (RFR)**



## 1. RFR Basis of Estimate

RFR is the single largest element of the RQE and its budget reflects the overall importance of this work to the DR Project. The RFR cost estimate was developed over the past three years by SNC/Aecon, the project's EPC contractor, under the terms of contract executed between the parties on February 8, 2012. SNC/Aecon prepared four separate estimate submittals, each intended to be a further refinement of the prior estimate. SNC/Aecon's current estimate was updated and finalized on September 18, 2015 and forms the basis of the target price contract the parties intend to finalize prior to the Board of Directors meeting. OPG's estimating team confirmed that the underlying quality of this estimate is Class 2. The most significant supporting facts for this classification include:

- The final target price value of \$2.750 B (2015\$) has been fully negotiated and is based on mutually agreed upon project durations and schedule contingency, and encompasses 12.9M work hours, project management, supporting tasks, fee and all other costs;
- SNC/Aecon has designed and procured the specialized tools needed for the work. Some of the schedule task durations used in the estimate basis are derived from actually using the tools on the Mock-Up reactor and timing the results;
- All detailed engineering for Unit 2 is complete;
- Construction Work Packages ("CWP's") have been prepared and submitted as a part of the estimate;
- All 53,000 pages of the SNC/Aecon's submission were vetted by OPG's subject-matter experts;
- Both OPG and SNC/Aecon have teams with considerable experience on prior CANDU refurbishment projects and much of that experience has been incorporated into the estimate;
- Tool design has been significantly improved over those used in prior refurbishments, increasing reliability and making the tools easier to use;
- Training on the full-scale Mock-Up, which has never been done on prior refurbishments, should significantly increase the trades' performance in the field;
- Risk identification and contingency planning have been thoroughly performed and known risks are incorporated into the base schedule durations and work planning efforts.

## 2. Vetting and Characterization of Estimate

Over the course of the 3+ years of SNC/Aecon's estimate development, OPG worked collaboratively with SNC/Aecon to ensure that its final Class 2 estimate plan and pricing of the work would be, when delivered, reasonable and achievable. This collaborative review process was intended to ensure that SNC/Aecon's estimate accounted for OPEX from past refurbishments, improvements to the tool set for Darlington and the value of the planning effort to date, including the full-scale Mock-Up at the Darlington Energy Centre ("DEC"). On May 8<sup>th</sup>, 2015, SNC/Aecon presented its first draft of the Class 2 estimate to OPG, [REDACTED]

From this point through September 2015, OPG engaged SNC/Aecon in a detailed vetting process aimed at reducing the overall cost estimate, providing substantive basis for SNC/Aecon's portion of the critical path, and challenging the nature of SNC/Aecon's stated risks and contingency. The OPG and SNC/Aecon teams established a review and vetting process that was driven by subject-matter experts from each team with specific experience in prior CANDU refurbishments. This process was extremely successful at achieving consensus between the subject-matter experts, who objectively agreed with the underlying schedule durations in most instances. In fact, there were only minor disagreements over a small handful of items with a value of approximately \$12M of the nearly \$750M of direct craft performance estimates. As we noted in our last report, the process utilized to reach these final estimates was extremely detailed and rigorous, which should provide confidence in the results of the vetting process.

### 3. Contingency

Contingency related to the RFR work is split between the following major buckets:

- The contract includes a contingency amount that can be utilized to resolve issues without impact on the target price. SNC/Aecon is holding, as part of the Target Cost, contractually required contingency in which the parties agreed to a set amount based on the results of the base cost development. The basis and monetization of this contingency was heavily vetted by the subject-matter experts and senior management. The resulting 13.5% contingency totaling \$368M is largely based on a deterministic analysis of the potential duration for work task performance and other discrete risks that could impact the work, as monetized with the use of Monte Carlo simulation. The DR Team has assumed for purposes of the control budget that this contingency will be utilized.
- OPG is holding \$282M of contingency at the project level which includes discrete risks not carried under the contract.
- OPG is also holding \$334M for schedule uncertainty which, due to the RFR project's significant critical path duration, is based on the modeled difference in impact to the critical path between SNC/Aecon's "most likely" (or P50) schedule and OPG's "late finish" (or P90).

In total, OPG is carrying \$616M in contingency for RFR or RFR-related risks over and above the contingency that is built into the contract. With a remaining cost for RFR of \$2.33B, this equates to 26%. Given the track record of prior CANDU refurbishments, the work performed to identify performance risks and the overall importance of RFR to the work, this level of contingency appears, at this stage, to be appropriate.

### 4. Summary and Remaining Issues

BMCD/Modus have been closely monitoring the development of SNC/Aecon's cost estimate and OPG's vetting of same, and believes the process the parties used to develop the cost estimate was robust and produced an estimate with significant detail. Moreover, we have witnessed the relationship between the parties substantially improve at every level, which will be important as issues arise. Based on the initial commercial goals the parties set forth, the contract appears to have thus far driven appropriate behaviours and a beneficial result.

With the Class 2 Estimate and target price agreement in place, the RFR team's attention is now turning to execution. The major near-term focus will be on the following:

- Recovery of procurement dates for some components: SNC/Aecon's procurement is generally lagging behind, though some of this lag is driven by aggressive contract milestones, not actual needs for the material. This is currently being addressed by the joint SNC/Aecon and OPG RFR team who have established a "war room" similar to that exercised for the Class 2 estimate development.
- Retube Waste Processing Building ("RWPB") estimate, schedule and performance: the work on RWPB continues while the estimate and schedule preparation continues. The \$167M estimate included in RQE was presented as an upper limit estimate, though SNC/Aecon's final estimate and execution plan needs to be fleshed out before that can be definitively stated.
- Logistics need further refinement: SNC/Aecon needs to devote further attention to its supporting activities for material and tooling logistics during the Execution Phase.
- SNC/Aecon's construction organization needs to be built.
- Execution Phase schedule needs additional work and must align with the Project's work breakdown structure so that metrics for reporting progress can achieve needed fidelity.
- SNC/Aecon needs to remobilize in the DEC and make full and beneficial use of the Mock-Up to practice tasks and



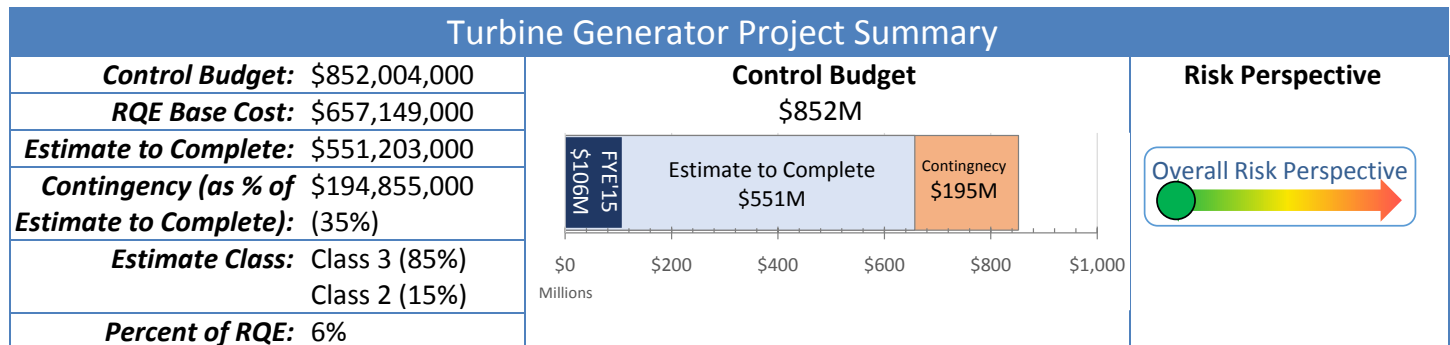
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train workers (this work is commencing as of the end of October).

Each of these elements will provide necessary information regarding cost, schedule, risk and overall confidence as the DR Project advances that can be rolled into the Unit 2 Estimate.

**TURBINE GENERATOR (TG)**



**1. Turbine Generator Basis of Estimate**

The Project's Turbine Generator work consists of two significant evolutions: (1) maintenance work; and (2) digital controls change-out for Unit 3, Unit 1 and Unit 4. In 2014, the DR Team decided to postpone the controls change-out for Unit 2 until the conclusion of the DR Project in order to reduce the risk of the Unit 2 work. Thus, the risk profile for the Project changes significantly with Unit 3, which will be the first of three units that will have a full replacement of the original TG controls during Refurbishment. The digital controls upgrade will be a first time evolution for OPG and will require significantly more planning than the limited maintenance scope for Unit 2. The risk profile of the subsequent units has been developed with this in mind. Based on the risk profile of similar controls replacements, the decision to delay Unit 2 appears to have been prudent.

Unit 3 will also be the first replacement of the generator mid-section and stator rewind. A new stator will be installed for Unit 3, and the existing Unit 3 stator will be rewound and installed in Unit 4. These evolutions have been planned sufficiently in advance that this work should not be a threat to the schedule of the later units.

OPG has accepted SNC/Aecon's Class 2 Estimate for the Turbine Generator for Unit 2, and Alstom has completed its detailed design. SNC/Aecon and Alstom have submitted their full estimates for the subsequent units, which are characterized as Class 3 in nature. These estimates are expected to be fully accepted before the Board of Directors meeting.

**2. Vetting and Characterizing the Estimate**

Vetting of the Turbine Generator Project estimates came in two phases. Alstom, the original equipment manufacturer ("OEM"), is supplying parts and engineering per a fixed price. That contract was assigned to SNC/Aecon for management after its team was awarded the labour portion of the work. SNC/Aecon's estimate followed much of the same structure as its RFR effort, including successive iterations of the estimate from Class 5 to Class 2. The final Class 2 estimate that forms the basis of the target price with SNC/Aecon was the test case for OPG's estimating process which was robust and laid the groundwork for the RFR estimating vetting that followed thereafter.

**3. Contingency**

The total contingency of \$194.8M equates to 35% of the project's remaining cost. The TG bundle includes three contingency buckets: (1) \$27.9M for cost uncertainty; (2) \$49.8M for discrete risks identified by the Project Team; and (3) \$117M for potential component replacement based on the results of concealed condition assessments on each unit's turbine generator. This contingency bucket was vetted and classified using the OPG estimating process. The team has fully examined the potential schedule impact of discovery work and believes it has reserved sufficient non-critical path

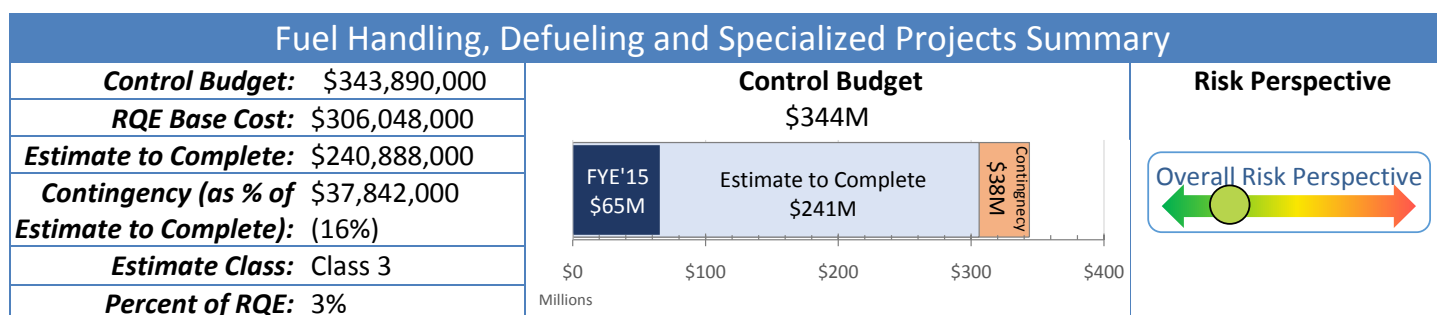


time for major component procurement and replacement in the event such work is required.

#### 4. Summary and Remaining Issues

BMCD/Modus monitored the process used for vetting the TG estimates, and we believe this effort was robust and resulted in further maturation of the estimate. SNC/Aecon's plan for execution was fully explored and significant cost reductions were realized for RQE. As stated above, the Unit 2 work is essentially routine maintenance, though the performance of that work will allow for improved understanding and efficiency for the future units. The controls change-out for Unit 3 needs to be further examined so that the team is assured the labour hours are properly estimated and risks from schedule impacts are mitigated. These will be issues for future unit estimates.

### **FUEL HANDLING, DEFUELING AND SPECIALIZED PROJECTS (FH, DF, SP)**



#### 1. Fuel Handling, Defueling and Specialized Projects Basis of Estimate

In summary, the scope of these project bundles includes: (1) Defueling each of the reactors to begin refurbishment, which is the first major evolution on the critical path and fully in OPG's control; (2) Fuel Handling equipment replacement to increase the likelihood of the power track maintaining operation through the Refurbishment outages; and (3) Specialized Projects to replace out of-date components to the Darlington Shutdown System computers, and replacement of the vault coolers that have reached the end of their useful lives. The work for these sub-bundles is directed by OPG, with the DR Team and the Darlington Station working cooperatively, with vendors supplying engineering, parts and labour for portions of the work. OPG decided to minimize the number of engineering changes to these critical components by calling for "like-for-like" replacements and thus limited the potential risk of execution.

While the total cost estimate for Fuel Handling/Defueling/Specialized Projects constitutes only about 3% of the total cost of the DR Project, each of these projects could strongly influence the critical path. Defueling each of the Project's reactors is the first critical path activity in the Unit 2 outage, and this is a first time evolution for Darlington. Ensuring the Fuel Handling components work throughout the DR Project is OPG's responsibility, as OPG will seek to maintain the operation of the running units during each defueling period of each unit's refurbishment. For these reasons, the planning, scheduling and risk mitigation of this work is extremely important. The DR Team has been focused on evaluating the past defueling evolutions at other CANDU plants and scrubbing the planned durations to the extent possible.

#### 2. Vetting and Characterizing the Estimate

The process for vetting the estimates for these sub-projects was robust, included a team drawn from the station and the project and involved an assessment of reasonable performance in light of past CANDU refurbishment execution, station and vendor performance, and the first-of-a-kind nature of some of this work. It was the latter that drove the estimated Class 3 designation, as the Defueling/Fuel Handling team needed at least one unit's performance before committing to tighter cost estimates.

The current assessment from the Defueling team shows the best case for defueling is 90 days, the most likely (i.e. P50) is 113 days, and the 90% confidence level duration is 134 days. **Figure 3** below depicts the criticality of the defueling duration

Low Moderate High

No Change

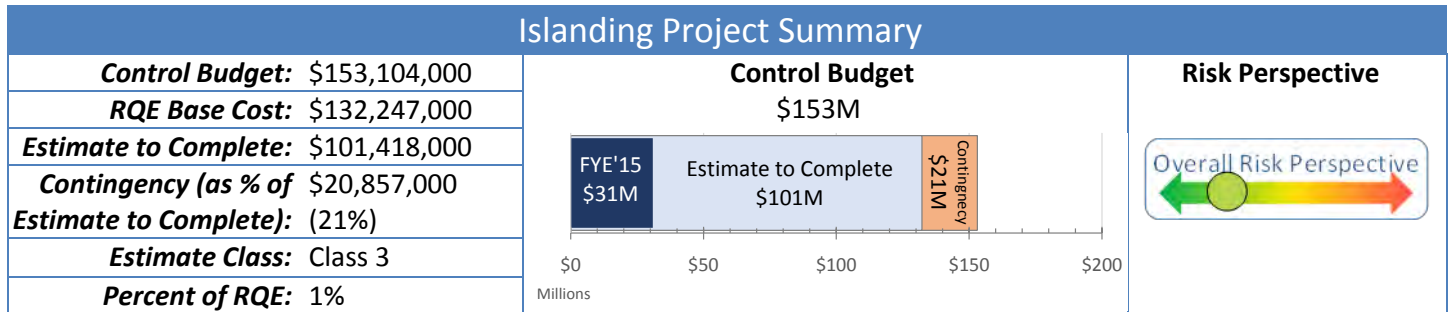
Decreasing Increasing



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**ISLANDING (IL)**



**1. Islanding Basis of Estimate**

The various islanding projects are relatively small in cost but are very significant to the DR Project's success. The design of the Darlington plant makes isolating a single unit for refurbishment a challenge. These projects include: (1) Installing a bulkhead that isolates the Refurbishment unit reactor vault from station containment once the irradiated fuel has been removed from the core, which will allow both airlock doors to be opened to facilitate worker and material transfer into/out of the vault, thus significantly improving RFR worker efficiency. Bulkhead installation is the single largest element of the Islanding Project and its performance will be by SNC/Aecon; (2) Establishing barriers and access control around the Refurbishment Island to keep the Refurb station staff from entering operating unit areas and to keep Station workers from entering Refurbishment work areas; and (3) Establishing terminal points on station systems to allow them to be isolated from the operating units to the maximum extent possible.

**2. Vetting and Classification**

The majority of the cost for the Islanding work is being carried under SNC/Aecon's contract and was estimated by SNC/Aecon using essentially the same process as it did for RFR.

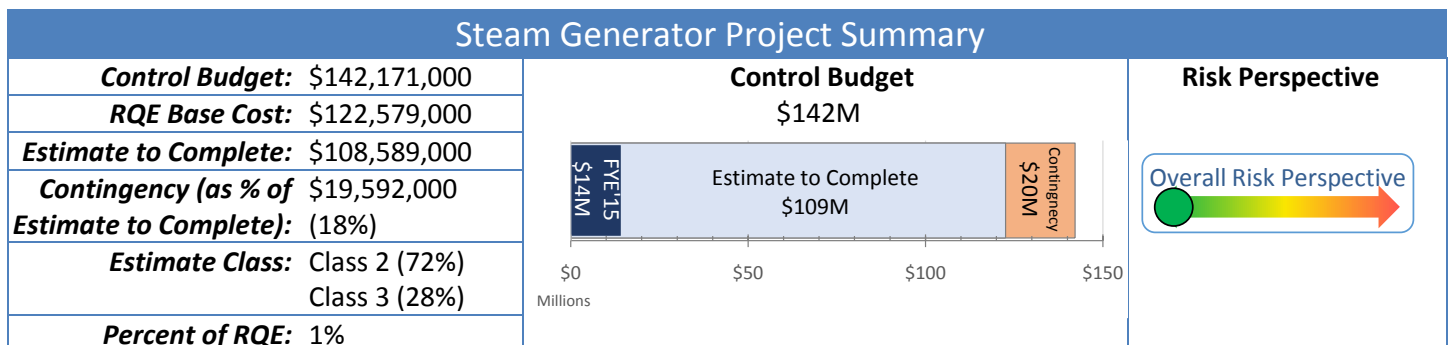
**3. Contingency**

The total contingency of \$20.86M equals 21% of the remaining costs. The largest and most significant driver of contingency is the potential impact on the DR Project's schedule from potential delays installing the bulkhead. The risk register for Islanding appears to be appropriate for its current state of maturity.

**4. Summary and Remaining Issues**

The DR Team has performed extensive reviews of plant conditions and OPEX, particularly from Bruce Power, and its efforts appear to have isolated and mitigated the risks to the extent possible. There will be some Islanding work during the Readiness to Execute phase that will allow the team to test its processes and metrics for the larger, more important scopes after breaker open.

**STEAM GENERATOR (SG)**





## 1. Steam Generator Basis of Estimate

The scope of the Steam Generator Bundle is largely composed of maintenance work, including the following: (1) Primary side cleaning; (2) Secondary side cleaning (Tubesheet Water Lancing); (3) Access Port installations (modification); (4) Inspection and Repair (Primary and Secondary Side); (5) Divider Plate Inspections, Boiler Open/Close & Inspection Support; (6) Lay-up work, and; (7) Bleed Cooler Inspection. All of the work has been executed in other plants. The contract for the work was let to a joint venture of B&W and CANDU Energy, a subsidiary of SNC Lavalin.

## 2. Vetting and Classification of the Estimate

The SG work is classified as Class 2 due to the nature of the work and the fixed-price contract.

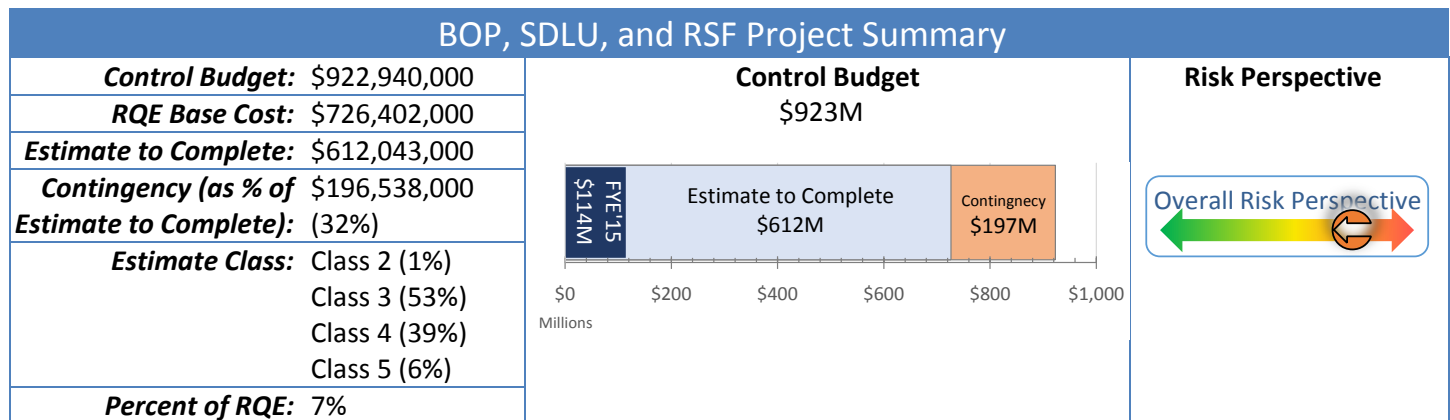
## 3. Contingency

The project is carrying \$19.6M in contingency (18% of remaining cost) which is largely driven by the potential for discovery work, and coordination issues with RFR and OPG's Inspection Maintenance Services.

## 4. Summary and Remaining Issues

The development of the SG project has proceeded well and the work planning is well underway. The risks discussed above with coordination and the Project's schedule appear to be the most important factors for the team to consider. The performance of the Primary Side Cleaning is currently planned to be the only work other than RFR to extend past the 60% window designated for non-critical path work.

### **BALANCE OF PLANT, SHUT DOWN LAY-UP AND REFURB. SUPPORT FACILITIES (BOP, SDLU, RSF)**



## 1. BOP, SDLU and RSF Basis of Estimate

This work scope includes a number of smaller to medium-sized packages. Approximately two-thirds of the work is based on design modifications, while the rest of the work is like-for-like replacement of aging components. The DR Team completed detailed engineering for the modification projects in time for the August 15, 2015 milestone, with some minor exceptions. The BOP work includes seventeen unique sub-projects that range in value from approximately \$700,000 to \$66M, and the scope includes replacement of components, electrical cable, and inspect and repair/replacement of valves. SDLU consists of twenty-eight different sub-projects and includes a number of prerequisites for construction, including breathing air for workers in the vault and barriers, as well as lay-up of plant systems for the unit being refurbished. RSF consists of building, improving and maintaining shops and other facilities for use during construction. The majority of this work has been released to ES Fox under the terms of the ESMSA contract.

The majority of the BOP work will be performed during the first 50-60% of the refurbishment schedule, with the goal of keeping BOP work off the critical path. Much of the SDLU and RSF work will proceed breaker open, but maintenance of the lay-up of systems will stretch throughout the length of the Project.



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## 2. Vetting and Characterizing the Estimates

These project bundles are the least mature in the Refurbishment scope, which is reflected by their respective estimate classifications; 1% is Class 2, 53% is Class 3, 39% is Class 4, and 6% is Class 5. Based on our observations, these characterizations by the estimating team appear to be appropriate. The DR Team has set aggressive goals to receive all of ES Fox's remaining BOP/Shut-Down/Lay-up/RSF estimates to a Class 3 level by no later than January 2016. The OPG estimating team is collaborating with ES Fox's estimators on these remaining estimates to keep the process on schedule and test the quality of the estimates.

## 3. Contingency

These bundles' contingency is broken down as follows:

Bundle	Base Cost Estimate	Est. to Complete	Contingency	% Contingency on ETC
Balance of Plant	\$430.0	\$353.6	\$125.3	35%
Shut-Down/Lay-up	\$218.0	\$196.8	\$53.1	27%
Refurbishment Support Facilities	\$78.4	\$61.6	\$18.1	29%
Total	\$726.4	\$612.0	\$196.5	32%

The drivers for contingency include: (1) cost uncertainty due to the maturity level of the packages and the recent completion of supporting detailed engineering; (2) potential upfront delays to Refurbishment causing early schedule issues; (3) past performance of ES Fox on the Campus Plan Projects; and (4) potential for discovery work.

ES Fox's performance on the Campus Plan Projects provides vital OPEX that the team has considered in identifying risk for these projects. The DR Team is aware of the issues [REDACTED] and are attempting to mitigate those issues. [REDACTED]

[REDACTED] The OPG scheduling team has recognized these shortcomings and worked with ES Fox to improve the deliverables. 45% of the BOP and Shut-Down/Lay-Up work estimates are in the Class 4 or 5 range, which increases the risk of estimating uncertainty for these projects. Moreover, the risk profile of these projects should reflect the risks from ESMSA vendor performance. The BOP and Shut-Down/Lay-Up project teams have identified discrete risks related to vendor performance. Additionally, OPG has included some program-level contingency due to the past track record of these vendors in the event performance issues resurface during Refurbishment.

## 4. Summary and Remaining Issues

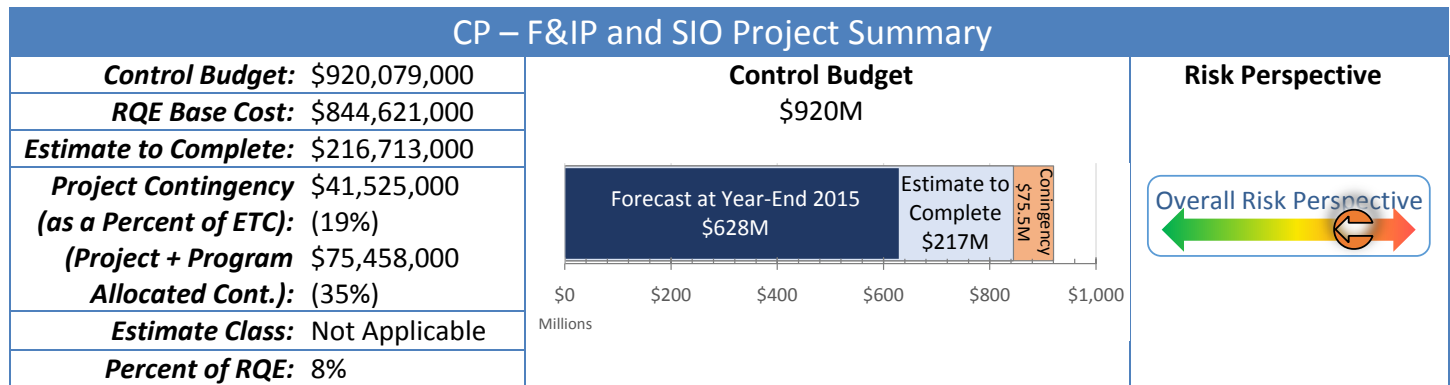
BOP and Shut-Down/Lay-Up will be under significant scrutiny once the DR Team's focus shifts to the Readiness to Execute plan. ES Fox must continue its planning work with more detailed and mature estimates, execution schedules and development of Construction Work Packages. The DR Team has placed a challenging goal of having all of the BOP projects proceed to their respective Gate 3 between late November 2015 and January 2016. To do so, ES Fox will need to complete the detailed level 3 execution schedules, Class 2/3 estimates and Construction Work Packages to support these gates. The BOP team has set interim milestone dates with ES Fox for these deliverables which may be too aggressive for the DR Team to receive quality work product.



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**CAMPUS PLAN PROJECTS (CP – F&IP AND SIO)**



**1. Budget Status**

There are six active Campus Plan Projects in execution at this time with the Refurbishment Project Office (“RPO”), the RFR Island Support Annex (“RFRISA”) and Replacement of Buried ESW Piping approaching completion. There are two other pre-requisite projects, the Auxiliary Heat System (“AHS”) which for budgetary purposes was reclassified as a Station project though P&M is still managing the work. The costs for AHS are no longer carried in RQE. The other pre-requisite project, the Refurbishment Waste Processing Facility (“RWPB”) is being performed by SNC/Aecon under the RFR Definition Phase contract and is not part of P&M’s reporting.

We have noted in past reports that while the remaining dollars involved in the Campus Plan Projects do not necessarily have a significant monetary impact to RQE, certain of the projects, most notably D20 Storage and EPG 3, remain a risk to breaker open of Unit 2. These projects’ completion dates have shifted over time and further delays could result in drawing attention away from the Readiness to Execute plan. Overall, the entire portfolio of Campus Plan Projects experienced \$76.3M in base cost growth from 4d to RQE, an increase of 9%, which resulted in contingency drawdowns from the allocated budget amount set in 4d. P&M is currently forecasting an Estimate to Complete (“ETC”) for all remaining Campus Plan and SIO work of \$216,713,000.

**2. Contingency**

Based on the history of these projects, the velocity of change and the volume of remaining work, the \$75.5 million in remaining contingency needs to be closely tracked to ensure it is enough to cover any remaining cost issues with completing these projects. In particular, D20 and EPG3 pose the greatest risk to the remaining Campus Plan Contingency, and EPG 3’s final cost estimate has not been fully vetted and approved. P&M’s change control process needs to be monitored so that the use of contingency is readily identified and so there are sufficient funds going forward. In Section III below we discuss the status of these projects and describe some of the risks that could cause the base costs for these projects to increase.

**FUNCTIONS**

With the exception of Operations & Maintenance, the remaining functional groups that compose the DR Team jumped in size from 4d to RQE. The non-Operations & Maintenance groups’ cost estimates increased in aggregate from \$1.28B (2015\$) to \$1.53B, an increase of 20%. The largest gains were for the Execution Organization (48%), Contract Management (38%) and Managed Systems Oversight (42%). Operations & Maintenance’s budget decreased by from \$1.1B (2015\$) at 4d to \$0.81B for RQE, a reduction of 27%. This reduction was due primarily to identification and removal from the DR Project of non-Refurbishment Operations & Maintenance costs.

The DR Team has high confidence in the extent of the estimates it has prepared for RQE and are all-inclusive of what could reasonably be identified for staffing at this time. However, the pace of the proposed ramp-up of the DR Team’s staff is aggressive and will be very difficult to meet. In order to meet the plan, the DR Team would have to increase from 770 to



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just over 900 (17%) staff in less than 3 months. The team has been chronically under-spent during the Definition Phase, and missing these major ramp-up dates will further impact the accuracy of the team's staffing forecasts.

The commitment from the NPET to further rationalize and organize the functions on the basis of a division of responsibility matrix ("DOR") has been held over to the Readiness to Execute phase. The DR Team committed to putting a DOR in place that defines each function's accountability and responsibility by early 1Q 2016, which in turn should result in optimizing the organization. While the DR Team's goal for RQE was to identify the outer cost limit for the functions, BMcD/Modus is more concerned that the DR Team operate efficiently, have highly qualified and skilled resources, and actively manage the field work during the Execution Phase. The team has considerable work ahead to meet these goals.

## **D. Summary of RQE Risk and Contingency**

As part of our assessment of RQE, BMcD/Modus has focused a lot of time and attention on the DR Team's development of contingency for the Project's control budget. Our review focused on the development of input factors, the Monte Carlo stochastic modeling, results analysis, and finalization of RQE contingency provisions. Specifically, we focused on the following aspects of the DR Team's contingency development:

- Whether the processes used for capturing risks were sufficiently robust;
- The extent to which contingency is properly modeled; and
- Whether the risks and associated contingency amounts were properly monetized.

The DR Team's development of the contingency for RQE compares favorably with what our team has observed in the industry. While risk management and contingency development has many subjective aspects, the DR Project's process is well constructed and executed. It is probably in the upper percentile of comparable project practices. Nonetheless, because of uncertainties and unknowns, contingency values are not perfect, but the DR contingency process likely contributes to a reliable and defensible RQE.

### **1. Contingency Process**

OPG prepared and approved the RQE Contingency Development Plan NK38-NR-PLAN-09701-10006 in Q1 2015, establishing the approach for developing the RQE contingency and describing the associated contingency development principles and processes. The Plan established a contingency process utilizing a number of AACE recommended practices for contingency development. It appropriately states that the practices will be supplemented with the expert opinion and judgment of the NPET (Nuclear Projects Executive Team) to ensure there is confidence that the contingency estimate is robust and sufficient to deal with the risks and uncertainties characterized at the time of RQE.

Six basic buckets were addressed in developing the RQE contingency:

1. **Cost Estimating Uncertainty** - The project managers and function leads provided three point estimate uncertainty ranges.
2. **Schedule Uncertainty** – Uncertainty range estimates for critical path durations were provided to the risk team by the project managers. Schedule cost impact was determined by applying a daily "burn rate" to any schedule impacts. Allocation of schedule contingency between the affected project and the overall program critical path was carefully addressed.
3. **Discrete Risks** - Discrete risks from the project, program and function Risk Registers were reviewed and post-mitigation probability of occurrence values were finalized. Quantitative cost & schedule impact values were developed with associated three point ranges as model input. In addition, provision for risk event recurrence over the four units was established for model input.
4. **High Impact Low Probability Risks** – The Board of Directors Controlled Contingency was established deterministically to address these issues and to provide for some coverage of unanticipated items beyond control of the DR team.



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5. **Campus Plan/ F&IP** – The nature of Campus Plan risk registers, estimates and schedules required that contingency be established through a combination of stochastic, deterministic and expert judgment means. Probabilities and impact ranges for the discrete risks were updated. Cost elements were assigned uncertainty ranges. The results of the risk probabilities and impact quantification with three point ranging, along with estimate uncertainty ranges were then submitted for Monte Carlo analysis. The Monte Carlo contingency values were assessed by P&M's management and deterministic adjustments were made for RQE. The stochastic and deterministic numbers were then compared and justifiable adjustments were made. In addition, program contingency was added to reflect the historic performance issues associated with Campus Plan projects.
6. **Insurance Uncertainty** – A premium cost point estimate and pessimistic/optimistic uncertainty range was provided by Finance and factored into the contingency calculation.

In developing the contingency at the project level, the DR Team took care to ensure there was no double-counting or duplication. From our review, the team was successful in not over-generating the contingency.

## 2. Vetting of Risks and Contingency

The RQE contingency was subjected to many stages of review and vetting. The RFR project received focused attention from SNC/Aecon and the DR Team, given its overall importance to the Program. The process used for vetting the base contract amounts also resulted in thorough understanding and development of the risk model.

For the various projects the Risk Team conducted contingency workshops, where subject-matter experts challenged, critiqued and provided constructive feedback. After the workshops, members of the risk team met with the respective managers to update data that was entered into the @RISK Monte Carlo model and preliminary results were obtained. Those results were analyzed and changes were made to the model and input data was refined. To monetize schedule impact, Finance reviewed cash flow projections and developed a point estimate for daily burn rate and an associated uncertainty range. That approach is considered reasonable.

The DR management team recommended establishing a contingency to be controlled at the Board of Directors level. This was done by considering deterministic estimates primarily based on experience-based judgement. Other considerations included OPG's risk tolerance, the budget ceiling, and the overall established contingency. Provisions for "Black Swan" (high impact low probability) risks were considered in establishing this layer of contingency. Factors included acts of God, the labor and political environment, vendor defaults, nuclear safety or security events, unforeseeable scope increases, and financial matters. No strict rules or best practices exist for estimating low probability/high impact events and the subjective approach employed by DR is not uncommon.

## 3. The Monte Carlo Model

The DR Team used modeling experts from the Palisade Corporation<sup>3</sup> to develop a Monte Carlo simulation method for the Project. In Palisade's final report, which focused on the RQE contingency process, Palisade stated that the model used by the DR Team contains all the elements of risk management's best practices and contains well-defined methodology as its foundation. Palisade also cited the collaboration of risk experts interfacing with project/functional managers and SMEs.

The RQE Monte Carlo model is extremely robust and comprehensive. All four units are addressed in one integrated fashion. Over 2600 three point estimates were used to model outcome (maximizing use of three-point range estimating contributes to the veracity of the input by allowing the source to avoid conservative single value "plug-in" numbers). Over 470 discrete risks were analyzed. Approximately 273 risks were included in the contingency calculation, which 55 were program/function related and 218 were from projects. Close to 800 estimate uncertainties were analyzed and 128 schedule activities assessed across the four Units.

<sup>3</sup> Palisade Corporation provides widely accepted @RISK software system to a global base of customers and consults on the process for developing stochastic tools for understanding and quantifying risks and uncertainties.





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A schedule correlation factor of 70% is included the contingency model, reflecting interdependence of schedule activities. In addition, because DR is a multiple unit project, provisions to address risk recurrence are incorporated based on project and functional manager input.

#### 4. Contingency Results

The resultant contingency amounts are reflected in **Table 1**. Monte Carlo based values are at the P90 level for Projects/Bundles/Functions and for allocated Program Contingency. “P90” means that, based on the inputs and model structure, there is a 90% confidence that the contingency value is appropriate to cover the risks and uncertainties analyzed by the model.

**Table 1**

#### RQE Contingency Summary

Contingency Element	P90 Amount (\$x1,000) <sup>4</sup>	Basis	Simplified Contingency Draw Approval Requirements <sup>5</sup>
<b>Projects/Bundles/Functions</b>	\$851,648	Monte Carlo analysis of Discrete Risks and Schedule/Estimating Uncertainty <sup>6</sup>	If less than \$100K – Project Manager approves for trending with no contingency draw until accumulated. Then... <sup>7</sup> ...If greater than \$100K and less than \$5M – Project Manager and Project Director approves contingency draw. <sup>8</sup> ...If greater than \$5M, CCB approves <sup>9</sup>
<b>Program</b>	\$854,475	Monte Carlo analysis of Discrete Risks and Schedule/Estimating Uncertainty	Program Change Control Board (“PCCB”) <sup>10</sup>
<b>Board of Directors Controlled Contingency</b>	\$800,000	Subjective analysis of unanticipated/uncontrollable items (Vendor default, Labor/political matters, etc.	PCCB + CEO or DR Board Committee <sup>11</sup>
<b>Total Contingency</b>	\$2,506,123		

The third column in **Table 1** reflects the DR Project’s recommendation for the management of contingency. It should be noted that the Board has not yet provided approval of this process. In determining level of control for contingency, it may also be beneficial for the Board to review contingency at both the P50 and P70 levels. We will provide a comprehensive review of how OPG intends to monitor and use contingency in our Change Management Assessment Report that will be issued later this year.

<sup>4</sup> See RQE Total Cost Snapshot 4 October 21, 2015.

<sup>5</sup> Other provisions are in place based on percentage of baseline and for schedule changes impacts.

<sup>6</sup> See Campus Plan Exception described earlier in this report.

<sup>7</sup> Change costs are trended and do not result in contingency draw unless the project/bundle/function can’t absorb the cost. At that point, approval is based on the amount of accumulated cost impact for the affected project, bundle, or function.

<sup>8</sup> N-MAN-00120-10001 PC-12 “Nuclear Refurbishment Program Change Management Section 6.1.

<sup>9</sup> *Ibid.* Section 6.1. The Change Control Board (“CCB”) is comprised of: VP Refurbishment Execution, Director Refurbishment Engineering, Director Refurbishment Operations & Maintenance, Director Refurbishment Planning & Controls, Director Refurbishment Unit Outage, and Director Nuclear Controllershship.

<sup>10</sup> *Ibid.* Section 5.13. The Program Change Control Board (“PCCB”) is comprised of NR Dir. Planning & Controls, SVP NR, VP Nuclear Finance, VP Assurance, VP NR Engineering, VP Refurbishment Execution and VP Operations & Maintenance.

<sup>11</sup> *Ibid.* Section 6.4.4.



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## 5. Observations and Recommendations

As stated, BMcD/Modus have found the process OPG has utilized for developing contingency to be sufficiently robust to support RQE. However, risk management is not a once-a-year exercise; it should be considered a pillar of project management. Thus, we have made certain recommendations for further enhancing the management of risk and governing the appropriate use of contingency established in the control budget:

- With some exceptions, the DR Team chose to monetize contingency utilizing the experience of the project managers as opposed to developing detailed estimates that were vetted by the OPG estimating team. We recommend that for the Unit 2 Estimate, OPG utilize the same estimating process for the contingency as it does for the base costs.
- OPG should ensure that significant contributors to contingency are justified and well documented. Justification of components such as: a) the broad application of schedule correlation; b) schedule burn rates; and c) levels of management control over contingency should be well documented.
- The infrastructure for identifying and managing risks has been in place for several years, though to a large extent, the program has been relegated to the “important, but not urgent” category as projects and functions focused on day-to-day challenges. While the RQE contingency process required the projects and functions to devote considerable attention to risk and contingency development effort, we observed some of that focus wane as the RQE effort was completed. Momentum and a sense of urgency for risk management needs to be maintained through the Execution Phase. The DR Team should consider making the discussion of risks and risk management a greater priority in its internal communications.
- Consideration should be given to developing information and training sessions that discuss the value of the risk program not only for development of RQE contingency but also the importance of sustained (or increased) efforts in executing and managing the DR Program. (This is also important for documenting and managing internal OPEX).
- OPG needs to increase senior management visibility and risk program advocacy throughout the organization.

Finally, it is important to understand that stochastic processes for developing contingency values do not create conclusive “answers”. They serve as statistical tools to inform management regarding a basis for establishing and justifying contingency. These tools do not manage or mitigate risks; only management can do so. Therefore, management focus on risks needs to be strong and ongoing.

## E. Remaining Work – Program Level

### 1. Quality Assurance

The DR Team is in the process of tying-up the remaining loose ends in the RQE submission and is performing quality assurance checks to ensure there are no major data fidelity issues in the control budget. The following are the priorities the team is using to ensure the quality of the RQE submission:

- All costs need to be supported by the documentation necessary to tie all numbers to their source;
- Risk registers need to incorporate any changes that came from NPET reviews; and
- The RFR team must close-out review SNC/Aecon’s full Class 2 submission that OPG received on September 18, 2015 to ensure that there are no significant gaps or unresolved issues prior to locking down the target price.

The process for close-out of 4d was not given priority status, which elongated its close-out. The team is putting appropriate focus on close-out of RQE at this time.

### 2. Schedule

A major component of the Readiness to Execute plan will be developing and finalizing the Unit 2 execution schedule with all work at the appropriate level of detail. The DR Team’s original goal of having the full execution schedule completed



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for RQE was not met, though as noted, the control budget is supported by a well-defined critical path and windows for non-critical path work have been vetted and considered. We believe that the DR Team has done sufficient schedule work to support RQE, though considerable work remains before the schedule is execution-ready. BMcD/Modus will be providing our comments and recommendations regarding the schedule development as the work progresses.

### **3. Documentation**

The DR Team developed considerable documentation in support of RQE that must be properly archived through a document control process which is directly traceable to the RQE. The team intends to implement a robust Integrated Data Base where the documentation will ultimately reside. The organization of this documentation should consider the future needs of subsequent cost estimates, configuration management, commercial uses and requirements for substantiating the basis of Project costs for regulatory purposes. Once the IDB is set-up, we recommend testing the sufficiency of the organization of the documents to ensure the documents are accessible and comprehensive. The team has put a goal of completing the document archive by the end of 2015.

## **III. Status of Campus Plan Projects**

The outlook for completion of the largest and most significant remaining Campus Plan Projects – D20 Storage and Emergency Power Generator 3 (“EPG3”) – had generally improved, though there are significant remaining issues and risks that have impacted both these projects’ schedules and cost estimates.

### **A. D20 Storage**

Ellis Don continues working on the foundation for D20 Storage, and SNC/Aecon is preparing to complete the building and perform the mechanical, electrical, HVAC and steel/structural erection. Ellis Don’s work must be substantially completed before SNC/Aecon can start its work in the basement of the D20 building. P&M has bifurcated its team to simultaneously focus on Ellis Don’s progress and SNC/Aecon’s preparation.

Ellis Don’s recent progress has ramped up since our last report. As of October 30, 2015, P&M reported Ellis Don to be 83% complete with its foundation work, and had only two walls and one staircase left to pour. Ellis Don’s progress has been positively impacted by adding a second shift to increase the volume of work. In addition, the P&M team has benefitted from assigning an experienced project manager to oversee the civil construction and from the Project Controls effort to field verify and report Ellis Don’s progress.

The DR Team’s Program Status Report dated October 23, 2015 stated that Ellis Don’s “concrete placement in the basement is expected to be completed by December 22<sup>nd</sup> for the north section and 1-2 weeks later for the south section.” The current schedule (as of October 30 in OPG’s network) shows Ellis Don completing its work on December 26, 2015 however with the increase in production and with good weather, their completion date could move forward. Ellis Don’s recent improvement makes completing the foundations in mid-to-late-December much more likely. Turnover of the entire site from Ellis Don to SNC/Aecon will likely miss the contractual date of November 30, 2015. However, Ellis Don is currently working on a recovery schedule so that it will turn over the West Annex Basement on November 30, 2015 and the seismic dyke by December 22, 2015. SNC/Aecon has fallen behind in its pre-fabrication of piping that is on its critical path, and has further indicated that it may accept partial acceptance of the site on November 30<sup>th</sup>. However, since its piping work and tank setting is on critical path, the value of SNC/Aecon’s partial site acceptance may be minimal until it can recover its critical work streams. Due to the fact that both contractors will be working in a confined space, it will be important for OPG to carefully manage this transition. The contractors’ schedule progress needs to be accurately recorded and based on recent objective progress so that OPG can document this transition for commercial purposes.

SNC/Aecon has prepared and revised its cost estimate and schedule (which still requires final vetting and disposition of its basis of estimate), and is now producing metrics that are reporting its progress based on quantities of work. These early metrics are showing SNC/Aecon is behind by approximately 2-3 weeks in its procurement and prefabrication of piping. The baseline schedule shows SNC/Aecon’s plan to meet all of the project’s key milestones; however, as noted these dates are likely to be impacted. Schedule updates from SNC/Aecon need to be properly captured so that an accurate forecast





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of any impact can be properly documented and managed. [REDACTED]

[REDACTED] SNC/Aecon intends to do so once it has secured agreements with its major structural, civil and HVAC subcontractors. SNC/Aecon has committed to reporting key subcontractor status via earned and actual work hours against its plan, which should provide P&M with enough information to track this key work.

The current SNC/Aecon schedule is based on the D2O project meeting an interim deadline of June 28, 2016 to accept water from Unit 2 so that there is confidence that Refurbishment of Unit 2 can proceed. This deadline was initially set about 1 year ago when the DR Team reviewed the need for a contingency plan for D2O Storage in the event the building could not be completed. We have recommended that P&M and Refurbishment re-examine this milestone if it is able to implement one of the alternatives it is currently reviewing for draining primary heat transport and moderator water from Unit 2. If an effective mitigation strategy can be implemented, it could allow deceleration of some of the work which could potentially reduce the overall risk of construction. However, such a deceleration should only occur if it is supported by objective progress data from field progress that substantially improves the confidence of all concerned that D2O Storage Facility will be available for Refurbishment of Unit 2.

## **B. EPG 3**

OPG has committed to placing EPG 3 in service prior to Unit 2's breaker open. The civil construction is currently approximately 20% complete, and ES Fox intends to set the EPG unit by the end of November. Construction has previously been impacted by issues with plant tie-ins and unforeseen underground conditions. In its Project Status Report issued October 29, 2015, P&M reports that "Corporate milestone "Generator In Place" – Nov 30, 2015 currently at risk." While there is a recovery schedule in place, the Project Status Report currently shows that the Turnover/Available For Service milestone is not forecasted to occur until August 5, 2016 (323 days late), only two months in advance of breaker open. Furthermore, it should be noted that neither the additional forecasted costs (\$21.3M over the approved amount of \$88.2M) nor the recovery schedule have gone through a gate for final approval. The gate approval was originally scheduled for September 11, 2015, but that has been delayed until 4Q 2015. It is critical for OPG and ES Fox to agree on a schedule that is doable and predictable as soon as possible.

In its Project Status Report, P&M reports that "Engineering holds remain on a number of packages to incorporate design input from LLM Vendors. Holds to be resolved by Dec 2015." These engineering issues should not impact the civil work, though some involve changes to allow the stock generator to meet OPG operational requirements which could impact the installation or in-service date of the EPG unit if they are not resolved in time. The VP of Engineering and Sargent & Lundy have established a process for working through these issues and bringing more timely visibility to engineering issues as they arise on ESMSA (Campus Plan, BOP and Shut-Down/Lay-up) projects.

P&M also identified EPG 3's commissioning as a risk. "This is a first time evolution for these modifications and there is limited commissioning experience with this type of equipment. The risk is that the commissioning of this new system may take longer and be more challenging than anticipated/estimated resulting in numerous work interruptions/clarifications and extension to the schedule or missing AFS (OPEX from Pickering Temporary Emergency Power System)." To mitigate this risk, the DR Team has assigned a dedicated manager to lead the commissioning effort, though the schedule should accommodate the time needed for commissioning with these risks in mind.

P&M's Program Status Report dated October 23, 2015 showed the forecast as \$115M, and noted that, "the forecast is expected to increase by an additional \$5-10M. The increase is a result of additional costs to recover schedule delays that occurred during excavation and fuel line relocation, design changes based on newly available equipment information, and additional resources and time allotted for commissioning. This cost increase can be accommodated within the available contingency." P&M further noted in the October 27<sup>th</sup> Project Status Report that, "Significant costs increases are being addressed with contractor. SCRs in place," and "A new gate package will be prepared to identify the new EAC and schedule completion," which P&M anticipates having in 4Q 2015. The gate approval was originally scheduled for September 11, 2015, but that has been delayed until 4Q 2015. It is critical for OPG and ES Fox to agree on a cost estimate and schedule that is doable and predictable as soon as possible.



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#### **IV. Readiness to Execute Planning**

With the completion of RQE, the DR Team intends to shift its entire focus to the Readiness to Execute plan. The team has developed detailed milestones and has established forums for progressing deliverables. In our review, we believe the Readiness to Execute plan is comprehensive and should provide a solid basis for testing the DR Team's execution planning. There are certain parts of the plan that are intended to deal head-on with key project risks; in future reports, BMcD/Modus intends to focus on certain key aspects of the readiness work, including the following:

- **Procurement:** The DR Team is piloting processes for tracking and overseeing vendor procurement, and is enhancing the warehouse capacity for the storage of materials and equipment. The risks for procurement are well known and documented in the industry, and OPG and its vendors are already experiencing some issues that will need to be managed carefully. Transparent reporting of status and identification of problem areas are the most effective means for mitigating those problems.
- **Project Team Development:** With the DOR in place, the team intends to sort out accountabilities and test its responses to real-time work situations. As part of this exercise, the team needs to review protocols for frequency and timing of key meetings and expectations for key communications.
- **Completion of Construction Work Packages:** Completing CWP's for the remaining work will require substantial effort, and is a necessary prerequisite for developing the schedule. In particular, BOP work packages must be completed by April 2016 to support the schedule and Unit 2 Estimate development.
- **Schedule Development:** The DR Team intends to iterate the baseline schedule two times prior to breaker open. In its Rev. B schedule, the team will flesh out all of the work known for RQE, which will expose certain areas in the schedule that are potentially problematic. During the first half of 2016, the schedule will be further refined, with Rev. C supporting the Unit 2 Execution Phase. In the process of developing the schedule, the DR Team should review lessons learned from the schedules prepared by SNC/Aecon and ES Fox for the Campus Plan Projects. These schedules are a leading indicator of how these vendors will schedule work (if allowed) for the Refurbishment. There are a number of issues with the vendors' current approach ( [REDACTED] ) that if not corrected will inhibit the schedule's ability to properly calculate and forecast the work. Not correcting these deficiencies will cause OPG to be reactive throughout the Execution Phase. Moreover, the Campus Plan Projects have also learned the importance of planning commissioning tasks well in advance, so that execution of the work (including physical testing, preparation of a multitude of documents and turnover activities) is performed in a manner that allows for the work to be accepted. These details need attention in the final Rev. C schedule.
- **Reporting and Metrics:** The DR Team has considerable work planned to improve metrics and reporting as part of the Readiness planning. It intends to put in place a new cost tracking system and developing metrics that will provide useful tools for project management. The team is committed to basing these systems on installed quantities which is standard in the industry. Much of the DR Project's current controls suite is based on financial reporting, which has its place but is not appropriate for field execution. In addition, the team needs to define a single source of data so that there is fidelity across all reports. BMcD/Modus will be closely reviewing the team's efforts in developing its reporting regime.
- **Unit 2 Cost Estimate:** The culmination of the Readiness to Execute activities will be the development of the Unit 2 Estimate for the BOD's approval. The work performed for RQE should position the team for this exercise, though it should consider lessons learned from the RQE effort and develop a Unit 2 Estimating Plan. As part of that plan, the DR Team should consider using the same RQE processes and protocols for all of the Unit 2 Estimate. During RQE, a decision was made to vary from the approved estimating process for some of the components of the estimate, including PMT costs, functional costs and the discrete risks. With the goal of the Unit 2 Cost Estimate being to tighten the estimates, the established process used for vetting EPC costs will allow for more formative vetting of these costs, increasing their reliability.

## **Nuclear External Oversight Assessment Report**

### **Cost Management & Earned Value**

#### **Objective and Scope**

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMCD/Modus") have performed an assessment with respect to OPG's cost management system; cost, earned value/performance reporting; and the forecasting capabilities for the Darlington Nuclear Refurbishment Project ("Project") programs. This assessment generally focuses on four major areas related to these topics:

1. Description of cost tracking and management systems and methodologies typically used in the construction industry.
2. Observations regarding the systems and methodologies currently being utilized by OPG.
3. Comparisons of system functionalities and methodologies being utilized by OPG versus those typically used in the construction industry for large capital / mega-projects. .
4. Examples of where OPG's selected cost and earned value systems and methodologies comport with the industry at large and identification of potential problems or inefficiencies with those systems.

In addition, BMCD/Modus provides recommendations for closing the observed gaps and addressing deficiencies in systems and methodologies being utilized by OPG.

#### **Period of Assessment**

August 1 2014 through October 16, 2014.

#### **Overall Assessment Risk Score: HIGH**

#### **Background and Methodology**

On August 13, 2013, BMCD/Modus presented its comprehensive Independent Project Assessment ("IPA") based upon our review of the Project from February 25 through mid-July, 2013. At that time, we reported that the team was encountering difficulties setting up and running the tools and programs for the Cost and Earned Value systems, focused mainly on the Proliance and Microsoft Business Intelligence ("BI") software. OPG had previously implemented these tools within the Projects and Modifications organization earlier on and so they were chosen to be implemented for the Darlington Refurbishment Program. We noted the generally problematic nature of setting up these systems, with particular concern over the potential timing issues of setting them up during the DR Project growth period. As of the IPA, we noted that only one Project Bundle, RFR, had an earned value process that was functioning for SNC/Aecon's Definition Phase work, though even its system had bugs.

Since then, OPG has made progress developing the Cost and Earned Value systems, and that progress allows for our team to perform a "dipstick" of those systems' effectiveness. Additional project bundles have been added to the system and at this time, nearly 100% of the project bundles have portions of an earned value process up and running. This assessment focuses on the output of OPG's cost, earned value, and forecasting system for those reporting Project Bundles with analysis performed by our own team. In addition, we have conducted numerous interviews with members of the Planning and Controls ("P&C") organization and the Cost & Schedule Analysts ("CSA") for each Project Bundle to determine to what extent the CSAs are utilizing the systems, how well they are performing, and current strengths and weaknesses.

BMCD/Modus has performed several Project Assurance reports prior to embarking on this oversight review of the OPG Cost Management and Earned Value programs. Observations and recommended actions with either

the Cost Management or Earned Value systems that have been documented in previous reports will be referred to or incorporated into this report as necessary.

**Interviews of the following individuals:**

Mike Allen, Vice President, Refurbishment Execution  
Gary Rose, Director, Planning and Controls  
Art Depres, Outage Director  
Robert Obertries, Section Manager, Estimating, Refurbishment Project Infrastructure  
Roy Brown, Project Manager, RFR  
Sorin Marinescu, Project Manager, Fuel Handling  
Ken Graham, Project Manager, Shutdown, Layup  
Scott Guthrie, Project Manager, Balance of Plant  
Andy Elliot, Cost Manager, Planning and Controls

Neil Mitchell, Vice President Engineering, Nuclear Refurbishment  
Art Rob, Vice President, Projects and Modifications  
Dragan Popovic, Director, Projects and Modifications  
Lindsey Greenland, Project Planning & Control Lead  
Alberto Castellanos, Cost & Scheduling Analyst  
Leo Saagi, Director Controllershship  
Derek McAuley, Schedule Manager, Refurbishment Project Infrastructure  
Norman Chan, Section Manager, Reporting / Cost  
Sudhakar Pulagam, Cost & Scheduling Analyst, Refurbishment & Feeder Replacement  
Walid Masud, Cost & Scheduling Analyst

**Attended the Following Meetings:**

06/06/13: Andy Elliot, Gary Rose, Eric Gould, Dan Meyer, Joe Byce, Ned Markey – Status of Proliance and the BI tools  
09/16/13: Andy Elliot, Eric Gould, Duke Bell - 4c Estimate, Gate Approvals, Proliance, Change Control and the data fidelity issue  
11/17/13: Norman Chan, Duke Bell – Review of Proliance and BI software as installed and operational  
08/13/14: Roy Brown, Sudhakar Pulagam, Carrie Okizaki, Duke Bell – RFR Cost Management, Earned Value and Performance Metrics  
08/21/14: Gary Rose, Art Depres, Derek McAuley, Andy Elliot, Duke Bell – Project Cost Management, Earned Value and Performance Metrics  
09/19/14: Sudhakar Pulagam, Justin Alizadeh, Duke Bell – JV daily, weekly and monthly metrics, use of SCADA system and schedule database integration with OPG  
10/07/14: Gary Rose, Duke Bell – Integration Findings and Cost Management Assurance Plan  
10/08/14: Scott Guthrie, Duke Bell – Cost Management, Performance Metrics and Earned Value issues and needs for BOP  
10/08/14: Leo Saagi, Duke Bell – Cost Management and Finance's role in the program  
10/09/14: Mike Allen, Gary Rose, Eric Gould, Geoff Thomas, Duke Bell – Discussion on assimilation of PMs for performance analysis needs  
10/16/14: Mike Allen, Gary Rose, Eric Gould, Duke Bell – Discussion on estimating program and

support of Cost Management and Performance Measurement

**Reviewed the Following Documents:**

Nuclear Refurbishment - Cost Management and Reporting, N-Man-00120-10001 PC-13

Management Work Stream Applications and Coding Requirements, N-Man-00120-10001 PC-14

Nuclear Refurbishment Earned Value Management, N-MAN-00120-10001 SCH-07

Nuclear Refurbishment - Cost And Schedule Change Control Instruction, N-MAN-00120-10001-PC-02-R000, 2012-07-31

Nuclear Projects Cost Estimating, N-MAN-00120-10001-EST-R001, 2012-11-30

Nuclear Refurbishment Cost Estimate, N-MAN-00120-10001-EST-01-R000, 2012-07-25

AACE Rec Prac 37R-06 Schedule Levels of Detail (2010)

AACE Rec Prac 40R-08 Contingency Estimating -- General Principles (2008)

AACE Rec Prac 41R-08 Risk Analysis and Contingency Determination (2008)

Program Schedule Management Plan, NK38-PLAN-09701-10067-0004-R001, 2013-03-27

Refurbishment Program Structure and Summary Management Plan, NK38-PLAN-09701-10067 - 0001-R002

Refurbishment Program Scope Management Plan, NK38-PLAN-09701-10067-0002-R001

Program Cost Management Plan, NK38-PLAN-09701-10067-0003-R000

Program Schedule Management Plan, NK38-PLAN-09701-10067-0004-R000, 2013-01-31

Refurbishment Program Reporting Management Plan, NK38-PLAN-09701-10067-0005-R000

Darlington Refurbishment Risk Management Plan, NK38-PLAN-09701-10067-0006-R003

DNR Program Scope Control, NK38-INS-09701-10001-R004

**Overall Assessment:**

OPG's original management philosophy for the Project was based on an EPC contracting strategy, where the risk of engineering, procurement and construction is shifted to the contractor and OPG would act in a role of passive oversight for the DR Project. This meant that the Project Controls processes and systems were set up to monitor progress of construction based on this passive approach.

In the first and second quarters of 2013, several of the contracts had been put into place and the overall philosophy of project management began to change based upon the shifting risk profile for the Project. It was generally recognized that while OPG continued with its EPC contracting strategy, there would be more than one contractor performing work at one time that would require more active management and coordination by OPG. Additionally, the project was not a greenfield project but the refurbishment and construction of new facilities on an operating nuclear site, and several of the contracts were being performed on a cost reimbursable basis. These facts, taken together, required OPG to engage in a much more active management philosophy of the contractors. This meant that the Project Controls processes and systems would need to be more extensive than had been originally planned. The Project Team began to realize that changes had to be made and began to contemplate change to the processes, procedures and systems. We have noticed that over the last two years, the active project management philosophy has taken root and begun to flourish. The Project Team Managers and Project Controls teams are developing the processes, procedures and



systems to support this new philosophy. The purpose of this report is to highlight areas within the Cost Management and Earned Value Management System (“EVMS”) where improvements could be made to support OPG’s ability to actively manage the DR Project.

In evaluating OPG’s systems, BMCD/Modus has reviewed the relative sophistication of the selected cost management, earned value and project forecasting process in light of what is generally used in the industry. OPG’s currently deployed EVMS and project forecasting processes and systems rely almost entirely on monthly financial cycles and cumulative performance to date; a methodology we understand has been utilized by the OPG Projects and Modifications organization on smaller projects. While this type of system may adequately support a portfolio of small projects spread over a very long period of time, such a Cost and EVMS system is not consistent with and unlikely to support an actively-managed project as large and fast-changing as the DR Project.

The Project Bundle managers within the DR Project are responsible for controlling and forecasting the project work and related costs. However, certain gaps within the EVMS, as of the Third Quarter of 2014, caused some Project Bundles to measure progress in unique and separate ways from the overall Program. While these “work-arounds” aided each project individually, it led to a lack of standardization across the organization. Additionally, OPG’s current system utilizes a process of manually inputting cost, budget and forecast data into a database that is cumbersome and requires duplicative work processes to keep the data aligned with the project teams’ forecasts. This lack of standardization and the cumbersome nature of the manual inputs caused conflict and variances in the reporting systems that were constantly being challenged by both the Project Controls and Project Teams. The organization is now addressing several of these misalignment issues between the Project Team Managers and the Project Controls organization and they reaching consensus on both program and process alignment. Teams have been put together to determine the best methodologies for analyzing and managing performance and guidance is being rewritten and standardized within the Project Teams to match current needs.

This report assesses the programs and processes the DR Team currently is using to control and forecast cost on the DR Project, and compares those systems that are generally considered to be the industry standards for these uses. In this Assessment, we provide: an overview of the system the DR Project is using for EVMS; a summary and comparison of best industry practices; and an assessment of the gaps that OPG should address with recommendations for improvement. Our findings include:

- The DR Program lacks an overall project EVMS and Cost reporting strategy (including corporate level reporting) that properly considers the planned, earned and actual quantities of work installed and workhour performance in a manner that is visible and which rolls up for validation of the monthly financial reports.
- The DR Team’s decision to utilize a fully integrated Primavera P6 schedule database results in the Project having most of information needed for an EVMS, including rules of earning credit based on quantities and work-hours performed. This information, however, needs to be integrated at the cost account level, especially for determining percent completions and remaining task durations for each project’s control accounts. While deliverable and quantity-based Earned Value mechanisms have been established for determining percentage completion of activities, hours and quantities are currently not integrated with the reporting system, thus impairing OPG’s ability to effectively monitor and report performance.
- Reports from the Project Team need more emphasis on forecasting, which depends on having recent data needed for trending. There is the potential that OPG will not recognize and mitigate cost and schedule issues/trends in a timely manner because cost data is being used as the basis for earned value and forecasting calculations can be up to 1.5 months old. Best industry practices are based on weekly analysis cost components in order to evaluate



performance and make informed management decisions.

- Level of Effort (LOE) activities are included in OPG's earned value and performance reporting calculations which is skewing indices and leading to inaccurate/ineffective metrics.
- The DR Program's cost management procedures do not require alignment between estimates and cost data in the cost management system at any point in time other than at a gate. The DR program does not have a standard format for project estimate preparation or a standard estimating platform for preparing and archiving project estimates.
- The DR Team lacks an estimating database and standard estimating template from which all project-specific controls are normally based. An accurate, clear and concise estimate that when updated properly represents the project Estimate at Completion ("EAC") is imperative for managing a large project and is an essential baseline to measure performance. This standard is being developed and is anticipated to be utilized for RQE.
- The DR program's change control process is partially reliant on the gated process for full identification of project scope; however, lag times in reaching gates has resulted in long periods during which projects are not accurately updating forecasts. This could be a self-correcting process for Refurbishment once all of the major projects are through their Gate 3 reviews and are funded for execution.
- Quantity and manhour data cannot be cross-referenced or validated to identify unit rate or production trends, which are usually not easily recognized by financial trends.
- The DR Team needs to evaluate its use of Proliance as the cost management database and Microsoft BI as the reporting software. This evaluation should include a review of whether Proliance and BI will be able to handle the volume of data regularly produced in a mega-project and if there are ways to improve system functionality.

Recent interviews with the DR Team have revealed the desire to implement the changes needed to the program to help them manage work and more accurately forecast the associated costs. These recommendations have been discussed in detail with the P&C Team and, as of this writing, are being integrated into the Project's cost management processes. For example, OPG is obtaining an estimating database, piloting quantity and work-hour analysis and reporting, and further specifying data needed for reporting and what should be delivered by the contractors. OPG is also addressing the software system deficiencies, the earned value process and system, identifying the data, data integration and data storage needs and developing quality analysis programs for schedule and schedule integration. While the Project Team is currently behind where we would expect them to be in terms of the development of these systems, time still exists to get these controls incorporated prior to the beginning of the Unit 2 Execution Phase, when it will be the most critical.

**Signatures:**

Prepared by: William Bell III  
William Bell

Date: November 19, 2014

**OBSERVATIONS/FINDINGS**

#	Observations/Findings	Risk Rating (Prior to MR)	Recommendations	Management Response
1	The DR Program lacks an overall project reporting strategy (including corporate level reporting) that considers and includes the necessary quantity and workhour performance analysis in a manner that rolls up for validation of the monthly financial reports, utilizing standardized formats.	MEDIUM	<ul style="list-style-type: none"> <li>• A strategy for reporting that identifies the data needed, the data mapping, the data storage and that enforces standard formats and analysis techniques on each Project Bundle needs to be developed.</li> <li>• Develop a standardized daily, weekly and monthly project reporting strategy and format should be developed, tested, implemented and rolled out to all Project Bundles.</li> <li>• Increase the ability of the Project Team to forecast and perform trend analyses. The data needed for monitoring and forecasting work activities should be gathered at more granular and timely intervals. The system should be capable of performing cumulative analysis techniques of daily, weekly and monthly earned value and performance reporting with quantities reported daily, workhours weekly and the cumulative results analyzed monthly for validation against cost.</li> <li>• The Primavera P6 schedule database information (such as quantities and work-hour based rules of credit) needs to be integrated at the cost account level so that EVMS will capture material quantities installed, earned / actual work-hours, unit rates and labor rates data on a timely basis (when available).</li> </ul>	<ul style="list-style-type: none"> <li>• Management will update it's Program Management Plans by the end of Q2, 2015 as well as the associated play books and governance. The updates will include : <ul style="list-style-type: none"> <li>○ Overall Reporting Strategy, and</li> <li>○ Identify the requirements, processes for Daily, Weekly, Monthly Quarterly reporting for each stakeholder group with a documented implementation plan.</li> </ul> <p>TCD April 30, 2015</p> </li> <li>• A forecasting/trending play book is under development. It will be rolled out to all Project Management and Project Controls staff.</li> </ul> <p>TCD May 15, 2015.</p>



2	Level of Effort (LOE) activities are included in OPG's earned value and performance reporting calculations which is skewing indices and leading to inaccurate/ineffective metrics.	MEDIUM	<ul style="list-style-type: none"> <li>The definition of measurable or direct work should be established to better identify the work that should be considered for performance measurement by this system.</li> <li>LOE work should not be included or combined with direct work for determining individual project SPI or CPI. It should only be included in total project CPI and identified when/if included.</li> <li>It should be validated that LOE work is separated from any other measurable work in all control accounts.</li> </ul>	<ul style="list-style-type: none"> <li>Changes are already in place to segregate Level of Effort activities from work packages that can be earned. A review of this will be completed as part of the reporting standards and implemented with Managements Response under Item 1.</li> </ul>
3	The DR program does not have a standard format for project estimate preparation or a standard estimating platform for preparing and storing project estimates	MEDIUM	<ul style="list-style-type: none"> <li>Create standard estimate forms to collect estimates from contractors.</li> <li>Complete the implementation of the US Cost estimating database.</li> <li>Add/update all current and future estimates to the estimating database and true-up estimates to desired format.</li> <li>All estimates should contain all of the elements that need to be measured for performance and earned value measurement (commodities, commodity units, unit rates, and labor rates, etc.)</li> <li>Each estimate should contain cost account detail down to the work package level to properly link the estimate, cost system and schedule databases.</li> </ul>	<ul style="list-style-type: none"> <li>All recommendations are accepted and incorporated into the current implementation plan for US Cost and as part of the RQE deliverables.  TCD June 30, 2015.</li> </ul>
4	The DR Program's cost management procedures do not require alignment between estimates and cost data in the cost management system at any point in time other than at a gate.	HIGH	<ul style="list-style-type: none"> <li>Establish the methodology for keeping the estimate database and cost system aligned for analysis, including change control process and identification of needed updates to Estimates to Complete.</li> <li>Changes in project scope should be estimated utilizing the standards in the estimate database (not yet established) prior to establishing the change and updating the cash flow and Estimate at Completion.</li> <li>Changes should contain the detailed information (quantities, unit rates, work hours, etc.) necessary for performance measurement and earned value</li> <li>The estimate database should be tied to the "data store" to align the two systems and provide a check mechanism.</li> </ul>	<ul style="list-style-type: none"> <li>NR is currently updating its Project Controls Playbooks and associated governance which will incorporate the requirement for alignment between estimate and cost data in the cost management system. The governance updates will address all recommendations. <ul style="list-style-type: none"> <li>TCD March 31, 2015</li> </ul> </li> </ul>

5	The DR program's change control process is partially reliant on the gated process for full identification of project scope, which without analysis of trends not related to costs does not allow timely adjustments based on forecasts and trends in performance unless notified of changes identified by the contractor	HIGH	<ul style="list-style-type: none"> <li>Create a formal change management process that monitors trends and other potential cost/quantity misalignments and addresses changes in scope and cost impacts in a more expedient manner. This would then allow for more timely evaluation and decisions by the management team.</li> <li>Formal weekly change control meetings should be held to address the changing financial needs and management of the organization in conjunction with providing guidance and focus to the Project Team for developing and utilizing trends and maintaining contingency.</li> </ul>	<ul style="list-style-type: none"> <li>A formal change management process and a Change Management Board will be established in conjunction with the execution organization. <ul style="list-style-type: none"> <li>TCD June 30, 2015</li> </ul> </li> </ul>
6	Rules of credit for percent complete and remaining activity duration used in the P6 database are primarily used for determining percent complete utilized in the earned value system. The backup data however (usually quantity or manhour data) is not available or not validated in conjunction with performance measurement.	MEDIUM	<ul style="list-style-type: none"> <li>Develop a process for quality checking or providing quantity and work-hour data from the performing contractors in the Project reporting system for progressing schedules and forming the basis of schedule performance indices.</li> <li>Review the existing rules of credit and basis for determining percent completions for P6 activities to ensure they meet the needs of a work hour and quantity based reporting system</li> <li>If not in place in all projects, move to a system that reports percent complete in P6 based on planned, earned and actual work-hour or quantity progress and validates that percent complete through a corresponding analysis technique.</li> </ul>	<ul style="list-style-type: none"> <li>A revised earned value process has been developed and associated Play Book and governance is being finalized and rolled out. After rollout, validation of appropriate earning rules will be verified at each Gate and results monitored on an ongoing basis. <p>TCD May 15, 2015.</p> </li> </ul>
7	The IT programs and software currently utilized for maintaining cost management data such as budgets (original and current) and actual cost were not designed as a mega-project cost management or earned value system, and is already reaching the limits of its capability. In addition, data manipulation required for developing project reports and metrics is tedious and cumbersome, requiring a duplication of effort to manually load data by a 3 <sup>rd</sup> party after collection from the project teams.	MEDIUM	<ul style="list-style-type: none"> <li>In conjunction with the automated change project underway, evaluate potential alternative data storage techniques to improve database integration and alignment for reporting.</li> <li>Reevaluate the use of Microsoft Business Intelligence (BI) software as the project's sole reporting toolbox. The decision to utilize BI as the report writing tool is based on a corporate standard. With the Nuclear Data Warehouse set-up, determine whether other reporting tools could be utilized that do not require trained programmers to set up reports.</li> <li>Consider whether it is desirable or feasible to replace Proliance with cost management software built for construction projects or standardized database system, preferably one that already contains a quantity and workhour storage database. In the alternative, establish that Proliance will be able to meet the cost management needs of a mega-project.</li> </ul>	<ul style="list-style-type: none"> <li>NR is discussing this issue with CIO and has had meetings with an external consultant to validate the scalability of the cost and reporting systems in conjunction with the implementation of the cost system and data storage improvements currently underway. <p>TCD June 30, 2015.</p> </li> </ul>

**Nuclear External Oversight Assessment Report**  
**Assessment of 4c Estimate and Cost Management**

**Objective and Scope of Assessment**

This assessment covers OPG's cost management processes and procedures as of the development of the Release 4c project cost estimate and 2014 Business Case (4c Estimate), including:

- Processes and procedures OPG has created internally to govern the development, implementation and management of project estimates and project related costs,
- OPG's actual development, implementation and management of the 4c Estimate, and
- OPG's planned continuous and ongoing improvements to its estimating and cost management processes and procedures in preparation for the next phases of Project estimating.

**Period of Assessment**

Our assessment was conducted over a four month period from roughly August 1, 2013 to December 15, 2013.

**Overall Assessment Risk Rating: MEDIUM**

**Background and Methodology**

Since the beginning of our engagement, BMcD/Modus has performed ongoing assessments of the Darlington Refurbishment Project's estimating and cost management processes and procedures. BMcD/Modus also reviewed in detail the methodology used by the DR Team in its preparation and development of its 4c Estimate. BMcD/Modus's assessments were provided to the Nuclear Oversight Committee of the Board of Directors (NOC) as part of our Initial Project Assessment report (dated August 13, 2013) and our Q4 2013 Nuclear Oversight Committee report (dated November 12, 2013). From Mid-July through the end of December, BMcD/Modus continued to review and assess the estimating and cost management processes, and the 4c Estimate, and to note progress against our initial observations and recommendations. Specifically, we have performed the following due diligence with respect to this assessment report:

**Documents Reviewed:**

See Appendix 1.

**Interviews and Meetings:**

See Appendix 2

**Overall Assessment**

In our Initial Project Assessment and in our reviews continuing through December 2013, BMcD/Modus has identified the following concerns:

- The overall quality of the 4c Estimate is commensurate with industry standards for this phase of estimate, e.g. one which is based on a level of project definition with little detailed engineering completed.

- For purposes of tethering its estimating effort to known industry standards, the DR Team has embraced utilizing the estimating standards from the Association for the Advancement of Cost Engineering (AACE) and its guidelines (discussed in detail herein) for the classification of cost estimates. In practice, BMcD/Modus found that the DR Team had inconsistently applied AACE guidelines and other processes and procedures central to the BOD's understanding of the underlying quality of the project cost estimates.
- The single most significant portion of the 4c Estimate and the entire DR Project's costs is the cost of the Reactor Retube and Refurbishment (RFR) Project, with whom OPG has contracted with the joint venture of SNC-Lavalin and Aecon (SNC/Aecon). The RFR cost estimate is also the most mature large scope of work due to the timing of the contact with SNC/Aecon. BMcD/Modus's initial focus for reviewing the 4c Estimate was on the SNC/Aecon's estimate, from which we drew the following conclusions:
  - By contractual design, SNC/Aecon's RFR Class 4 Estimate does not follow all aspects of the AACE classification. In particular, the Class 4 Estimate does not monetize contingency nor will it until the date of the 2015 Class 2 Estimate. This has the potential to fog the budgeting process and could complicate later target price negotiations with SNC/Aecon over risk identification. Moreover, as of the time of this assessment, OPG and SNC/Aecon appeared to have differing opinions regarding the definition and identification of certain types of risks.
  - The methodology used by SNC/Aecon in the development of the RFR Class 4 Estimate portrays project performance under best "theoretical conditions"; thus, it will form the basis for comparison with actual results. Contrary to AACE guidelines, Project maturation specific to the DR Project was not a factor in SNC/Aecon's estimates through the Class 4 estimate.
  - Other aspects of the SNC/Aecon's estimates, such as its tooling prove-out and mock-up practice, will require an ample window of time once the Class 3 Estimate is completed. To the extent that SNC/Aecon's work in these areas is behind the baseline schedule, this could compress the time needed, and thus the quality, of the Class 2 Estimate.
- BMcD/Modus's review of the 4c Estimate yielded the following high-level observations:
  - The estimating and risk management functions need to be better aligned with regard to deriving contingency. The essential linkage between contingency and cost estimating needs clearer definition and would be helped by more deterministic identification of specific risk items.
  - The 4c Estimate is not a full re-examination of the DR Project's underlying cost estimates; this may be appropriate at this stage of estimate though BMcD/Modus would recommend OPG focus on more of a "bottoms-up" approach for 4d.
  - Revised planning assumptions in the 4c Cost Estimate are calculated toward reducing the Project's risk and increase positive outcome, though the full impact of those planning assumptions, as well as the Minister's Long Term Energy Plan (LTEP) will need to be modeled in 4d.
- OPG's new processes and procedures are in some cases conflicting and repetitive.

- The 4c Estimate work began in earnest in the summer during vacation season, and was impacted by the new planning assumptions which caused considerable reworking of many aspects of the estimate.

In addition to the above observations, BMcD/Modus has the following additional concerns and recommendations:

- The DR Team should consistently apply AACE guidelines to the extent these guidelines are applicable. Where they are not, such as with the RFR estimates, the DR Team should seek to identify how the estimate will differ from AACE guidance while still meeting the same level of confidence intended in the classification system.
- Since RFR is the test case for the other project cost estimates, the team needs to ensure that adequate vetting of the RFR estimate is accomplished as the cost estimate moves toward the RFR Class 3. The DR Team also should ensure that the vendor is aligned with OPG's view of the criticality of the Class 3 Estimate.
  - As of this writing, SNC/Aecon's Class 3 Estimate preparation is behind schedule and all related estimating activities are without float. The DR Team needs to carefully monitor and question SNC/Aecon as it prepares the estimate, and plan to deal with the bow wave of information that SNC/Aecon is likely to produce at the last minute.
  - OPG should seek SNC/Aecon's monetizing of PMT costs.
  - OPG should consider asking SNC/Aecon to monetize risks at a much earlier stage, and create a clear and repeatable process for calculating contingency at all levels and for all program participants.
- OPG should perform a full project reforecast for the Release 4d 2015 Business Plan estimate in order to progress the project's cost estimates as far as possible before RQE. Such a reforecast will provide management with a detailed blueprint for all of the work needed to satisfy the RQE with information related to the budget that should match the DR Project's growing level of maturity. Moreover, this effort should start earlier and with more focus than with the 4c Cost Estimate.
- Proliance with all of its functions needs to be implemented as soon as possible to ensure the cost and schedule management systems and reporting are aligned and in sync. This is critical to ensure data fidelity as the bundles move through the gate review process and move toward RQE and execution.
- Although designed to provide a forum for challenging scope and cost estimates, the gate review process has thus far had mixed results for that purpose.
  - Quality and consistency of the materials in Gate packages should be addressed. Gate review packages are often hastily assembled by the project teams and provided to the GRB only shortly before the gate review meetings.
  - Within gate packages, there are requirements for explaining variances in cost estimates, though there is no formal controlled process for presenting these changes. We have generally found little consistency between the various files kept on the bundles, and in some cases, the estimates used for gate reviews were not preserved.

- Records preserving the progression of the estimates are also inconsistent. The backup documentation for each gate should clearly be organized to provide the reader with the needed steps, particularly when scope has changed.
- OPG has mischaracterized the maturity level of vendor-supplied proposals for Campus Plan work as Class 2 or 3 level submissions, even though those estimates from the vendors had not reached the needed design plateau to make such a claim. This has caused OPG to make decisions based on unrealistic cost estimates and under-reserve contingency for certain scopes of work to date, resulting in draws from general or program-level contingency. This practice needs to be thoroughly reviewed by the DR Project.
- Contingency: Our review found that while risks are being identified and analyzed in a reasonable manner, the value of individual risks are not directly traceable or otherwise transparent all the way through the estimate to the bottom line. Instead, management has made a decision to carry Monte Carlo Output risk amounts at a more global level, namely, at the project bundle level only. As a result, discrete risks and associated amounts are merely subsumed into a single contingency number with no traceability back to the individual risk elements.
- The number, mapping and consistency of the various cost control processes and procedures should be reviewed by the DR Team, with an eye toward simplifying and streamlining such procedures. OPG's estimating and cost management procedures should be revised and updated to reflect to explain OPG's revised and current processes.

#### Signatures

Prepared by: \_\_\_\_\_  
*Eric Gould*

Date: April 6, 2014

Prepared by: \_\_\_\_\_  
*Joe Byce*

Date: April 6, 2014

## **OBSERVATIONS/FINDINGS**

#	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
1	<b>4c Estimating Process:</b> The processes the DR Team used to develop the 4c Cost Estimate were robust and generally conformed to customary practices for an AACE Class 4/5 estimate. The DR Team has also properly characterized the nature of the estimate that it has advanced for approval. This characterization is generally confirmed by the DR Project's current overall status at this time. However, Vetting of OPG costs was impacted by the timing of the 4c Cost Estimate effort, which began in the middle of the summer months.	None	<ul style="list-style-type: none"> <li>The next phases of estimating should have a schedule of activities and begin earlier in the year, particularly considering the increased complexity expected for the 4d Cost Estimate. It is our understanding that the DR Team intends to assign to a SPOC the management of the 4d Estimate and RQE readiness effort. This should address our concern and increased focus on the 4d Estimate.</li> </ul>	

#	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
2	<p><b>4d Cost Estimate:</b></p> <p>The 2015 Business Plan, 4d Cost Estimate will need to reflect an expected leap in Project maturity that will occur over the next 8 to 10 months; thus, we would expect that the quality of OPG's estimate would parallel that increase.</p>	MEDIUM	<ul style="list-style-type: none"> <li>With the expected ramp-up of the amount of information needed to support estimates, the DR Team should focus on improving traceability, sourcing, vetting and suitability of database information underlying the estimate as this will be even more essential for vetting the Class 3 Estimates.</li> <li>OPG should perform a full project reforecast for the Release 4d 2015 Business Plan estimate in order to progress the project's cost estimates as far as possible before RQE. Such a reforecast will provide management with a detailed blueprint for all of the work needed to satisfy the RQE with information related to the budget that should match the DR Project's growing level of maturity.</li> <li>Quality control will be critical as the estimates move from ranges to point numbers. The DR Team is migrating to a standard estimating platform (US Cost) that is similar to what SNC/Aecon is now utilizing for its Class 3 RFR cost estimate.</li> <li>Many of the tools Finance and Project Controls developed for reviewing of the 4c Cost Estimate should be captured in the metrics the DR Team uses in an attempt to increase cost consciousness in between forecasts and gates.</li> </ul>	



#	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
3	<b>Source of Hard Costs:</b> The primary driver of hard costs in the 4c Cost Estimate is direct “norm” labor hours which are sourced from an F+G library of data bases and OPG Model Work Orders held in Passport. When in-house data was not available, third party sources were used as appropriate; such as international standards, OPCA (Oil and Petroleum Contractors Association), DACE (Dutch Association of Cost Engineering) and RS Means.	MEDIUM	<ul style="list-style-type: none"> <li>With the expected ramp-up of the amount of information needed to support estimates, the DR Team should focus on improving traceability, sourcing and vetting of database information underlying the estimate as this will be even more essential for vetting the Class 3 Estimates.</li> </ul>	

#	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
4	<b>Estimating Factors:</b> The 4c Cost Estimate relies on a number of estimating factors, some of which are a product of the current level of Project definition (i.e. Class 5/4). Factors have been used to approximate the result that will come with greater Project definition.	MEDIUM	<ul style="list-style-type: none"> <li>Utilizing such factors in estimating is common industry practice. However, OPG should increase the level of documentation regarding the factors that are used so that these are traceable when used.</li> <li>Going-forward, OPG will need a more organized set of estimate templates for vetting of Class 3 estimates and target price proposals from contractors. Utilizing a standard estimating platform (US Cost) should provide an acceptable alternative.</li> </ul>	

#	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
5	<b>OPG Estimating Factors:</b> Labor estimates used in the 4c Cost Estimate are generally based on productivity and include: a crew sheet that analyzes process flow and work series and height of operations. These factors are unique to OPG and have been developed over the past three years.	MEDIUM	<ul style="list-style-type: none"> <li>Traceability of the source of such factors is critical. Industry-based studies for developing productivity factors can be distinguishable, as can a contractor's experience when work is not entirely similar.</li> <li>Vetting of these factors and record-keeping related to the source will be critical for Class 3 estimate reviews.</li> </ul>	

#	Observations	Risk Rating	Recommendations/Findings	Management Action Plan
6	<p><b>OPG Cost Drivers:</b> The major drivers the DR Team examined for the 4c Cost Estimate were: Impact of unlapping of Unit 2, Scope rationalization and impact on overall size of the Project and associated level of effort. The different work groups were given a blank template for defining their staffing needs; this was later changed to variance reporting against 4b when it was apparent the work groups were exceeding cost boundaries. Costs were eventually brought in line via vetting and challenge meetings with RPET and the efforts of the Finance and Project Controls groups.</p> <p>Finance and Project Controls developed metrics for showing cost flows and variances over time that were extremely helpful in determining the right-sizing of the team. These (and similar) tools should be incorporated into the metrics the team is reviewing in an attempt to increase cost consciousness</p>	MEDIUM	<ul style="list-style-type: none"> <li>The DR Team needs to thoroughly examine the Operations and Maintenance estimates and buckets of cost for the DR Project. This is a large cost item that should be thoroughly vetted in light of the reduction in maintenance work scope the DR Team has adopted.</li> </ul>	

#	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
7	<p><b>Gate Review Process:</b></p> <p>Although designed to provide a forum for challenging scope and cost estimates, the gate review process has thus far had mixed results for that purpose.</p> <p>Quality and consistency of the materials in Gate packages should be addressed. Gate review packages are often hastily assembled by the project teams and provided to the GRB only shortly before the gate review meetings.</p> <p>Within gate packages, while there are requirements for explaining variances in cost estimates, there is no formal controlled process for presenting these changes. We have generally found little consistency between the various files kept on the bundles, and in some cases, the estimates used for gate reviews were not preserved.</p>	HIGH	<ul style="list-style-type: none"> <li>• Key documents should be delivered well in advance of the GRB, and increased accountability for timely delivery of the entire gate package.</li> <li>• The DR Team needs to exercise care in making assumptions regarding the maturity of contractor submissions in the gate process. The Campus Plan work has examples where OPG has associated greater maturity to an estimate simply because it was the result of a competitive bidding process.</li> <li>• Improve record keeping and chain of document retention.</li> <li>• The estimates developed for evaluation at the gates should follow the same general vetting methodology and adhere to the same quality and consistency standards as those used in vetting Estimate 4c.</li> <li>• Provide a reconciliation within the gate package template of the estimates presented with the gate package to prior estimates (i.e., 4b, 4c) and the basis of estimates so that changes can be traced and sources are identifiable.</li> <li>• In addition to Project Controls, the DR Team should consider utilizing a 3rd Party (e.g., Finance and the Controllershship) to provide an independent analysis and examination of the sufficiency of the gate packages. The 3rd party can report to the GRB its findings and concerns.</li> </ul>	

#	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
8	<p><b>Contingency:</b> Our review found that while risks are being identified and analyzed in a reasonable manner, the value of individual risks are not directly traceable or otherwise transparent all the way through the estimate to the bottom line. Instead, management has made a decision to carry Monte Carlo Output risk amounts at a more global level, namely, at the project bundle level only. As a result, discrete risks and associated amounts are merely subsumed into a single contingency number with no tractability back to the individual risk elements.</p> <p>OPG's choice to aggregate risk at the bundle level is not without precedent in the industry. However, given this choice, OPG will lose transparency as well as the ability to focus on and manage individual post-Monte Carlo risk amounts, which is particularly important for addressing the Project's most significant risks.</p>	HIGH	<ul style="list-style-type: none"> <li>As noted in our Initial Project Assessment, the DR Team needs wider and increased appreciation of the importance of accurately identifying risks and related parameters. Furthermore, as evidenced by a review of the risk register, more than a few DR Team members do not understand the distinction between management performance issues, business as usual issues and true project risks. Senior management needs to continue to focus the DR Team on weeding-out unnecessary risk items that take up management time and attention.</li> <li>The risk group needs to be more involved and empowered as part of the initial risk identification efforts. Challenge meetings would help to identify true project risks and proactively eliminate false risks and duplicate inputs.</li> <li>Without having a discrete risk basis for formulating contingency, project managers will need to request individual Monte Carlo analyses on selected risk items and expend extra effort to track those risks. In addition, such retrospective calculations will not be consistent with the results of bundled-level analyses.</li> <li>The distinction between Management Reserve and Contingency needs further definition as do the rules for allocation of funds.</li> <li>Future cost estimates should include a composite roll-up of contingent scope so that the extent of the "unknowns" in the estimate are transparent.</li> <li>Going forward, contingency dollars for the Project's most significant known risks should be developed on a deterministic basis with stochastic modeling limited to chances of occurrence.</li> </ul>	

#	Observation	Risk Rating	Recommendation	Management Action Plan
9	<b>OPG Estimating and Cost Management Procedures:</b>  OPG's estimating and cost management procedures should be streamlined, revised and updated to reflect to explain OPG's revised and current processes.	LOW	<ul style="list-style-type: none"> <li>N-MAN-00120-10001 PC-13 Nuclear Refurbishment - Cost Management And Reporting and N-MAN-00120-10001-CST-R000 2012-07-19 Nuclear Refurbishment - Cost Management and Project Reporting should be consolidated.</li> <li>OPG estimating procedures should be updated and revised to clarify and qualify the references to the AACE estimating classes, procedures and standards.</li> </ul>	

## **Appendix 1**

### **Documents Reviewed**

N-MAN-00120-10001 RISK-05 Nuclear Refurbishment - Contingency Development And Management Guide

N-MAN-00120-10001 PC-13 Nuclear Refurbishment - Cost Management And Reporting

N-INS-09701-10000 Process For Estimation Of Post-refurbishment Costs For OPG Nuclear Stations

N-GUID-00400-10000 Nuclear Projects Cost Estimate Review

NK38-PLAN-09701-10067-0003-2013-01-31 Program Cost Management Plan

N-MAN-00120-10001-CST-R000 2012-07-19 Nuclear Refurbishment - Cost Management and Project Reporting

N-MAN-00120-10001-EST-01-R000 2012-07-25 Nuclear Refurbishment Cost Estimate

N-MAN-00120-10001-EST-R001 2012-11-30 Nuclear Projects Cost Estimating

SNC/Aecon Class 5/4 Estimates and related Estimate Plans

SNC/Aecon Class 3 Estimate Plan

4c Cost Estimate documents

- BOP Common
- BOP Conventional
- Fuel Handling
- Islanding
- BOP Pre-refurbishment
- BOP Reactor Systems
- Safety and Control Systems
- Shutdown and Layup
- BOP Special Programs
- Steam Generator
- Turbine Generator

## Appendix 2

### Assessment Meetings/Interviews

Location	Date	Attendees	Position	Organization	Items Discussed
GM Bldg.	23-May-13	Ian McCory	RFR Project Director	OPG	Introduction meeting regarding methodology used for the Class 4 Cost Estimate; discussion on source data (OPEX) used from Wolsong and other projects.
		Scott Waters	RFR Project Manager	OPG	
		Perrik LeDreff	RFR Project Manager	OPG	
		Lonnie Schofield	Estimating Manager	OPG	
		Joseph Byce	Senior Cost Analyst	B&McD/Modus	
GM Bldg.	11-Jun-13	Daniel Meyer	Senior Cost Consultant	B&McD/Modus	Kick-off meeting regarding completion goals and time table for 4c Cost Estimate.
		Gary Rose	Manager of Project Controls	OPG	
		Eric Gould	Senior Manager	B&McD/Modus	
		Ned Markey	Schedule & Cost Analyst	B&McD/Modus	
DEC	13-Jun-13	Joseph Byce	Senior Cost Analyst	B&McD/Modus	Discussion regarding the use of Wolsong OPEX data for RFR Class 4 estimate; screen walk through of DSR estimate data base.
		Lonnie Schofield	Estimating Manager	OPG	
		Ian Wright	Estimating Lead	F+G	
		Juan Natividad	Estimator	F+G	
DEC	26-Jun-13	Joseph Byce	Senior Cost Analyst	B&McD/Modus	Discussion regarding factors used in the RFR Class 4 estimate; progression methodology from Class 5 to Class 4; discussion of detailed mini-estimate reports.
		Ian McCory	RFR Project Director	OPG	
		Lonnie Schofield	Estimating Manager	OPG	
		Eric Gould	Senior Manager	B&McD/Modus	
DEC	16-Jul-13	Joseph Byce	Senior Cost Analyst	B&McD/Modus	Discussion regarding risk register and contingency amounts regarding RFR Class 4 estimate.
		Daniel Meyer	Senior Cost Consultant	B&McD/Modus	
		Gary Rose	Manager of Project Controls	OPG	
		Lonnie Schofield	Estimating Manager	OPG	
DEC	18-Jul-13	Trevor Green	Senior Manager	F+G	Discussion on the general plan and timetable for development of 4c Cost estimate.
		Tracy Leung	Risk Management	OPG	
		Neinke Smith	Risk Management	OPG	
		Eric Gould	Senior Manager	B&McD/Modus	
DEC	26-Jul-13	Carrie Okizaki	Senior Manager	B&McD/Modus	Discuss methodology for development of 4c Cost Estimate and role of project controls.
		Joseph Byce	Senior Cost Analyst	B&McD/Modus	
		Gary Rose	Manager of Project Controls	OPG	
		Eric Gould	Senior Manager	B&McD/Modus	
DEC	28-Aug-13	Joseph Byce	Senior Cost Analyst	B&McD/Modus	General discussion regarding estimating templates utilized for the 4c Cost Estimate; locations of estimating files on Sharepoint.
		Ian Wright	Estimating Lead	F+G	
		Juan Natividad	Estimator	F+G	
		Daniel Meyer	Senior Cost Consultant	B&McD/Modus	
DEC	04-Sep-13	Joseph Byce	Senior Cost Analyst	B&McD/Modus	Discussion regarding 4c estimating files and location of BoE project bundles.
		Ian Wright	Estimating Lead	F+G	
		Lisa Crisologa	Estimator	F+G	
		Joseph Byce	Senior Cost Analyst	B&McD/Modus	
DEC	06-Sep-13	Lonnie Schofield	Estimating Manager	OPG	Discussed DSR estimates by Basis of Estimates (BoE's); walk-through Master Estimating file - DSR Estimates by BoE.
		Joseph Byce	Senior Cost Analyst	B&McD/Modus	
		Lisa Crisologa	Estimator	F+G	
		Joseph Byce	Senior Cost Analyst	B&McD/Modus	
DEC	23-Sep-13	Daniel Meyer	Senior Cost Consultant	B&McD/Modus	Discuss targeted BoE cost samples for vetting 4c Cost Estimate.
		Leo Saagi	Controller	OPG	
		Eric Gould	Senior Manager	B&McD/Modus	
		Mark Cirra	Cost Analyst	B&McD/Modus	
DEC	25-Sep-13	Joseph Byce	Senior Cost Analyst	B&McD/Modus	Meeting with Controller regarding 4c Business Planning.
		Lonnie Schofield	Estimating Manager	OPG	
		Lisa Ren	Estimator	OPG / P&C	
		Shane Howe	Estimator	F+G	
DEC	27-Sep-13	Juan Natividad	Estimator	F+G	Meeting with Estimating Team involved in the development of 4c Cost Estimate; estimators discussed their background and estimating experience specific to power industry. Discussed cost sampling and vetting process.
		Nazar Aljasim	Estimator	F+G	
		Nicole Zhang	Estimator	OPG / P&C	
		Lisa Crisologa	Estimator	F+G	
DEC	09-Oct-13	Joseph Byce	Senior Cost Analyst	B&McD/Modus	Meeting with Estimating Team to sample DSR estimated costs for Balance of Plant (BoP) and Turbine Generator (TG) project bundles; walk through estimating program.
		Daniel Meyer	Senior Cost Consultant	B&McD/Modus	
		Lonnie Schofield	Estimating Manager	OPG	
		Ian Wright	Estimating Lead	F+G	
DEC	09-Oct-13	Lisa Crisologa	Estimator	F+G	Discussion regarding the traceability of discrete risks to contingency amounts carried in 4c Cost estimate.
		Clan M. Neieist	Estimator	F+G	
		Nazar Aljasim	Estimator	F+G	
		Juan Natividad	Estimator	F+G	
DEC	10-Oct-13	Joseph Byce	Senior Cost Analyst	B&McD/Modus	Meeting with estimating team regarding cost sampling of turbine generator DSR's; view database for estimating metrics.
		Daniel Meyer	Senior Cost Consultant	B&McD/Modus	
		Lonnie Schofield	Estimating Manager	OPG	
		Ian Wright	Estimating Lead	F+G	
DEC	10-Oct-13	Nazar Aljasim	Estimator	F+G	
		Joseph Byce	Senior Cost Analyst	B&McD/Modus	
		Daniel Meyer	Senior Cost Consultant	B&McD/Modus	
		Lonnie Schofield	Estimating Manager	OPG	

**Nuclear External Oversight Review of**  
**OPG Risk Management Practices and Procedures**

**Objective and Scope**

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMcD/Modus") have performed an assessment with respect to OPG's Risk Management Program for the Darlington Nuclear Refurbishment Project ("Project"). This assessment addresses the risk management procedures, risk registers, training, management and overall execution of the Risk Program. The assessment was conducted during the second, third and fourth quarters of 2013. Our assessment measures both progress during this time as well as observations and recommendations for further improvement.

**Background and Methodology**

On August 13, 2013, BMcD/Modus presented its comprehensive Project Assessment Report based upon our review of the Project from February 25 through mid-July, 2013. At that time, we reported that the Darlington Refurbishment Project Team ("DR Team") established a Risk Management Program that is generally consistent with those commonly encountered on other large mega-projects and complies with published literature such as the Project Management Book of Knowledge ("PMBOK") published by the Project Management Institute. We also noted several areas for improvement, particularly with respect to risk identification, leadership and training.

From Mid-July through the end of December, BMcD/Modus continued to review and assess the Risk Management Program and to note progress against our initial observations and recommendations. Specifically, we have performed the following due diligence with respect to this assessment report:

**Interviews of the following individuals:**

Gary Rose, Director, Planning and Controls  
Ninke Smith, Manager, Refurbishment Project Infrastructure  
Tracy Leung, Risk Section Manager  
Ryan Smith, Section Manager  
Atef Soliman, Cost and Schedule Analyst  
Roy Brown, Project Manager, RFR  
Todd Josefovski, Project Manager, Turbine Generator, Steam Generator  
Sorin Marinescu, Project Manager, Fuel Handling  
Ken Graham, Project Manager, Shutdown, Layup and Services

Bert Boston, Section Manager, Islanding  
Scott Guthrie, Project Manager, Balance of Plant  
John Gierlach, Senior Manager Strategic Initiative  
Jody Hamade, VP Enterprise Risk Management  
Carlo Crozzoli, SVP Corporate Business Development  
Patrick Iemma and Steve Wong, RFR Risk Management (outside contractors)  
Andre Macatangay, Risk Manager, AECON  
Simon Taylor, OPG independent Risk Consultant, Questant, Inc.

**Attended the Following Meetings:**

Risk Management Workshop (Identification of Risks) held on September 6, 2013  
Risk Oversight Committee Meetings on September 12, 2013 and December 4, 2013  
Monthly Risk Review Meeting for Balance of Plant on October 2, 2013 and October 25  
JV RFR Monthly Risk Workshop on November, 21 2013  
JV Risk Management Process Review on December 18, 2013



**Reviewed the Following Documents:**

- DR Risk Management Plan (NK38-PLAN-09701-10067 0006 R003)
- Nuclear Projects Risk Management Process (N-MAN-00120-10001-RISK-R001)
- Task Instruction—Closing Risks (N-MAN-00120-10001-RISK--R000)
- Risk Management Guide (N-MAN-00120-10001 RISK-04 R001)
- Contingency Development and Management Guide (N-MAN-00120-10001-RISK-05 R001)
- Darlington Refurbishment Lessons Learned And Opex Management (N-MAN-00120-10001-RISK-06-R001)
- Assumptions & Decision Management (N-MAN-00120-10001 RISK-07)
- Program Risk Registers run on November 19, 2013; December 3, 2013 and January 4, 2014
- Project Risk Registers run on November 19, 2013, December 3, 2013 and January 4, 2014
- Risk SPOC Meeting Materials, November 7, 2013
- Risk Oversight Committee Meeting Handout Materials, September 12, 2013 and December 4, 2013
- Risk Identification Training Materials prepared by Simon Taylor

**Overall Assessment**

In our Project Assessment in August, BMcD/Modus identified the following concerns with respect to the Risk Management Program:

- **Risk Identification and Scoring Issues:** Many of the identified risks are really “concerns” (or “business as usual risks”) stemming from potential inadequate management and thus serve to only clutter the Risk Register – contingency should not be added for poor management, rather, better management should be added. Cluttering the register with false risks is energy consuming and serves no productive purpose. In addition, there is evidence of wide ranging ambiguity and inconsistency in the risk titles and descriptions which leads to uncertainty in understanding the risk that may in turn lead to misplaced mitigations.
- **Tools for Risk Management Program:** The reporting systems databases used for Risk Management and related programs (i.e. RADAR, AIDA, OPEX) are cumbersome with limited capabilities and do not interface well or cross reference with each other. This limits effectiveness as a management tool and causes inefficient use of personnel time. Efforts by the IT group to improve this critical system has been slow in coming.
- **Opportunities:** A good Risk Management Program also attempts to identify “opportunities” and provide for a proactive response to improve the likelihood of the “opportunity” occurring. No such opportunities have been observed in the DR Project RM Program, suggesting that latent opportunities may be out there.
- **Training:** There was a noted lack of training for the Risk Management Program that would foster an understanding and acceptance of the importance of risk management and stimulate proactive participation and encourage the identification of risks and opportunities in the Risk Registers.
- **Lack of Metrics:** The Risk Management and associated programs have a less than desirable number of meaningful metrics to provide management with a sense of the maturity or fidelity of the underlying the data and the DR Project's performance.

- **Staffing and Leadership:** The Refurbishment Planning and Controls Risk Group (“Risk Group”) is responsible for the development, implementation and oversight of the Risk Management Program. The Risk Group is staffed with capable but relatively inexperienced individuals - several staff are Co-ops or interns. The DR Project’s philosophy appears to be for the individual projects and departments to perform the majority of Risk Management duties and related work, while the central Risk Group serves only an administrative, support and oversight role. This creates a condition that risk management is viewed as a collateral duty of project or department personnel which dilutes and diminishes the attention focused on risk management efforts, given other duties of such entities.

Since the Project Assessment, the DR Team has continued to develop and implement the Risk Management program through the end of the last quarter. Although much remains to be done to effectively initialize the program, numerous improvements have been initiated that address matters such as:

- Greater emphasis on risk identification clarity and the progressive elimination of “business as usual” items from the Risk Registers
- Some formal training has been conducted
- Improvement to the Risk Register Reports
- Consolidation and clarification of the applicable risk procedures
- The Risk Group has taken a more aggressive role in managing the Risk Management Program

However, complete implementation of these essential improvements has yet to be accomplished. To date, there remains over 500 named risks in the project and program risk registers, many of these risks are still what could be considered “business as usual” type risks. The risk reporting tool is somewhat cumbersome and is difficult for end users to sort and analyze information. The DR Team has commenced some formal training on the Risk Management Program, however, there needs to be more as evidenced by the current state of the Project Risk Registers. While we have seen some evidence that the Planning and Controls Risk Group has taken a more active role with respect to the implementation and management of the Risk Management Program, we would like to see much more progress in this regard. Additionally, we have not seen much improvement with respect to the identification of opportunities or the development of useful metrics.

The assessment Observations listed below and discussed herein reflect matters where improvements have been initiated as well as matters that still need to be addressed.

Observation 1: Risk Register Reporting Limitations

Observation 2: Lack of Clarity of Risk Titles and Descriptions

Observation 3: Numerous Entries in the Risk Registers are not “Risks”, but Business as Usual “Issues”

Observation 4: Lack of Appropriate Risk Management Program Staffing & Leadership

Observation 5: Risk Management Program Training

Observation 6: Missing Identification of “Opportunities”

Observation 7: Weak Risk Responses

Observation 8: Long Periods Between Risk Register Reviews and Updates

Observation 9: Risk Oversight Committee Effectiveness

Observation 10: Lack of Trending and Other High-Level Metrics

Issues identified in these Observations are causing the DR Risk Management Program to be cumbersome and sub-optimized. Once properly addressed, a streamlined, efficient and effective Risk Management Program will result, eliminating unnecessary and wasted effort and contributing to the success of the Darlington Refurbishment Program.

## **1.0 Observations**

### **1.1 Observation 1: Risk Register Reporting Limitations**

RADAR (Risk Assessment Database and Register), the DR Program's and Project's Risk Registers, were developed and maintained by the Risk Group using a Microsoft Access-based platform. It has served a purpose in initially documenting risks associated with the Darlington refurbishment. However, RADAR data entry and report generation was limited to a few trained individuals and the program lacked the functionality to effectively support the risk management program. In addition, RADAR was not integrated with related databases, thereby limiting the ability to effectively track and manage OPEX, Issues, Decisions, Assumptions and Action Items as they relate to the management of identified risks.

A recent migration from Access to SharePoint is a step in the right direction because it provides direct risk register access to the DR Team. Additional work remains, however, before an essential integrated risk management software tool is in place. These include:

- Establish interfaces between the Risk Register and other supporting databases. Hyperlinks to Action Items that track each risk's mitigating activities are desirable to understand how each risk is managed. The current schedule for incorporating this feature is June 2014.
- Establish a methodology for creating custom Risk Register reports. Only three "canned" reports are available from the SharePoint Risk Register. Users cannot directly obtain the data sorts that suit their specific need. For instance, users should be able to sort by "project/bundle" and "phase" of the project. However, users must export the entire SharePoint Risk Register file to Excel in order to manipulate the data. While this does not require a large effort, a potential document control issue may arise, causing confusion when users are not working with current data. These limitations also make it less likely that end users will want to take the time to analyze the critical information in the Risk Register.
- Create the ability to generate reports detailing mitigating actions for each risk. Such reports should identify the action, the responsible party and relevant required dates. Clearly, the necessary data must be in the Actions database before such reports can be produced. Ideally, with a fully integrated database system, managers could obtain reports that support their need.
- Provide reference in the Risk Register to P6 activities which reflect the mitigation strategy for scheduled risk responses. Where multiple activities constitute a risk response (especially those with precursor and successor ties), risk mitigation activities should be scheduled in the integrated P6 schedule. As an example, pre-outage scope defining inspections that are linked to risk items should have a schedule tie back to resolving an open risk item.

### **RECOMMENDATIONS:**

- Expedite interfacing the SharePoint Risk Register with other related databases.
- Consider formally exporting a "controlled" Excel version of the Risk Register into a SharePoint folder on a definite time table (e.g. the 1<sup>st</sup> of each month and the 15<sup>th</sup> of each month). That way, everyone will know when updated versions are available; and therefore, when their working copies are outdated. Each exported RR filename should include the date and the worksheets should include a locked footer with the version and date. Doing this will allow users to create needed reports while retaining the dated version identification.
- Ensure that all risk mitigations items are included in the Actions Database and that a reference to associated risks is provided. In addition, provide for the sorting of the Actions Database by risk number, responsible party, due date and other fields
- Increase efforts to schedule multi-activity risk responses in P6 and provide reference to the P6 activity string in the Risk Register.
- Consider convening a group of SharePoint Risk Register users to obtain feedback on the current database. Take necessary actions to further conform the Risk Register and associated databases to the need of users.

## 1.2 Observation 2: Clarity of Risk Titles and Descriptions

In general, a “risk” involves an event driven by a cause; and the event, along with its impact, is the focus of the Risk Response (e.g. mitigation) strategy. Many DR Risk Titles and Risk Descriptions are poorly written and ambiguous, causing confusion regarding the intended meaning. This is not a mere administrative compliance matter. Risk Responses must target the cause of the event. Without a clearly defined cause, it is difficult, if not impossible, to develop an effective strategy for reducing the likelihood of occurrence. Furthermore, without clearly defined impact, it is difficult to create an impact reduction strategy and to determine financial and schedule impact scores.

The Risk Management Program procedures, in particular Risk Management Guide, N-MAN-00120-10001 RISK-04 R001 (“Risk-04”) provides very clear instruction on risk identification and descriptions. The Risk Group has implemented various training sessions with respect to risk identification and appropriate descriptions. This has included the hiring of Simon Taylor, an independent risk consultant, to conduct training workshops specifically on risk identification. Seven Risk Workshops have been conducted between August 22 and Dec 3, 2013. Additionally, a training session for Risk SPOCS on the entire Risk Management Program was held in early November. At the September Risk Oversight Meeting, there was an action taken by all risk stakeholders to “clean up” the risk register—i.e. the removal of business as usual risks. As a result, we have seen noticeable improvement in the risk descriptions from September through December. However, this effort is not complete as the Program and Project Risk Registers still have risks that are not well identified or defined. In December, the Risk Group issued a Manager’s Briefing Card, mandating updating of all risks in accordance with Risk-04 by the end of January. Until all risks have been updated, review of the Risk Registers will cause much wasted time and confusion when assessing risk scores and responses. Such confusion has been observed in project meetings, as well as in Risk Oversight Committee meetings. Examples of vague and misleading Risk Titles and Descriptions are provided in Appendix 1 Table A1.1.

### RECOMMENDATIONS:

- Once the risks have been updated, the Risk Group should act as a gatekeeper to ensure that all risk titles and risk descriptions in the current Risk Registers to be consistent with the revised RISK-04 guideline<sup>1</sup>. Doing so should add clarity and eliminate the wasteful confusion. In addition, by describing a risk as an event and indicating the cause, one can focus on the actual risk rather than an open-ended ambiguous description that creates difficulty in: a.) communicating the problem, b.) creating and reviewing risk responses, c.) understanding the effectiveness of mitigations and d.) causing uncertainty when considering closure.
- The Revised RISK-04 document is a major step forward to consolidate and clarify a number of risk program requirements. It should be rolled out with a strong message regarding its purpose and key changes. The rollout presents a significant opportunity for senior management to demonstrate commitment to effective risk management and to stress the importance of all personnel to participate in the RM program and to properly use the procedure. Furthermore, once RISK-04 is approved and issued, a collective effort, driven from the Project’s RPET in combination with ERM, should be undertaken to perform a thorough review of risk titles and descriptions, re-writing them where necessary and confirming that risk responses effectively and aggressively address the risks.

Once the Risk Registers are cleaned up, tracking and managing risks can become focused, efficient, and effective.

<sup>1</sup> RISK-04 Revision 1 addresses “Vague or Misleading Risk Titles and Risk Descriptions” at Sect. 2.2.1.3:

#### **Risk Titles**

(a) Risk titles describe the **event** and the **context** of the event. E.g. “There is a risk of insufficient welders available **<event>** to support Execution **<context>**”

(b) Risk titles should not include potential impact, especially if there are multiple impacts (as these should be characterized under Risk Description instead)

#### **Risk Descriptions**

(a) Risk descriptions should be comprised of the risk **event**, the **cause**, and the **impact** of the event.

E.g. “There is a risk of insufficient welders available **<event>** to support Execution due to competition with other large industrial projects in the province **<cause>**, resulting in a delay that will impact the critical path by 30 days **<impact>**”.



### **1.3 Observation 3: Numerous Entries in the Risk Registers are not “Risks”, but are “Issues”**

Based on a review of the Project Risk Registers, a large number of entries are not risks, but are “issues” that should be addressed in the normal course of business; or they are events that have 100% probability of occurring, or have occurred already and require resolution. OPG has recognized that there were a fair number of “issues” on the Risk Registers and made a sustained effort to “scrub” both the Project Risk Registers and the Program Risk Register. As a result, the total number of risks carried on the Project and Program Risk Registers has gone down by approximately 22% since October 1, 2013. However, we believe that the DR Team would continue to benefit from additional work and focus to cut the risks down to an even more manageable level.

Risks require a higher level of management attention than issues as well as specific (and often extraordinary) actions to reduce the likelihood of occurrence and impact. Risks may also be factored in contingency calculations. In addition, “issues” should be addressed in base cost budgets, not as contingency. Therefore, “issues” should not be considered “risks” and should be tracked in the Issues Database, not the Risk Registers.

Examples of Risk Register entries that should be considered “Issues” are provided in Appendix 1 Table A1.2.

#### **RECOMMENDATIONS:**

To date, the DR Team has undertaken an effort to eliminate “Issues” from the Risk Registers. This effort needs to be completed as soon as possible and Risk Register maintenance instituted through training and periodic review. As stated above, the Risk Group has implemented various training sessions with respect to risk identification and appropriate descriptions. This has included the hiring of Simon Taylor, an independent risk consultant, to conduct training workshops specifically on risk identification. Additionally, a training session for Risk SPOCS on the entire Risk Management Program was held in early November. The DR Risk Team has also begun one-on-one training/challenge sessions with each of the Project Teams. This effort needs to continue.

#### **1.4 Observation 4: Risk Management Program Staffing & Leadership**

The Refurbishment Planning and Controls Risk Group is lean and staffed with capable but relatively inexperienced individuals – until recently, several staff members dedicated to the implementation of the Risk Management Program within the Projects were Co-ops or interns. As currently constituted, the Risk Group lacks the appropriate deference from the various project groups, which is necessary for effective, efficient and consistent risk program management. This results in a sub-optimized inter-organizational interface and lack of full attention to established risk program requirements, as evidenced by:

- A general unwillingness of project groups to accept support from the Risk Group when it is clearly needed.
- Lack of attention to direction from the Risk Group (e.g. in developing conforming contingency input, creating unambiguous Risk Register entries, and addressing risk vs. issue considerations) leading to inconsistent application of Risk Management Program requirements.
- Apparent willingness to accept an outside contractor, Simon Taylor's, guidance over that of the Risk Group.

In addition, limited senior management visibility in driving a strong risk program tends to relegate the risk management effort to a back seat priority. We have seen some positive movement with respect to this observation—as the Risk Group has begun a more “hands-on” approach with respect to the Project Risk SPOCS. Projects that had previously identified interns as their Risk SPOC have now appointed more qualified and senior individuals for this role. However, there still appears to be a lack of a project culture that sees risk management as an important part of the overall project management strategy. Additionally, several key personnel are transferring out of the Risk Group as of the end of January—including Tracy Leung and Ninke Smith. Ryan Smith will replace Ms. Leung (a position that he has held in the past), but thus far there has been no named replacement for Ms. Smith. This is a key position with respect to the Risk Management Program, and it will be important to put an individual with the right risk management experience in this position. It is also our understanding that ERM will be playing a more active role in monitoring the Project risks, which should be very beneficial in raising the level of importance of risk management.

#### **RECOMMENDATIONS:**

- Appoint or hire a strong, experienced, and assertive central Risk Management Program Manager/Coordinator with an established track record of success. The risk manager should be visibly supported by senior management, and have well-defined responsibilities such as: a.) oversee RM, OPEX, AIDA activities on a day-to-day basis, b.) proactively advocate the documentation of decisions, assumptions, lessons learned, etc., c.) eliminate ambiguity and inaccuracies of database entries, d.) facilitate consistency in risk analysis/scoring and in contingency development, e.) conduct training, f.) establish and maintain risk program tracking metrics, etc.
- Require the Risk Management Program Manager/Coordinator to periodically challenge the various project (function) risk register and risk management activities. This responsibility should be done with strong endorsement from the Darlington Refurbishment SVP.
- Consider performing a staffing analysis to ensure that the Risk Group is right-sized with the appropriate skill sets. This is important for everyone in the Risk Group, not just the Section Managers and above. Currently, the Section Manager and Manager are spending too much time doing what should be lower level tasks due to the fact that there are not enough qualified individuals in the Risk Group.
- Consider elevating the Risk Group in the DR Project organization to give it more stature and to demonstrate that senior management considers Risk Management, OPEX Management, Decision and Assumption Programs to be critical elements of a successful Nuclear Refurbishment. A culture change that sees risk management as an important part of project management will need to be driven top-down from executive management.

### 1.5 Observation 5: Risk Management Program Training

Lack of formal risk program training contributes to ineffectiveness and inconsistencies in how the various groups implement and execute the Risk Management Program. This is evident by the execution of the risk program to date (See Observations 2 and 3 above).

Seven Risk Workshops have been conducted between August 22 and Dec 3, 2013. While success of these sessions has been noted, they were limited to small groups (primarily project and functional group SPOCs) and comprised limited scope. Several more workshops are scheduled for Q1-2014. The small group limit has value insofar as the groups are comprised of individuals from a specific project or function and the sessions are focused on salient issues associated with that group's risk program. However, the training effort does not reach broadly into the DR organization to educate all personnel. Lack of broad participation may suppress identification of risks and opportunities; thereby, omitting critical risks and opportunities from the program. Limiting participation in the risk program may also exclude effective input regarding risk response strategies. Proper training could stimulate meaningful and productive participation by a broader slice of the DR population.

The P&C Risk Team plans to employ feedback from the project and functional workshops as input for a Risk Management Program training plan to be developed by February 28, 2014.

#### **RECOMMENDATIONS:**

- Establish a structured training program and curriculum that includes all relevant aspects of DR risk management and consists of regularly scheduled sessions that require attendance by DR personnel in a progressive manner that reflects the individuals' role in the DR organization. The curriculum should address the value of and rationale for a strong risk management program and the role of all individuals in supporting it. Examples of other projects where risks were not properly addressed would be helpful in creating an appreciation for a strong RM program. Such examples could be pulled from personal experience and the OPEX database. Training content could also focus on current risk program matters such as "risk" vs. "issue", clarity of risk descriptions, thoroughness and efficacy of risk responses, etc.
- Consider training by the current qualified F&G contractor to initiate the program, with the intention for an OPG person to assume direct training responsibility (i.e. "train the trainer").
- Establish attendance requirements, track attendance and hold managers accountable for personnel attendance.
- If appropriate, advanced detailed sessions could be conducted for individuals expected to perform detailed functions such as contingency development, etc.

### **1.6 Observation 6: Identification of “Opportunities”**

Most successful risk management programs also attempt to identify “opportunities” that could improve project performance. Risk-04 alludes briefly to opportunity identification, but does not provide details regarding identifying and managing opportunities. No “opportunities” have been identified in the Risk Registers to date. Forgoing the identification and management of “opportunities” may leave significant program/project improvements on the table.

#### **RECOMMENDATIONS**

- Elevate attention to the identification and management of opportunities by strongly addressing “opportunities” in training, establishing metrics for tracking opportunities and directing managers and supervisors to be more proactive in identifying and managing opportunities.
- Often, some of the best opportunities are identified by individual contributors. As with safety, strong risk identification culture provides meaningful input on risk and mitigation, and instills within project team members a greater sense of pride and common purpose. Therefore, all members of the DR team should be strongly encouraged and incented to identify new ideas and opportunities and management should be receptive to status quo challenges from the floor.

### **1.7 Observation 7: Weak Risk Responses**

The key to a successful Risk Management Program (and overall project success) includes the thoughtful development of effective Risk Responses (e.g. mitigating) actions. Based solely on a review of the Risk Registers, many risk responses appear to be perfunctory and ineffective. Risk responses should be well-calculated actions that directly address the cause of the risk and/or the impact. As stated previously, it is difficult to address cause and impact, if the cause and impact are not clearly stated. Even when the cause and impact are clear, risk responses don’t always provide a well thought out strategy for dealing with the risk.

Examples of weak responses in the Risk Register are provided in Appendix 1 Table A1.3.

#### **RECOMMENDATIONS:**

- Expedite the removal of “issues” from the Risk Register (Observation #3) and complete creation of clear unambiguous risk titles and descriptions (Observation #2).
- Once those items are addressed, a rigorous review of Risk Responses should be undertaken with a focused challenge of every risk response by senior management.



**1.8 Observation 8: Risk Register Reviews and Updates are not Occurring at Required Frequency**

In many respects, risk registers are not being properly used as a management tool. Periodic management reviews of the Risk Registers, if they occur at all, appear to be ineffective. This is evident by other Observations in this report related to the quality of the risk registers and the apparent lack of timely entry updating.

Revision 1 to "NUCLEAR REFURBISHMENT RISK MANAGEMENT GUIDE (N-MAN-00120-10001 RISK-04) requires that each risk owner perform, at minimum, monthly risk reviews to:

- (a) Ensure risk responses are still reasonable based on the latest information
- (b) Ensure mitigation actions are on track and status the actions in the Actions Log
- (c) Determine if the assumptions related to the risks are still valid and update in the Key Assumptions Log, if applicable
- (d) Determine if the risk characteristics have changed and update in RADAR
- (e) Determine if new risks should be identified
- (f) Determine if risk has realized or expired and can be closed in RADAR (with justification)

While attention to this prudent practice seems to be increasing, it is not at the level necessary to achieve a strong Risk Management program.

**RECOMMENDATIONS:**

- Management should stress the value and importance of periodic Risk Register reviews that are meaningful and effective. Monthly Project Integration meetings provide an opportunity to both challenge and elevate the importance of high level risks, as well as increase accountability for mitigating risks.
- Project managers and functional managers should conduct a detailed review of all risk registers for clarity, and quality considering the Observations of this report. Once completed, a senior management spot-review should be performed to confirm conformance.
- Subsequent to the initial detailed review identified above, establish a program for periodic management review of a different project/function risk register every two weeks. Review items can be based on the RISK 04 requirements delineated above and on the Observations of this report. This review would be most effective if performed by responsible managers at the Vice President level.

### 1.9 Observation 9: Risk Oversight Committee Effectiveness

The Risk Oversight Committee is addressed in the Darlington Refurbishment Risk Management Plan (Section 3.4 of NK38-PLAN-0971-10067 Sheet 006 R003). The Plan refers to a "Terms of Reference" for the committee that describes the "objective, scope, membership and meeting frequency". According to the "Terms of Reference" (NK38-REF-08130-xxxxxxx R000<sup>2</sup>) provided to External Oversight, the scope of the Risk Oversight Committee is to:

- ✓ Review top program risks
- ✓ Evaluate their assessment of probability and impact
- ✓ Evaluate the adequacy of mitigation plans
- ✓ Evaluate the status of mitigation actions

The ROC meets quarterly. Three meetings have been held to date and, as the risk program matures, they are progressively improving by focusing less on process and more on substance. The meetings to date have lacked focus and become mired down in discussions regarding process and the actual meaning of risk descriptions. Once the Risk Registers are properly constructed and the Risk Management Program processes are settled, the ROC meetings can more readily focus on the intended purpose. At the December 4, 2013 ROC meeting, remaining Risk Register deficiencies (such as proper titles and descriptions, effective risk responses, elimination of "issues", etc.) were directed to be completed by the next ROC meeting in March, 2014.

#### **RECOMMENDATIONS:**

- Ensure that Risk Register deficiencies are corrected before the March, 2014 ROC meeting and structure subsequent ROC meetings to focus on their intended risk review functions, rather than process and interpretation discussions.
- Hold ROC meetings monthly rather than quarterly. Such meetings will be more effective if they are held more often and shorter in duration, at least until the program stabilizes.

### 1.10 Observation 10: Lack of Trending and Other High-Level Metrics

DR has struggled with establishing effective metrics to track Risk Management Program performance. This is due, in part, to the functionality of the lack of database integration and the quality of entries in the registers. Proper metric tracking is an essential element of an efficient risk management program. These metrics should focus on effective visibility of risk items and mitigation. The Risk Group recognizes this and is currently evaluating various metrics for implementation. The last Program Report included a metric to identify how many risks had been put into the correct format.

#### **RECOMMENDATIONS:**

- Create a strawman of potential metrics and seek input from the management on their utility. The metrics package should include some sort of trending information related to the overall Program Risk. The metrics should be more than bulk numbers of risks in various categories. Issues such as changes in risk scores (particularly trending), the number of risk responses to be developed, projected costs of risk responses, and cumulative cost impacts should all be visible through a published set of metrics
- After development of appropriate metrics, the Risk Group should aggressively use the metrics as a tool for Risk Management Program compliance and monitor their effectiveness.

<sup>2</sup> An unapproved Document was provided to External Oversight. No "approved" TOR has been reviewed.

## 2.0 Signatures

Prepared by:   
James Carter

Date: February 28, 2014

Prepared by:   
Carrie Okizaki

Date: February 28, 2014

## Appendix 1

### Assessment Supporting Details

**Table A1.1 Examples of Vague and Misleading Risk Titles and Descriptions<sup>3</sup>**

#### **Risk 641**

Title: Uncertainty related to ability to recover Refurbishment costs

Description: The risk is that there is uncertainty in ability for OPG to recover its costs.

*[This states that the risk is "uncertainty". No cause of the uncertainty is provided and nothing is indicated to trigger the risk.]*

#### **Risk 11821**

Title: RFR Contractor Claims

Description: The risk is that OPG does not meet its obligations resulting in the contractor claiming for additional cost and schedule per article 4 of the Agreement

*[It's not clear which obligations would not be met, what would cause them to be missed. There may be numerous obligations, each with a different risk response. Moreover, this entry may be considered an "issue" that is addressed in the normal course of action...not a "risk". See Observation No. 3 below.]*

#### **Risk 11866**

Title: Shutdown Layup Project - Secondary Side Steam and Water Systems (SG, SGECs and feedwater circuit)

Description: General risks that apply to the SG secondary side, SGECs, and secondary side steam and water systems. The dry air will be provided by and executed by an ESMSA contractor (doing Dry Air systems Risk 11854). Dry air connection points for the layup of multiple systems will be provided by an ESMSA contractor.

*[The risk title merely identifies systems and does not state an event or the context of an event. The risk description does not address an event. It states that some vague "general risks" apply. No cause that can be mitigated is stated. Any relevance for the provision of dry air is lost. Currently, there is no risk response strategy in the Risk Register.]*

<sup>3</sup> The examples were extracted from early January 2014 Risk Registers. They are illustrative of the Observation. However, these specific examples may be eliminated or modified as the DR team makes changes to the Registers.

**Table A1.2 Examples of Risk Register Entries that should be considered “Issues”<sup>3</sup>**

ID	Title	Description	Risk Response Strategy
11860	Valve and Valve Parts Delivery	The risk is that valve parts are not delivered on time for the required installation leading to schedule impacts.	-monitor work orders for parts holds. Expedite through materials/PE as required.
11143	Emergent scope or new knowledge impacts Project	The risk is that effort outside the RFR project or additional DSRs that once planned impacts RFR leading to extra refurbishment scope or rework. This may occur in the Definition, preparation and execution stages.	-Oversight Focus - Provide Adequate Prioritization, Follow DR Gated Process, Follow SRB process, Keep stakeholders aware of processes, Attend Scope Fidelity Meetings, Ensure DRAS's are completed where required / warranted.
11158	Contractor Ramp up too Slow - Definition	The risk is that the RFR Contractor takes too long to fully implement their plan leads to delays and thus impacting cost and schedule due to the delays.	-Weekly Meeting of Team Leads -Elevate to higher organizational levels in the event it continues -Integrated Baseline Schedule - OPG and Vendor -RFR Action ID 21
11866 <sup>4</sup>	Gate 1 Cost Assumption for Cold Water Flooding is incorrect due to vague scope	There was not a DSR cost associated with this DSR SI0290-5. The scope of work is vague in the DSR. Conceptual design has not been completed. A CBA is required after Conceptual design which has just been assigned to OSS Eng.	-Reevaluate cost for Gate 2 based on Conceptual design and CBA due in Nov 2013

<sup>4</sup> Risk 11866, as written, is an example of a “risk” that has already occurred (i.e. the cost assumption is incorrect).

**Table A1.3 Examples of Weak Risk Responses<sup>3</sup>**

ID	Title	Description	Risk Response Strategy	Assessment Comment
11060	Contractor damage to plant equipment	There is risk that the contractor may damage plant equipment resulting in unanticipated repairs.	-Article 2.16(e) and cost allocation table covers	Response appears to be limited to contract penalty upon contractor, with no equipment protection, no training, and no removal of susceptible equipment.
11232	TG Installation of Mechanical Side	The risk is that there is delays to critical path due to inexperienced trades/vendor staff during turbine reassembly.	-Oversight discovers that EPC or OEM is unable to acquire skilled craft labour specific to turbine generator work as planned, or oversight discovers quality issues in installation due to lack of skilled or experienced labour. Delay to critical path. Retain experienced staff to perform the work.	Response seems to be more of a trigger statement that the risk has been realized, rather than a risk mitigation. No consideration is given to establishing a plan for acquiring and training skilled craft or for providing qualified professional craft supervision.
639	Work that can be performed by contractor is limited by regulator	The risk is that the proposed new regulatory document on hours of work which will include casual construction trades workers will be onerous to implement and will limit the availability of construction trades workers for execution of Refurb.	-Within OPGN, the VP of Fleet O&M has the lead in addressing this concern. He is supported by DRAD, Human Resources and the Refurbishment VP of Execution.	Risk Response states responsibility, not mitigating actions.

**Appendix 2****Documents Reviewed and Assessment Meetings****Select List of Documents Reviewed**

- NK38-PLAN-41000-10001-R000 TG Project Management Plan
- NK38-PLAN-09701-10074 R002 RFR Project Management Plan
- N-Man-00120-10001-Risk-04-R001 Risk Management Guide
- NK38-PLAN-09701-10067 -0006-R003 Darlington Refurbishment Risk Management Plan
- OPG-MAN-08708-0001-R002 Guide To The Project Risk Management Standard
- OPG-STD-0062 R002 Project Risk Management Standard
- N-MAN-00120-10001- RISK-R001 Nuclear Projects Risk Management Process
- Islanding PMP R00 Draft 18Mar2013
- Program and Project Risk Registers at various times during the review period
- Faithful and Gould Risk Management Program Gap Analysis July 2011 and March 2012
- OPG Risk Management Self-Assessment 4-13
- Rm Self-Assessment Summary Table June 2013

**Select List of Relevant Meetings Discussing DR Risk Management**

6/5/2013	Risk Oversight Committee Meeting
9/9/2013	Meeting with N. Smith & T. Leung - Risk Management Program General
9/9/2013	Meeting with Roy Brown - R&FR
9/11/2013	Meeting with Scott Guthrie - BOP
9/12/2013	Risk Oversight Committee Meeting
10/8/2013	Meeting with Bert Boston - Islanding
10/8/2013	Meeting with Todd Josifovski - SG & TG
10/9/2013	Meeting with N. Smith & T. Leung - Risk Management Program General
10/9/2013	Meeting with K. Graham - Shutdown Layup Services
10/10/2013	Meeting with Sorin Marinescu - Fuel Handling
10/10/2013	Meeting with Atif Soliman & Mohammed Siddiqui - Risk Register IT Improvements
11/10/2013	TG Project Risk Workshop
11/18/2013	Meeting with G. Rose - Risk Management Program General
11/19/2013	Meeting with N. Smith - Risk Management Program General
11/20/2013	Meeting with R. Smith - BOP
11/20/2013	Meeting with P. lemma and S. Wong - R&FR
12/4/2013	Risk Oversight Committee Meeting



### Appendix 3

#### Summary Table

Area	Observation No.	Comments	Change from Previous Assessment
Risk Register Reporting Limitations	1	Migration to SharePoint and Excel reporting tool have increased reporting functionality, but there are still limitations.	↑
Lack of Clarity of Risk Titles and Descriptions	2	Significant progress has been made by the DR Team over the last several months on this issue. Current TCD to complete updating of all risks is January 31, 2014.	↑
Numerous Entries in the Risk Registers are not "Risks", but Business as Usual "Issues"	3	Significant progress has been made by the DR Team over the last several months on this issue. Current TCD to complete updating of all risks is January 31, 2014.	↑
Lack of Appropriate Risk Management Program Staffing & Leadership	4	There will be some significant changes to the Risk Group in January. This issue will have to be monitored once the new team is in place.	↔
Risk Management Program Training	5	There has been a concerted effort to implement formal training by the Risk Group	↑
Missing Identification of "Opportunities"	6	There has been no effort to identify opportunities within the risk register.	↔
Weak Risk Responses	7	The key to a successful Risk Management Program (and overall project success) includes the thoughtful development of effective Risk Responses (e.g. mitigating) actions. Based solely on a review of the Risk Registers, many risk responses appear to be perfunctory and ineffective.	↑
Long Periods Between Risk Register Reviews and Updates	8	Efforts to update all risks has caused more frequent review of risks. OPG should consider having ROC meetings more frequently than once per quarter.	↑
Risk Oversight Committee Effectiveness	9	Three meetings have been held to date and, as the risk program matures, they are progressively improving by focusing less on process and more on substance.	↑
Lack of Trending and Other High-Level Metrics	10	There was no change as of the end of December. However, we have noted some improvement in this area in the last couple of weeks. New metrics are being developed, but not yet rolled out.	↔

Legend: ↑ = improved, compared to Project Assessment  
 ↓ = weaker, compared to Project Assessment  
 ↔ = no change, compared to Project Assessment  
 ↔ = no change





## **Report to Board of Directors**

### **Board Retreat**

**October 1-2, 2015**

**Darlington Nuclear Refurbishment Project**



**Burns & McDonnell  
Modus Strategic Solutions**

**October 1-2, 2015**

## I. Executive Summary

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Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMCD/Modus") provide the following Report to the OPG Board of Directors ("BOD") regarding the status of the Darlington Nuclear Generating Station's Refurbishment Project ("Project" or "DR Project") as of September 21, 2015. Our main focus continues to be assessing the DR Team's development of the Release Quality Estimate ("RQE"). In this report, we provide the BOD with our view of the current status of RQE and the remaining gaps the DR Team intends to resolve with RQE prior to the next Board Meeting and a look-ahead to the DR Team's post-RQE activities that will be focused on for the preparation of the execution of Unit 2, the first refurbished unit at Darlington. BMCD/Modus will provide its full assessment of RQE as part of its report to the Darlington Refurbishment Committee ("DRC") for the November 12, 2015 meeting.

As part of our ongoing oversight of the DR Team's RQE activities, BMCD/Modus has monitored the development of the vendors' estimates for work, schedules and identification of risks. We have also monitored the DR Team's progress in developing its management team and its plan for Project execution, as well as the performance of key prerequisite "Campus Plan Projects" executed by OPG's Projects & Modifications ("P&M") organization. As we have previously noted, OPG's commitment to pre-planning the Refurbishment Project stems from OPG's strong desire to learn from and avoid the problems that have caused prior CANDU refurbishments to exceed their budgets and schedules. Notably, the DR Team has been committed from the start of the Project's Definition Phase to:

- Complete scoping and design engineering well in advance of execution, which the team recently accomplished;
- Utilize the Recommended Practices provided by the Association for the Advancement of Cost Engineering International ("AACEi") in order to develop detailed sub-project (or "bundle") cost estimates in a progressive manner based on the design, scope and planning as they matured;
- Provide intense focus on the Retube and Feeder Replacement ("RFR") project with the SNC Lavalin/Aecon joint venture ("SNC/Aecon"), including: carefully studying the reasons for the difficulties experienced by past CANDU refurbishments; building and utilizing a full-scale mock-up of the Darlington Units' reactors in order to refine the schedule of the longest portion of the Project's critical path, and; engage in detailed vetting of SNC/Aecon's estimate, which is the largest single cost component in the DR Project; and
- Build over \$1B in new facilities needed to support the construction and future operation of the refurbished Darlington station. Some of these required pre-requisite projects, including the Heavy Water Storage Facility ("D20 Storage"), Auxiliary Heating Steam ("AHS") building and Emergency Power Generator 3 ("EPG 3"), have experienced ongoing difficulties that the DR Team is addressing. These projects have also provided lessons learned and operational experience ("OPEX") that will be valuable as the Project moves forward into the DR Project's Execution Phase.

While the DR Project remains a complex and difficult project to execute, the planning effort in the Definition Phase has demonstrably reduced the risk of performance, which should result in greater predictability and therefore reduced overall cost relative to other CANDU refurbishments.

All of the DR Team's efforts during the Definition Phase will culminate in the RQE. Should the BOD accept the RQE, it will form the DR Project's control budget against which the DR Team's progress will be measured for the full, four-unit duration of the DR Project. Additionally, the DR Team is planning to further refine the RQE and present a unit-specific cost estimate and execution schedule to the BOD prior to each unit's execution. The first such estimate for Unit 2 will be presented in August 2016 on the basis of the DR Team's "Readiness to Execute" initiative with each subsequent unitized budget and schedule building upon the experience of the prior units.

From the outset of our engagement, BMCD/Modus has focused on the process the DR Team has employed for developing RQE, rather than on specific cost and schedule outputs. In our experience, the proper cost and schedule will emerge from

a robust process. Our last report expressed concerns over the DR Team's ability to meet the revised RQE submission date, which has subsequently been restored to the original November 12<sup>th</sup> milestone. Over the last month, the RQE-related components have matured and the DR Team's leadership team (Nuclear Projects Executive Team, or "NPET"), consisting of the SVP of Nuclear Projects, the VP of Execution and their direct reports, has conducted initial vetting sessions focused on each sub-project (referred to also as "bundles"), the OPG functional support groups and the Project's risks and contingency. With more time available, NPET can now complete these initial reviews and perform more detailed vetting of the integrated RQE package.

A major concern in completing RQE was the delay to the preparation of SNC/Aecon's Class 2 Estimate, which arrived 2 ½ months later than planned. SNC/Aecon presented its Class 2 estimate totalling \$2.713B, and a schedule upon which OPG can base its critical path for each of the four refurbishment units. The estimate review culminated with a three-month long detailed vetting process in which subject matter experts from SNC/Aecon and OPG collaboratively challenged each work series and component of cost. The resultant estimate and schedule is, importantly, based on the mutual confidence of both teams and will result in a lessening of the overall project duration and associated burn rates. SNC/Aecon's Class 2 estimate should significantly strengthen the Project's outlook. The parties must now conclude the target price negotiations based upon this estimate.

While the majority of the vendor estimates have now been received, there is important work remaining for RQE that will require the entire DR Team's focus until it is completed. The major priorities for completing the work are:

- (1) **Quality Assurance** – providing sufficient basis and support to the elements of RQE and closing remaining challenge items;
- (2) **Integration** – now that the individual estimate components are substantially complete, the NPET plans to engage in more integrated reviews of contingency, risk, schedule and the like;
- (3) **Campus Plan Projects** – while not a large cost item, the DR Team needs to shore up the schedule, costs and fully identify and effectively manage remaining risks so that there is confidence the key pre-requisite projects (D20 Storage, EPG 3) will not threaten Refurbishment; and
- (4) **Readiness to Execute Planning** – the DR Team needs to finalize and test its processes for the Execution Phase, optimize its team, complete and vet the integrated Level 3 Execution schedule and develop the Unit 2 estimate.

BMCD/Modus believes that given ample time, the DR Team is capable of providing the Project's RQE with an appropriate level of confidence that would be commensurate with AACEI's recommended practice for a megaproject's control budget. The next 4-6 weeks will be challenging and there is a great deal of work left for the DR Team to do. Our next report will evaluate the basis for RQE and the associated critical path schedule in more detail.



## II. DR Project RQE Overview—Status

In our last report to the DRC, we expressed concern that the DR Team would have difficulty completing its RQE activities by the revised October 1-2 date. Subsequently, the original schedule for BOD presentation in November has been restored which should result in a more complete estimate for RQE. Since our last report, the following major developments contributing to RQE have occurred:

- SNC/Aecon met its revised date for submitting its Class 2 Estimate, detailed schedule and agreed risk register. We discuss some of the key points regarding this submission below.

- The DR Team has provided its NPET leadership team with bundle and sub-bundle-specific reports that summarize the bases of estimates, scope, schedule, risks and other details. These initial reports provided a good basis for NPET to begin its reviews but the meetings that were held for their discussion resulted in a significant number of questions, gaps and open items that need resolution before further vetting. NPET also initiated further vetting of the DR Team's functional groups, which makeup approximately 22% of the Project's expected cost. These vetting sessions netted similar challenges that the DR Team is currently addressing.
- An initial "snapshot" was taken of the DR Project's contingency for NPET's vetting. NPET issued a number of challenges based on this presentation that the Project Teams and the risk team are endeavoring to resolve, including another full review of the formulation of the Project's critical path.
- SNC/Aecon has issued its revised schedule and cost estimate for D20 Storage, and the DR Team engaged in a lengthy vetting session with SNC/Aecon to validate its basis. SNC/Aecon should be able to produce meaningful metrics showing its progress on D20 Storage in the near future. In the meantime, P&M has put additional resources over the foundation work for D20 Storage, which must be completed by Ellis Don prior to SNC/Aecon's mobilization, though this work continues to lag 1-2 months behind schedule and has encountered additional field performance problems.

#### A. Summary of RQE Status

The DR Team has significant work remaining to complete the RQE effort. In general, we see the cost elements for the direct work of RQE coming together. The EPC base cost estimate for each of the bundles has been reviewed by the estimating team, and most of the estimates have been classified pursuant to the AACEi recommended guidelines. Additionally, the risk and contingency development process is robust and if followed with sound inputs, should provide the necessary basis for contingency amounts needed for RQE. However, a "bounding" estimate for RQE must still be supported by the documentation describing the assumptions that have been made as the basis for RQE as an upper limit.

BMCD/Modus sees the following as major focus areas for the DR Team to complete RQE:

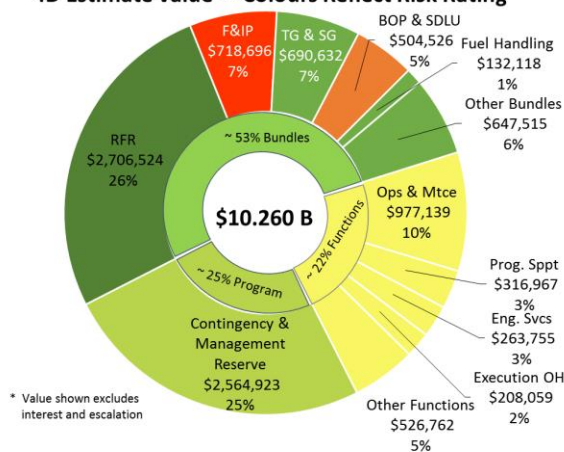
- **Quality Assurance:** The DR Team needs to tie-up the remaining loose ends in the RQE submission and perform sufficient quality assurance to show that there are no major data fidelity issues in the submitted product. The DR Team intends to lock-down all submissions on September 30<sup>th</sup> and devote time to addressing quality issues and ensuring that the documentation necessary to support RQE is in place and that all numbers can be tied to their source. In addition, the RFR team must review SNC/Aecon's full Class 2 submission that OPG received on September 18, 2015 to ensure that there are no significant gaps or unresolved issues prior to locking down the target price. In a product of this size, there will certainly be some quality issues that will not reasonably be caught prior to RQE, though the goal should be to limit those issues to technical compliance needed for maintaining the Project's controls suite and not have issues that would be considered material to the BOD's decision.
- **Integrated Reviews:** NPET and key stakeholders to the Project need to engage in multiple additional integrated reviews, particularly regarding the Project's overall schedule and basis for contingency in order to fully vet the interrelationships in the work windows for each bundle in the integrated schedule and to identify and evaluate risks that affect multiple bundles and functions. Moreover, NPET needs the time and opportunity to vet the result of any changes (i.e. has the change been properly captured in all of the documentation? Does a change impact other bundles? If a risk is accepted, is there a downstream schedule impact?). Doing so ensures the impact of each successive review/challenge stage has been properly captured. The functions also will require additional attention, with focus on ensuring that the proper division of responsibilities between and among the project teams and functions is well established. We have provided some specific recommendations for these reviews to the team. One gap for RQE that should be noted is the relative immaturity of the BOP and Shut-Down/Lay-Up estimates and schedules. Due to their relative size, this gap can be accommodated through the use of adequate

risk identification and contingency, but there is significant integration work that will need to occur post-RQE with the Project's execution schedule in order to incorporate these work packages once they have been developed.

- **Campus Plan:** While the dollars involved in the Campus Plan Projects do not necessarily have a significant impact to the total amount of RQE, the fact that the schedules (D20 Storage, EPG 3 and potentially others) are a risk for breaker open of Unit 2, and these projects' paths continue to be uncertain, is drawing attention away from readiness for Refurbishment. The P&M team needs to ramp up its management of the contractors' performance in order to obtain realistic and achievable schedules and cost estimates. The recent award of the D20 Storage completion to SNC/Aecon is a positive step but the rest of the work needs similar focus.
- **Readiness to Execute Planning:** As noted, the DR Team intends to use the period from RQE to Unit 2's breaker open in October 2016 to further mature its planning, estimates and schedules, and present a Class 2 unitized estimate and detailed execution-ready schedule in 3Q 2016. The team has developed a "Readiness to Execute" ("RTE") plan through which it will test multiple processes and improvement initiatives with smaller BOP and Shut-Down/Lay-Up packages that need to be performed prior to Unit 2's breaker open. We have recommended to the DR Team that the RTE plan needs a detailed, resource-loaded schedule of activities with assigned owners who are held accountable for their portion of the product. This type of schedule was not deployed for RQE and we believe its absence has resulted in some churn, delays and uncertainty within the Project Team that must be avoided in the future. It will be particularly important for the DR Team to incorporate into the RTE schedule resolving the remaining open issues with the BOP and Shut-Down/Lay-Up work packages as they are completed by the vendors, which will involve closely tracking the vendors' progress.

A major component of the RTE plan will be developing and finalizing the Unit 2 execution schedule with all work at the appropriate level of detail. The DR Team's original goal of having the full execution schedule completed for RQE was not met, though the critical path durations and windows for non-critical path work have been well-defined. We believe that the DR Team has done sufficient schedule work to support RQE, though considerable work remains before the schedule is execution-ready. BMCD/Modus will be providing detailed assessments of the schedule development as the work progresses.

**4D Estimate Value\* - Colours Reflect Risk Rating**



As with our prior reports, the adjacent **Figure 1** shows the 4d cost estimate values for each of the major sub-projects, or bundles, as well as the OPG Functional costs and contingency (in \$2010). We will update this figure to reflect the RQE-based values and percentages of the Project's cost in our next report.

**Figure 1** also provides context for the relative size and percentage of each component of RQE. The three largest parts of RQE are: RFR (26%); OPG Functions (22%); and Contingency and Management Reserve (25%). BOP and Shut-Down/Lay-Up (5%), the Turbine Generator project (6%) and Campus Plan Projects (7%) are next largest slices of the budget. Below, we provide a brief update regarding the status of each of the major inputs to RQE.

## B. Status of RQE Components

### **Detailed Engineering:**

One of the lessons learned from other refurbishment and other nuclear megaprojects is that the control budget should be based upon completed engineering in order to mitigate the risk of unreliable and uncertain initial cost estimates. OPG met its commitment to substantially complete detailed engineering for Refurbishment well in advance (15 months) of Unit 2's breaker open date. However, there is still considerable engineering effort left for the DR Project throughout the

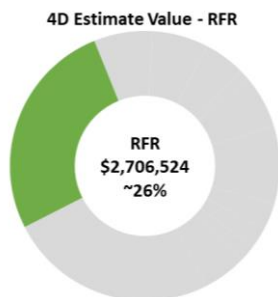
program's lifecycle, including:

- **Procurement Engineering and Support** – the DR Team must ensure that components the vendors are purchasing meet the intent of the specifications and resolve any sourcing issues;
- **Field Engineering** – issues will inevitably arise in the field that will require engineering to address and evaluate;
- **Construction Work Planning** - the development of Construction Work Packages needs to involve engineering, and the Construction Work Packages' accuracy will depend on proper insertion in the "Issued for Construction" engineering plans, those details needed for construction; and
- **Configuration Management** – OPG's engineering team will need to ensure that the work in the field is captured in the plants' permanent documentation record.
- **Detail Engineering** – the engineering packages that were excluded from the Detailed Design Complete milestone, including the RWPB design, needs to be completed, and P&M projects require ongoing engineering support.

Currently, there are very few (less than 15%) of these future engineering tasks that are resource-loaded in the Project's integrated schedule. This needs to be addressed so that the OPG engineering team can be right-sized and critical work effort and milestones are properly assessed within the overall schedule. Moreover, engineering resources should be "projectized" so that the work is properly integrated in the work flow.

#### **Retube and Feeder Replacement:**

SNC/Aecon's Class 2 Estimate for RFR is the single largest input to RQE. Some notable highlights since our 3Q Report:



- The final estimate of \$2.713 B (2015\$) is based on mutually agreed upon project durations and schedule contingency, and encompasses 12.9M work hours, project management, supporting tasks, fee and all other costs.
- As we noted in our last report, the OPG and SNC/Aecon teams reviewing the details of the schedule were given targets (including contingency) for cost (\$2.6B) and schedule (1110 days). The "Rev 1." Submission was approximately \$110M more than the \$2.6B target and 28 days longer (for Unit 2) than the 1110 day target. However, the process utilized to reach these final estimates was robust, which should provide confidence in the level of accuracy.
- The final assessment of risk and contingency in the SNC/Aecon estimate was on the basis of lengthy technical and commercial discussions. The resulting 13.5% contingency totaling \$368M is largely based on durations and potential risk items that could impact the work. The OPG team successfully negotiated the SNC/Aecon risk register to omit risks that were considered "business as usual" in nature and agreed to shift a limited number of risks to OPG's responsibility in exchange for reasonable cost reductions.
- SNC/Aecon's Rev 1 Class 2 answered some key questions regarding its estimate of for Units 3, 1 and 4. After significant commercial discussion, the parties decided to leave as-is the successive unit improvement (from 1138 days on Unit 2 to 1095 days on Unit 4) in place. The agreed base duration (which does not include any contingency) of 847 days is identical for the last 3 units though contingency durations drop by 55 days across these units.
- There are some issues that have not been included in the SNC/Aecon's estimate which still need to be resolved totaling approximately \$12.5M per unit that the SNC/Aecon has not able to confirm in the Rev 1 estimate.
- While not part of the SNC/Aecon's Class 2 Estimate, completion of the Retube Waste Processing Building ("RWPB") estimate has been hampered to a certain extent by changes in the building's design basis and completion of engineering. These changes have caused the cost estimate to steadily increase by 20-30% to its current estimate of \$160 M. With the award of D20 Storage to SNC/Aecon, there should be some economies of scale that could be

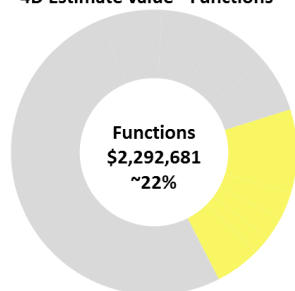


achieved that have not, as yet, been quantified.

The DR Team is in the process of finalizing the target price negotiations around SNC/Aecon's Class 2 estimate. SNC/Aecon has resubmitted a full Rev.1 version of the Class 2 Estimate concurrent with the preparation of this report; this submission will require review and vetting by OPG, though the DR Team is confident that the remaining issues with SNC/Aecon over their estimate are relatively small in nature and can be achieved in time to support the RQE submission.

### **Functional Groups:**

4D Estimate Value - Functions

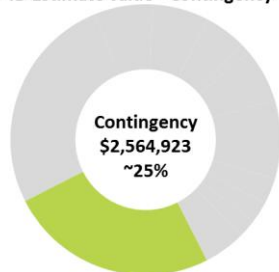


The DR Team's intention for RQE with the Functions is to develop a "bounding" estimate that incorporates all necessary staff, roles and responsibilities, and then examine the organization in the Readiness-to-Execute roll-out after RQE. The initial round of NPET reviews of the Functions revealed that there are still many open questions regarding roles, responsibilities and accountabilities that need to be resolved in order to determine whether the RQE estimate is inclusive of all potential costs. Management is also still committed to taking another looking at the integration and management of centre-led resources. While the DR Team's stated goal of developing a bounding estimate for functions should be possible, as these costs are completely in OPG's control, doing so will require additional work and focus by the team.

The final Functional resources and responsibilities will be determined through the RTE exercise.

### **Risk and Contingency:**

4D Estimate Value - Contingency



Contingency is the third largest category of costs in RQE behind RFR and the Functional Groups. In our last report, we noted that the process the DR Team was using for developing risk and contingency was robust, though we were concerned that the time for vetting the result for RQE would be condensed. Even with additional time, the team will need to stay focused to complete and document all of its risk-based assumptions for RQE.

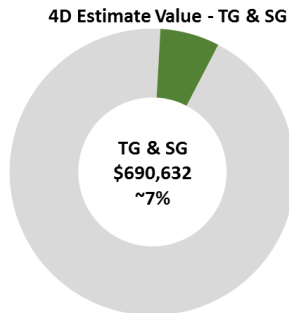
In order to get an idea of the total integrated contingency amount for RQE, the Risk team put together an "initial snapshot" for review by NPET. The initial snapshot of contingency was approximately \$1.9B (30% of remaining Estimate to Complete) derived from a combination of contingency for estimating and schedule uncertainties and the discrete risks identified by the DR Team and project bundle teams. Upon review, NPET requested additional vetting of the critical path durations and the contingency amounts set aside for schedule uncertainty, which made-up the largest portion of contingency. These vetting sessions that have been completed to date have resulted in an increased understanding of basis of those estimates and greater confidence in the contingency amounts. However, there is still a lot of remaining work that needs to be done in order to complete the contingency review.

In our view, the most critical remaining work on contingency includes:

- The NPET needs to analyze the results of integrating all the project bundles in order to see if there has been adequate identification of risks;
- The Project Teams should perform quality checking—including integration of the contingency input data for accuracy, reasonableness of all OPEX from past refurbishment projects and completeness – and finalize all descriptions and risk bases;
- Provide greater analysis of Project expected burn rates for more accurate monetization of potential schedule risks;
- OPG's experience with the Campus Plan Projects needs to be fully integrated and accounted;
- OPG's executive management needs to identify any potential management reserves that it may want to maintain over and above the DR Project's contingency.

Related to the last item, the DR Team and management should consider whether the existing processes for management reserve needs adjustment for the DR Project. Once set, the contingency can be carefully monitored and tracked against the original assumptions.

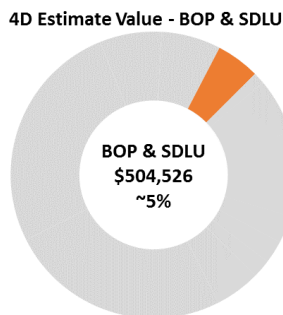
### **Turbine Generator and Steam Generator:**



OPG has accepted SNC/Aecon's Class 2 Estimate for the Turbine Generator for Unit 2, and Alstom has completed its detailed design. SNC/Aecon and Alstom have submitted their full estimates for the subsequent units, which are characterized as Class 3 in nature. OPG's approval of those detail estimates is pending final review, though a recently identified issue in finalizing the four-unit estimate has delayed approval.

As with RFR, the OPG and the SNC/Aecon project teams are integrated and working well together. The remaining risks at this time appear to center on completing the Construction Work Packages for execution and finalizing the Unit 3, 1 and 4 detailed schedule. In addition, the risk profile for the Project changes significantly with Unit 3, which will be the first of three units that will have a full replacement of the original TG controls during Refurbishment. This will be a first time evolution for OPG and will require significantly more planning than the limited scope for Unit 2. The risk profile of the subsequent units is being developed with this in mind, though the results still need to be fully vetted at the NPET level.

### **Balance of Plant/Shut Down-Lay-Up:**



At this time, the focus for BOP and Shut-Down/Lay-Up has been Phase I/II engineering and planning work. The DR Team completed detailed engineering for these projects in time for the August 15, 2015 milestone, with some minor exceptions. The DR Team has provided guidance to ES Fox to improve the development and quality of its related project estimates, and is in the process of characterizing the estimates it has received at this time. Approximately 50% of the BOP and Shut-Down/Lay-Up work estimates are in the Class 4/5 range, which increases the risk of estimating uncertainty for these projects. Moreover, the risk profile of these projects should reflect the risks from ESMSA vendor performance. While the BOP and Shut-Down/Lay-Up project teams have identified discrete risks related to vendor performance

NPET will need to decide if the associated contingency has been properly monetized in the DR Project's risk profile.

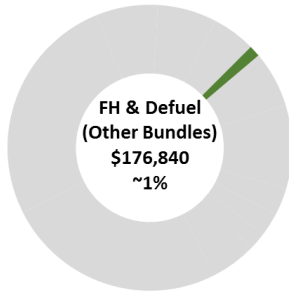
The initial round of NPET reviews of these projects produced a long list of items that require answers for RQE. These issues must be resolved along with further vetting of costs to increase the confidence level of the BOP and Shut-Down/Lay-Up projects. Notably, the DR Team needs to finalize the risk registers for these projects so that contingency can be properly attributed.

BOP and Shut-Down/Lay-Up will be under significant scrutiny once the DR Team's focus shifts to the RTE plan. ES Fox must continue its planning work with more detailed and mature estimates, execution schedules and development of Construction Work Packages. The DR Team has placed a challenging goal of having all of the BOP projects proceed to their Gate 3 between late November 2015 and January 2016. To do so, ES Fox will need to complete the detailed level 3 execution schedules, Class 2/3 estimates and Construction Work Packages to support these gates. The BOP team has set interim milestone dates with ES Fox for these deliverables which may be too aggressive for the DR Team to receive quality work product.



## Fuel Handling/Defueling:

4D Estimate Value - FH & Defuel



While the total cost estimate for Fuel Handling/Defueling constitutes only about 1% of the total cost of the DR Project, Defueling each of the Project's reactors is the first critical path activity. Furthermore, this is a first time evolution for Darlington. For these reasons, the planning, scheduling and risk mitigation of this work is extremely important. For these reasons, the planning, scheduling and risk mitigation of this work is extremely important. The DR Team has been focused on evaluating the past defueling evolutions at other CANDU plants and scrubbing the planned durations to the extent possible.

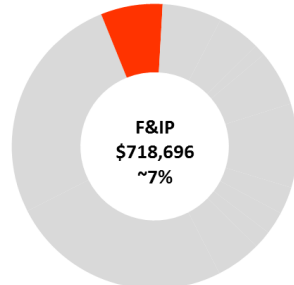
The current assessment from the Defueling team shows the best case for defueling is 90 days, the most likely is 113 days, and the 90% confidence level duration is 134 days. The Defueling

Project Team believes these same durations should be carried for all four units, as the learning curve for performing defuel will have limited value in improving performance over time. The team believes the 90 day best case is strictly a function of reactor physics and cannot be improved, while the worst case is based largely on the potential for equipment failure. In the course of deriving these point durations, the Defueling team has dispositioned OPEX from Bruce Power and Pickering and has consulted with its vendor, GE/Hitachi. The due diligence performed by the Defueling team has greatly improved the DR Team's understanding of this critical duration.

Regarding the Fuel Handling refurbishment, which is needed to support the Project's critical path, cold commissioning is ongoing for Fuel Handling system modifications and vendor progress has dramatically improved overall schedule performance. The recovery plan initiated in 2Q 2015 with GE/Hitachi has also allowed the team to advance plans for testing and training.

## Campus Plan Projects:

4D Estimate Value - F&IP



The most significant Campus Plan Projects – D20 Storage, Auxiliary Heating Steam ("AHS") building, and Emergency Power Generator 3 ("EPG3") – continue to be impacted by ongoing issues with poor initial estimates and scope definition, site conditions, contractor performance and OPG oversight.

- **D20 Storage** – Ellis Don is currently working on the foundation for D20 Storage and SNC/Aecon is preparing to complete the building and perform the mechanical, electrical, HVAC and steel/structural erection. Ellis Don's work must be substantially completed before SNC/Aecon can start its work. P&M has bifurcated its team to simultaneously focus on Ellis Don's progress and SNC/Aecon's preparation.

Ellis Don's progress in completing the foundation continues to lag behind schedule. The current schedule shows that Ellis Don is approximately 2 months behind schedule, depending on the outcome of the pour of a wall section that will require rework. The key November 30, 2015 date for turn-over from Ellis Don to SNC/Aecon is a milestone in the SNC/Aecon purchase order which will almost certainly be missed, so forecasting the extent of the delay and mitigating its impacts will be critical for 4Q 2015. The P&M team is currently focused on driving Ellis Don to completing by December 22, 2015 which will require acceleration and reversal of some of its performance trends. P&M has added new field personnel who have been charged with managing Ellis Don's progress and clearing issues. It will be essential for P&M to quickly ascertain the current performance trend so that the date for transfer of the site to SNC/Aecon can be more accurately forecasted.

In accordance with its purchase order, SNC/Aecon has prepared and revised its cost estimate and schedule. The OPG team has vetted the schedule, but still needs to complete its review on the estimate. The schedule shows SNC/Aecon's plan to meet all of the project's key milestones; however, as noted, this plan is based on a turn-over date from Ellis Don that is unlikely to be met. The SNC/Aecon team believes it will experience essentially a day-for-day push should the turnover date be missed. We have reviewed the schedule and it would appear that SNC/Aecon has limited opportunities to recover any upfront delays and will be impacted in some manner as long

as Ellis Don is working on the building. SNC/Aecon has agreed to provide OPG with the necessary metrics from which its progress can be more accurately forecast, which should result in increased confidence once SNC/Aecon has mobilized.

The current SNC/Aecon schedule is based on the D20 project meeting an interim deadline of June 28, 2016 to accept water from Unit 2 so that there is confidence that Refurbishment of Unit 2 can proceed. This deadline was initially set about 1 year ago when the DR Team reviewed the need for a contingency plan for D20 Storage in the event the building could not be completed. We have recommended to P&M and Refurbishment to re-examine this milestone if it is able to implement one of the alternatives it is currently reviewing for draining primary heat transport and moderator water from Unit 2. If an effective mitigation strategy can be implemented, it could allow deceleration of some of the work which could potentially reduce the overall risk of construction.

The OPG team is working on updating the D20 Storage project's risks for RQE and management tracking. We have recommended that P&M assess these risks based on Ellis Don's performance trends and using SNC/Aecon's estimate and schedule. P&M needs to evaluate whether there is sufficient contingency and should also revisit the business case to confirm whether the path chosen for execution is the most prudent course, and whether the team should update its options for temporary storage of Unit 2's heavy water in the event of further schedule delays.

- **AHS** – The AHS project, which has been subject to schedule delays and cost increases, is nearing completion though the Available for Service date has slipped to November 15, 2015 due to some commissioning and fit-up issues. P&M's cost projection remains unchanged at \$99.5M, which required a contingency draw of \$15M over the approved \$84.52M budget in 4d. AHS has provided multiple lessons learned that Refurbishment is taking into account in planning of BOP and Shut-Down/Lay-Up work with ES Fox.
- **EPG 3** – This project must be completed prior to Unit 2's breaker open. Construction has previously been impacted by issues with plant tie-ins and unforeseen underground conditions. Currently, the project is being further impacted by incomplete design, issues with rebar supply and installation, and lacks an acceptable schedule or cost estimate for the full execution phase. There are a number of engineering packages that require completion, though P&M has withheld approval pending substantiation of \$2.2M in charges. Some of these engineering packages involve modifications to the stock EPG unit so that it will operate in a similar fashion to the existing units.

ES Fox has prepared a "what-if" schedule that depicts its attempts to recover the time lost due to the various issues that have impacted the project. That schedule shows the building being available for service on August 12, 2016, which is only two months in advance of breaker open. ES Fox also submitted a revised "Estimate at Completion" in mid-June that was initially lacking sufficient back-up. The Estimating Team is now assisting P&M in the review of this estimate. In the meantime, the project missed its September 11, 2015 gate and without an approved schedule and cost estimate, the project is in danger of running out of authorized funds to continue. This project will require an immediate recovery in order to meet the breaker open need date for Refurbishment.

There are other projects within P&M that will require close monitoring as the DR Refurbishment draws nearer and the need to begin using these facilities becomes imminent.

**BMcD/Modus Recommendations  
2Q 2015 Report to NOC**

*Jos: Take sure all  
of these are in the  
RMO foot. Let me know  
if you need help.*

*Reg.*

*cc. Graeme*

• **RFR**



- In light of SNC/Aecon's delays delivering the completed Class 2 Estimate, DR Team should take necessary time to review, vet and comment, and should consider SNC/Aecon's delays as (at least) a "day for day delay"

• **Balance of Plant / Shut Down/Lay-up**



- DR Team should consider whether to carry contingency at the Program level due to contractor performance under ESMSA agreement
- DR Team should revisit roles and responsibilities for ESMSA contractors, as well as level of management oversight needed
- DR Team should take a risk based approach to estimating, scheduling and engineering completion related to Balance of Plant and Shut Down/Lay-up to balance the resources needed for assisting the ESMSA with pre-RQE tasks
- DR Team should develop lessons learned from AHS project for use in Refurbishment; focus should include estimating, scheduling, engineering progress, constructability planning and execution of work in field

• **RQE**



- Project Team should identify all risk mitigation plans that can be estimated in a deterministic fashion and ensure that these estimates are (1) properly developed; and (2) properly characterized within AACE guidance
- Data alignment and mapping of results of RQE should be given significant attention and be fully vetted to ensure that schedule and cost inputs into the Project's control budget are aligned and capable of cost comparison for the entire lifecycle of the Project.

• **Engineering**



- Requirements for replication engineering for Units 1,3 & 4 need to be fully vetted, and team should consider release of funds for long lead engineering needed to support subsequent units in RQE
- Engineering and the Project Teams need to develop a roles and responsibilities guideline for field engineering during the Execution Phase

• **Campus Plan Projects**



- P&M should review its change management process to ensure standards for contractors' proposed change authorizations ("PCA's") are robust and being adhered to by the contractors and project teams; in particular, vendors should be required to support changes emanated from OPG's direction or other allowable conditions under their contract, and not due to their own rework/mismanagement

## **Nuclear External Oversight Assessment of** **OPG Operating Experience & Lessons Learned Practices and Procedures**

### **Objective and Scope**

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMCD/Modus") have performed an assessment of OPG's Operating Experience and Lessons Learned Program (the "OPEX" program) for the Darlington Nuclear Refurbishment Project ("Project"). This assessment addresses the OPEX procedures, action tracking, training, management and overall execution of the OPEX Program. Our assessment measures both progress during this time as well as observations and recommendations for further improvement.

### **Period of Assessment**

August 2013 through June, 2014.

### **Overall Assessment Risk Score: MEDIUM**

### **Background and Methodology**

On August 13, 2013, BMCD/Modus presented its comprehensive Project Assessment Report based upon our review of the Project from February 25 through mid-July, 2013. An in-depth analysis of the OPEX Program was not performed at that time. However, during that report period, we did focus on the incorporation of OPEX/Lessons Learned into the Darlington Refurbishment ("DR") Definition Phase schedules, estimates processes and risk registers. We reported that an OPEX Program was established that is consistent with nuclear industry practices. We also noted several DR activities where OPEX and Lessons Learned could be improved, particularly with respect to tracking metrics and database software integration.

BMCD/Modus continued to review and assess the OPEX Program considering our initial observations and recommendations as well as overall performance and execution. Specifically, we have performed the following due diligence with respect to this assessment report:

### **Interviews of the following individuals:**

Ryan Smith, Manager (Acting), Refurbishment Project Infrastructure  
Joe Reid, Nuclear Refurbishment Section Manager OPEX & Lessons Learned  
Roy Brown, Nuclear Refurbishment RFR Project Manager  
Various RFR JV managers, in conjunction with the review of the RFO Class 3 Estimate

### **Attended the Following Meetings:**

Lunch and Learn: Conventional vs. Nuclear Plant Refurbishments on January 22, 2014  
Lunch and Learn: Point Lepreau on February 19, 2014  
Lunch and Learn: Oversight-Lessons from the Lower Mattagami Project on April 10, 2014  
Various DR Corrective Action Review Board (CARB) Meetings  
Numerous RFR JV Class 3 Estimate Review Sessions



## Monthly RFR JV Risk Workshops

### Reviewed the Following Documents:

Darlington Refurbishment Lessons Learned and OPEX Management (N-MAN-00120-10001-RISK-06 R000)

Darlington Refurbishment Lessons Learned and OPEX Management (N-MAN-00120-10001-RISK-06 R001)

Darlington Refurbishment Processing Operating Experience and Key Lessons Learned (N-MAN-00120-10001-RISK-06 R002)

Operating Experience Process (N-PROC-RA-0035 R017)

Nuclear Refurbishment OPEX Library Desktop Guide (NK38- GUID-09701-0495214-R000)

DR OPEX/Lessons Learned Work Program 2014

DR OPEX/Lessons Learned Strategic Plan 2014 (DRAFT)

OPEX Lessons Learned Snapshot Self-Assessment (RF14-000043)

Nuclear Refurbishment OPEX/Key Lessons Learned (KLL) Quarterly Reports

Monthly OPEX Metrics Reports

OPEX Library (database)

Key Lessons Learned (database)

AIDA Action Items (database)

Introduction of the COG Knowledge Management Program (5-2-12)

Internal LL Reporting Guide

Internal LL Report – June 2014

Internal OPEX and Key Lessons Learned (KLL) Program Presentation (3-6-14)

OPEX Huddle Talking Guide (1-28-14)

Point Lepreau Lessons Learned Presentation (1-22-14)

### Overall Assessment:

In our August 2013 Project Assessment, BMCD/Modus identified the following issues with respect to the OPEX Lessons Learned Program:

- **Software Tools for OPEX and Lessons Learned Management Program:** The OPEX database was not fully integrated or cross referenced with the RADAR and AIDA databases. In addition, the software systems were cumbersome with limited capabilities. These issues reduce the database effectiveness as a management tool, cause inefficient use of personnel time, and can result in important OPEX and lessons learned issues to be lost, ineffectively tracked, or not executed. We also noted that the DR Team had not fully updated the AIDA databases, which further compromises their overall usefulness in tracking important action items.
- **OPEX Training:** We observed limitations of the training program and recommended that the DR Team consider developing and executing a comprehensive Risk, OPEX and AIDA training program. This training would foster an understanding and acceptance of the importance of these programs, stimulate proactive participation and encourage the identification of (Lessons Learned).
- **OPEX Action Tracking Metrics:** The Risk Management and associated programs (OPEX) had a less than desirable number of meaningful metrics to provide management with a sense of the maturity or fidelity of the underlying data and the DR Project's performance.
- **Execution and Tracking:** The DR Project's philosophy at that time appeared to be for the individual projects and departments to perform the majority of Risk Management (OPEX) duties and related work, while the central Risk (OPEX) Group serves only an administrative, support and oversight role. This created a condition that risk (OPEX) management was viewed as a collateral duty of project or





department personnel, which diluted and diminished the attention focused on risk (OPEX) management efforts, given other duties of such entities. In addition, the available software tools (addressed above) limited effective and efficient tracking and management of Lessons Learned action items.

- **Processes and Procedures.** OPG's processes and procedures were in some cases conflicting and repetitive. We recommended that OPG consider a strategic review and consolidation of redundant procedures, and optimization of the process map.

Since the August 2013 Project Assessment, the DR Team has continued to develop and implement the OPEX program. Meaningful improvements have been initiated that address matters such as:

- **Dedicated Lessons Learned Personnel:** The DR Team now has a dedicated OPEX manager. The team tasked with implementing the OPEX program has a lot of enthusiasm and has been able to make significant progress in a short period of time.
- **Communication of potential OPEX and Lessons Learned items:** Identification and communication of external OPEX has improved. This will become increasingly important to inform forthcoming activities, such as the release quality estimate, final schedules and execution phase processes.
- **Training:** An OPEX training program was initiated at the beginning of 2014 and has addressed topics such as capturing and reporting OPEX, utilizing the new OPEX website, and identifying Lessons Learned.
- **Tracking metrics:** An initial set of tracking metrics have been deployed. These focus primarily on communicating and dispositioning OPEX.
- **OPEX procedures consolidation and clarification:** The key DR OPEX Procedure, "Processing Operating Experience and Key Lesson Learned" (N-MAN-00120-10001), has been advanced to Revision 002. It now reasonably clarifies and consolidates DR OPEX process requirements. In addition, an DR OPEX website has been established in SharePoint. This serves as a convenient access portal for OPEX related information and material.
- **Coordination with the Corrective Action Program:** Monthly OPEX metrics and Lessons Learned Report are now being addressed in Corrective Action Review Board (CARB) meetings. Beginning 3Q 2014, quarterly CARB meetings will extend an additional 30 minutes to address details of the OPEX Program.

Overall, the DR Team has a clear appreciation for the value of OPEX and has significantly considered Lessons Learned in numerous aspects of the Definition Phase organization and planning processes. However, complete implementation and refinement of the above improvements is necessary to ensure that Lessons Learned are efficiently generated and addressed throughout the life of the Project. To that end, an OPEX/Lessons Learned Strategic Plan is under development, which is expected to advocate specific actions for continuous improvement of the OPEX program. The assessment observations listed below and discussed herein reflect matters where improvements have been initiated as well as matters that still need to be addressed.

Observation 1: Limitations of Reporting and Tracking Software

Observation 2: Internal OPEX identification

Observation 3: Action Tracking and Management

Observation 4: OPEX and Lessons Learned Metrics



Issues identified in these Observations may result in relevant OPEX or Lessons Learned to be missed causing avoidable project impact to occur.

## Signatures

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_  
*James Carter*

Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_  
*Carrie Okizaki*

## **OBSERVATIONS**

#	Observations	Risk Rating	Recommendations	Management Action Plan
1	<p><b>Limitations of Reporting and Tracking software:</b></p> <p>Databases used for documenting and tracking OPEX/Lessons Learned items and their associated implementing actions are still not integrated. The lack of cross referencing between these databases creates difficulty in tracking Lessons Learned descriptions to their respective actions items (and vice versa). This encumbers management's ability to review the combined data sets and to oversee the timely performance of required actions. Failing to effectively define or execute the prescribed actions may cause preventable problems with the Project performance.</p>	MEDIUM	<ul style="list-style-type: none"> <li>• Expedite interfacing of the SharePoint OPEX and Lessons Learned databases with related databases that document and track relevant actions (e.g. AIDA, Risk Register). Hyperlinks to action items that connect OPEX and Lessons Learned descriptions with related responses and action activities would facilitate understanding and management of how each Lesson Learned is intended to be addressed.</li> <li>• Ensure that all cross references are accurately identified and properly mapped in the initial software launch and that future interfaces are automatically incorporated.</li> <li>• Ensure that end users have appropriate input to the development of the software tool.</li> </ul>	



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2	<p><b>Internal OPEX identification:</b></p> <p>Currently, the process is in place for disseminating and evaluating OPEX; and for developing Lessons Learned implementation plans. However, more needs to be done to stimulate the generation of OPEX from within the various projects and departments; and to communicate items to others outside the initiating group.</p> <p>The DR Team has developed a strong and effective culture that has drawn upon OPEX lessons learned for the Definition Phase of the Refurbishment program. Appropriately, most of that OPEX has come from sources external to the Project. As the Refurbishment Program matures, positive and negative experiences will be generated. If properly captured, communicated and addressed, these internal experiences can guide subsequent Project activities.</p> <p>This will be particularly true between successive unit refurbishments. Much of the valuable OPEX and Lessons Learned (both positive and negative) will be derived from the day-to-day management of the contractors. At this time, it appears that lessons learned are generated only as a result of a significant negative event, such as the recent Campus Plan experience. We do note that the OPEX Team has developed guidance for capturing internal Lessons Learned and has commenced some training activities. Success in this critical area is going to depend on the entire team's awareness of this guidance and their proactive identification and communication of relevant lessons learned.</p>	MEDIUM	<ul style="list-style-type: none"> <li>• Proceed with the planned training regarding Internal OPEX and Lessons Learned generation and communication. Ensure the training has appropriate focus on the value proposition of proper OPEX identification. This may help motivate team members to identify OPEX.</li> <li>• Work with vendors to disseminate their relevant OPEX and Lessons Learned throughout the Project.</li> <li>• Increase visibility of the current metric that tracks the "Monthly Total of Internal DR OPEX/Lessons Learned Submissions", as well as its trend.</li> <li>• Consider providing proactive management encouragement of internal OPEX/Lessons Learned Identification.</li> </ul>	

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3	<p><b>Action Tracking and Management</b></p> <p>OPG has set up an Actions, Issues, Decisions, and Key Assumptions database called AIDA. The intent of this database is to track, review and manage actions and document issues, decisions and assumptions—though “significant” decisions and assumptions have to be further documented through additional processes such as Decision Record and Analysis Summary (DRAS) Form, N-FORM-11390, and the Key Assumption Identification Form, N-FORM-11394.</p> <p>The AIDA Actions Database includes activities intended to address lessons learned. In general, the AIDA database has a large number of entries, many of which that have not been actively managed. We found a significant number of old entries that have not been updated. This is true for OPEX related entries as well as for non-OPEX actions. Due dates have passed, but status updates have not been made, and many of items that have been closed lack adequate closure notes.</p> <p>The condition of the database suggests that many action items are loaded and then forgotten. Obviously, the purpose of an OPEX/Lessons Learned program is defeated if actions to address the lessons are not performed.</p>	MEDIUM	<p><i>The below recommendations should be considered for all AIDA actions, whether OPEX related or not.</i></p> <ul style="list-style-type: none"> <li>• Identify and assign responsible parties to refresh the AIDA Actions database, ensuring that entries are still relevant, responsible parties are accurately identified, actions are clear and “actionable”, and due dates are appropriate.</li> <li>• Institute a process to periodically review the entire actions database, especially overdue actions; and to hold responsible parties accountable.</li> <li>• The question of whether OPG has adequately integrated the lessons learned and OPEX from other, similar refurbishment projects will be a topic of interest for the public and OPG’s shareholder. It possible that OPG will have to articulately convey these efforts on an on-going basis. There is clear evidence DR Team has actively sought out and implemented OPEX from these projects. However, OPG’s responses to similar-project OPEX and Lessons Learned is disaggregated throughout its databases or other project documentation. OPG should consider the best way to pull together in a single document or database this information in order to effectively communicate and relay its efforts to publically, particularly of known significant issues that caused delays and additional costs on other like-projects</li> </ul>	

#	Observations	Risk Rating	Recommendations	Management Action Plan
4	<p><b>OPEX and Lessons Learned Metrics</b></p> <p>The recently-created OPEX metrics are a good start. They focus on OPEX and Lessons Learned identification and disposition. Current metrics however do not track implementing actions.</p>	MEDIUM	<ul style="list-style-type: none"> <li>• Develop additional metrics that will track AIDA action items. Elements of these metrics may be temporary to monitor near-term database updating (e.g. “number of entries remaining to be reviewed and refreshed”); or more long term (e.g. “number of entries past due”, “number of entries past due by ‘Owner Organization’”). Lessons could be learned from the CARB metric process.</li> <li>• As time progresses, track trends of the individual metric data.</li> <li>• Establish a forum (or a designated individual in authority) to hold responsible parties accountable for executing their assigned actions and updating the database in a timely manner.</li> <li>• As the upgraded database software is developed, consider building in an automatic metrics generation feature.</li> </ul>	

## **Nuclear External Oversight Review of**

### **Darlington Refurbishment Schedule Management Practices and Procedures**

#### **Objective and Scope**

The Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company external oversight team ("BMcD/Modus") has performed an assessment with respect to OPG's Schedule Management Program for the Darlington Nuclear Refurbishment Project ("Project" or "DR Project"). This assessment addresses the DR Project's integrated master schedule development ("Project Schedule") and associated schedule management procedures, standards, training, and metrics. This assessment was conducted during the second, third, fourth quarters of 2013 and the first quarter of 2014 and includes ongoing progress monitoring during this period. Our assessment measures both progress of the development of the Project Schedule as well as observations and recommendations for further improvement regarding the execution of the Schedule Management Program.

#### **Period of Assessment**

The assessment was conducted during the second, third, fourth quarters of 2013 and the first quarter of 2014.

#### **Overall Assessment Risk Score: MEDIUM**

#### **Background and Methodology**

On August 13, 2013, BMcD/Modus presented its comprehensive Independent Project Assessment ("IPA") based upon our review of the Project from February 25 through mid-July, 2013. At that time, we reported our concerns regarding the manner in which the DR Project Team was developing the integrated Project Schedule for both the Definition and Execution Phases of the Project. We recommended several changes which have since been accepted and implemented by OPG. From mid-July of 2013 through the end of March 2014, BMcD/Modus continued to review and assess the maturation of the Project's Schedule Management Program. This Schedule Assessment Report ("Assessment") provides some additional observations and recommendations based upon this review. Specifically, we have performed the following due diligence with respect to this Assessment:

#### **Interviews of the following individuals:**

Gary Rose, Director, Planning and Controls  
Derek McAuley, Schedule Manager, Refurbishment Project Infrastructure  
Walt Arnsby, Outage Manager  
Robert Adley, Section Manager, Scheduling, Refurbishment Project Infrastructure  
Roy Brown, Project Manager, RFR  
Norman Chan, Section Manager, Reporting / Cost  
Todd Josefovski, Project Manager, Turbine Generator, Steam Generator  
Sorin Marinescu, Project Manager, Fuel Handling  
Ken Graham, Project Manager, Shutdown, Layup  
Scott Guthrie, Project Manager, Balance of Plant  
Mark Arnone, VP of Refurbishment Projects  
Bill Robinson, SVP Nuclear Projects

Howard Constable, Construction Manager  
Andy Elliot, Cost Manager, Planning and Controls  
Neil Mitchell, Vice President Engineering, Nuclear Refurbishment  
Diane Gaine, Manager, Refurbishment Interface  
Oscar Wynia, Manager, Projects and Modifications  
Terry Murphy, Vice President, Projects and Modifications  
Dragan Popovic, Director, Projects and Modifications  
Julian Read, Section Manager, Projects and Modifications  
Mike Nairne, Section Manager, Projects and Modifications

**Attended the Following Meetings:**

C&C Level 2 Meetings: July 19, 2013; August 16, 2013; September 20, 2013; October 18, 2013; November 15, 2013; December 13, 2013; January 17, 2014; February 14, 2014; March 21, 2014

Proliance Development and Philosophy for Use – August 29, 2013

Status of Schedule and Self-Assessment - September 16, 2013

Corrective Action Review Board (CARB) Schedule Self-Assessment – September 18, 2013

Level 3 Schedule Development Requirements Discussion – September 19, 2013

Earned Value, EV Rules of Credit, Estimate Finalization Discussion – October 18, 2013

Three Stratum Schedule Adherence Meeting – October 21, 2013

RPET Level 3 Schedule Requirements Alignment Meeting – December 13, 2013

Proliance / Business Intelligence (BI) Phase Development Plan Discussion – January 16, 2014

Corrective Action Review Board (CARB) D20 Incident Investigation Review – February 19, 2014

Delivery of Engineering Resource Curves – March 15, 2014

**Reviewed the Following Documents:**

- Program Schedule Management Plan NK38-PLAN-09701-10067-0004-R001 2013-03-27
- Nuclear Projects Schedule Management N-MAN-00120-10001-SCH-R001 2013-05-14 (includes C&C Level 2 Schedule Management)
- Task Instruction - Work Breakdown Structure Direction N-MAN-00120-10001-SCH-01 R000 2012-01-23
- Task Instruction - DNG Refurb - Standard Projects Milestone List N-MAN-00120-10001-SCH-02
- Task Instruction - DNG Refurb - Program And Project Missed Milestones Recovery Process N-MAN-00120-10001-SCH-03 R001 2012-08-29
- Nuclear Refurbishment Program\Project WBS Manual N-MAN-00120-10001-SCH-05 R001 2013-04-05
- Nuclear Refurbishment - Milestone Definition Framework N-MAN-00120-10001-SCH-06 R002 2013-11-27
- Nuclear Refurbishment Earned Value Management N-MAN-00120-10001-SCH-07-R000 2013-03-15
- Nuclear Projects Scheduling Requirements From EPC Contractors N-MAN-00120-10001-SCH-09-R000 2013-06-27
- Darlington Refurbishment: Schedule Management Plan For Integrated Level 3 Execution N-MAN-00120-1000-SCH-11 R000 2014-04-04
- 509407-0000-00000-32IM-0001-R02 RFR JV Schedule Management Plan
- Various C & C Schedule Reports and Schedule Binders from August 2013 through March 2014

It is important to note that this Assessment is specific to the master schedule that is being developed for the planning and execution of the DR Project. Schedules for the Campus Plan Projects by the Projects and Modifications organization will be discussed in a separate assessment report.

**Summary of Assessment**

The DR Team has made significant strides in addressing the concerns and observations we raised at the time of our IPA. In particular, the DR Team has changed its Schedule Management Plan to call for OPG to manage a fully integrated Level 3 schedule as the Project's master schedule, this in place of a manually created Control & Coordination (C&C) Level 2 Schedule that merely depicts the aggregation of multiple detailed schedules. There were other observations regarding the Project Schedule in the IPA including:

- Resource work hour loading was generally absent from the contractor Level 3 schedule files;
- Unacceptable/inconsistent time frames allowed for contractor schedule delivery after contract award;
- Complete standards, processes and tools for establishing and maintaining industry best practices for scheduling did not exist;
- The DR Team had not defined or vetted its schedule float management process;
- Earned Value rules were built for “hands-off” oversight, not active project management;
- The DR Team was not requiring that the contractors build or progress their schedules in a manner that would allow OPG to identify risks or hold contractors accountable to planned productivity.

Since our IPA, the DR Project Controls team has revised the Schedule Management Program, culminating with the issuance of the Schedule Management Plan For Integrated Level 3 Execution (N-MAN-00120-1000-SCH-11) in April, 2014 (“Schedule Management Plan”). As part of this revision, the DR Team has launched a significant number of initiatives to address many of the identified issues. Some of the improvements we have noted include:

- The DR Senior Management Team now recognizes that in order to be successful, it will have to actively manage all of the DR contractors. For purposes of schedule management, this active management approach means making specific demands from the contractors with respect to schedule quality, requiring sufficient information that allows for real-time schedule progress and monitoring, and holding the contractors accountable for meeting schedule commitments. For example, the DR Team has required the RFR Contractor, a joint venture between SNC Lavalin Group, Inc. and Aecon Group Inc. (“SNC/Aecon”) to provide its planned work hour loading; measured progress (% complete), and actual hours expended. Moreover, SNC/Aecon is reporting on its schedule progress in all meetings with OPG, which the DR Team plans to use for all contractors.
- The DR Team is now developing and implementing a Level 3 integrated Project schedule, which is being updated by each contractor/work group on a monthly basis. The current schedule at any time during the Definition Phase reflects the level of development for each project bundle; as of this writing, the most complete of the bundle schedules is for the RFR project. The integrated Level 3 schedule will provide a detailed, logical finish to start sequence with the longest duration linked tasks creating the critical path. As the Execution Phase approaches and the Level 3 schedule matures, the contractors will be required to update their activities once a week.
- The DR Team is developing placeholder activities for detailed schedules not yet received from the DR contractors. We note that such placeholder schedules should include enough detail so that the Work Breakdown Structure (“WBS”), key milestones, integration points with other work groups, responsibility codes and any other necessary activity codes are in place and mature with the schedule. This allows for continued schedule development, as well as supporting other on-going front-end planning activities by the project managers.

The DR Team has acquired several licenses for the Acumen Fuse software that will help OPG assess the quality of the Project Schedule (and the various contractor schedules that are integrated into the Project Schedule). While these changes are positive in nature, there is still work to be done before the DR Team will fully resolve all the issues we noted in our IPA and subsequent reports. In particular, the change in project management style is a cultural issue that will have to be continuously stressed by senior management—not just with respect to the Schedule Management Plan, but with all aspects of the DR Project. Additionally, we believe that more can be done by the DR Team to identify and communicate the schedule requirements to the contractors.

Since issuing the IPA, we have continued to monitor the progress of the Project’s schedule development, and as a result, have documented some additional observations. If executed properly, the Schedule Management Plan should provide a good baseline that incorporates industry standard schedule management techniques. Our observations, identify gaps in the Schedule Management Plan as well as identify potential barriers to its





successful implementation and execution. The observations and associated recommendations discussed in this Report are as follows:

Observation 1: DR Team Requires Training in Schedule Management Practices

Observation 2: Continued Lack of Clarity for Contractor Schedule Requirements

Observation 3: Schedule Float Management Plan Needs Focus for the Execution Phase

Observation 4: Earned Value Implementation Needs Focus

Observation 5: Metrics for Monitoring Level 3 Schedule Development Performance Need Improvement

Observation 6: Refurbishment Scheduling Network Needs Attention

These observations and associated recommendations are set forth in the following table. All of the observations noted in this Assessment have been communicated to DR Project Controls. Once properly addressed, an integrated Execution Phase schedule can be used and maintained as an effective project management tool. Confidence in the earned value reporting and project forecasting should also increase.

## 2.0 Signatures

Prepared by: \_\_\_\_\_  
*Duke Bell*

Date: \_\_\_\_\_

Prepared by: \_\_\_\_\_  
*Jim Wilson*

Date: \_\_\_\_\_

## OBSERVATIONS/FINDINGS

#	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
1	<p><b>DR Team Requires Training in Schedule Management Practices:</b></p> <p>The team now sees themselves as a project management (rather than an “oversight”) organization and is putting programs in place to properly manage the Project’s contractors, including an integrated Level 3 Project Schedule.</p> <p>While this is a good start, we have observed some confusion among the rank and file as to what this change means. We have also observed a lack of understanding of basic schedule management techniques. Additionally, the DR Team will likely need different skills to fulfill management’s expectations, and it is likely that the team will need to acquire resources where gaps are currently apparent.</p>	LOW	<ul style="list-style-type: none"> <li>Identify and communicate the resource/skill set requirements needed to support development and management of the new Level 3 integrated schedule. Acquire the proper resources for positions not adequately staffed and relocate skillsets that are no longer necessary. The earlier these needs are provided in the business planning review effort, the more likely these needs will be approved.</li> <li>Provide training to the DR Team with respect to the newly-issued Schedule Management Plan for Integrated Level 3 Execution. This should also include senior management cultivating a “schedule culture” where knowledge of, and adherence to, the Project Schedule is paramount.</li> <li>Additionally, we would recommend that the various schedule procedures be merged into one document to facilitate use, updating, and to eliminate redundancy and potential conflicts. Those documents include: <ul style="list-style-type: none"> <li>Nuclear Projects Schedule Management N-MAN-00120-10001-SCH-R001 2013-05-14</li> <li>Nuclear Refurbishment Program\Project WBS Manual N-MAN-00120-10001-SCH-05</li> <li>Nuclear Refurbishment - Milestone Definition Framework N-MAN-00120-10001-SCH-06</li> <li>Nuclear Refurbishment Earned Value Management N-MAN-00120-10001-SCH-07</li> <li>Nuclear Projects Scheduling Requirements From EPC Contractors N-MAN-00120-10001-SCH-09</li> <li>Darlington Refurbishment: Schedule Management Plan For Integrated Level 3 Execution N-MAN-00120-1000-SCH-11</li> </ul> </li> </ul>	



	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
2	<p><b>Continued Lack of Clarity for Contractor Schedule Requirements:</b></p> <p>The level of detail now required by the DR Team from the various contractors for proper schedule management is currently neither standardized across all of the project bundles nor are contract requirements specific enough. The vendors were not given specific direction to deliver, among other things, fully resource-loaded (planned work hours) and actual work hours per vendor task alignment to the Level 3 schedules for preparing resource curves and earned value SPI and CPI calculations.</p> <p>We have observed that the DR Team has worked well with SNC/Aecon to identify the schedule requirements, and negotiated an agreement with the contractor to adhere to those requirements despite a lack of specific contractual language. Recently, some of the same requirements have been communicated to the other DR Project contractors, however, as of the end of the first Quarter of 2014, there is no written "protocol" or process document fully approved and accepted that identifies all of the needed requirements that can be used by all of the project managers. This is important to ensure that all of the contractors submit and maintain the same level of schedule detail and quality for each sub-project.</p>	HIGH	<ul style="list-style-type: none"> <li>• Develop a protocol document detailing the contractor scheduling requirements for some or all of the following areas: <ul style="list-style-type: none"> <li>• Roles and Accountabilities</li> <li>• Communication</li> <li>• Security</li> <li>• Hammock Structure</li> <li>• Integration Protocols</li> <li>• Asset Suite and p6 Rules</li> <li>• Coding Requirements</li> <li>• Reporting Requirements</li> <li>• Resource loading requirements</li> <li>• Schedule change control standards</li> <li>• Baseline, Updating, Status and Earned Value Rules</li> </ul> </li> <li>• Once developed, the protocol document should be agreed-to and executed by all of the Project's vendors. If possible, it should be made a contract document (i.e. through an executed project change directive or change order).</li> </ul>	

	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
3	<p><b>Schedule Float Management Plan Needs Focus for the Execution Phase:</b></p> <p>Currently, it is anticipated that OPG's activities will be on the DR Project's critical path (i.e. defueling and commissioning) for approximately 25% of the time while RFR will be on the critical path for the remainder of the Execution Phase. All of the other planned DR Project work is expected to fit within a 60% time window of the RFR critical path duration.</p> <p>The change to an integrated Level 3 schedule for planning the Execution Phase requires that both critical and non-critical area float is properly managed. In particular, it important to maintain sufficient float for non-critical path Balance of Plant work and potential discovery work on the first unit. As a result of this requirement, float management will be an increasingly important factor in developing the Execution Phase schedule.</p> <p>In order for OPG to effectively manage all of the DR Project work, it will need to have visibility to all DR Project float, first by phase and then cumulatively. It does not appear to us that there is widespread understanding or consensus on managing the float on non-critical path project schedules within these phases.</p>	MEDIUM	<ul style="list-style-type: none"> <li>The DR Team needs to reach consensus on Project phase definitions, management of Project phase float (including non-critical work), overall project float and management of contractor float by the various project teams. These standards should be documented in the appropriate DR Project manuals (N-Man level documents).</li> <li>The term "Negative Float" needs to be defined consistently in the schedule manuals along with the standard methodologies for resolving Negative Float on a project-by-project basis. Because Negative Float is generally considered unacceptable, its' visibility should spur some action by the DR Team such as development of a recovery plan, mitigation strategies, lessons learned, etc.</li> <li>The DR Team should revisit the implementation requirements for each of the project bundles and evaluate the best overall float management strategy for the DR Project. All stakeholders including Darlington Plant Operations should be included. Specific milestones and assumptions for the team's overall conclusions need to be well documented. .</li> <li>The Project should perform a backwards pass analysis of the Execution Phase schedule when enough of the schedule's detail has been developed, which should determine whether float rules or allocation need adjustment.. Once again all appropriate stakeholders need to be included in these reviews. The first reviews could be performed at a higher level to develop familiarity with the schedule for those not involved in the day to day planning process.</li> <li>The final Execution Phase schedule needs to be developed with the 60% limitation in mind for BOP work and appropriate contingency for discovery work.</li> </ul>	

	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
4	<p><b>Earned Value Implementation Needs Focus:</b></p> <p>The DR Project Controls team has not yet provided a complete prescriptive program of earned value techniques, rules of credit and reporting requirements.</p> <p>The Project Controls group has put a significant amount of effort into creating a system that utilizes Proliance and the Microsoft Business Intelligence reporting software to perform earned value analysis. While this program should provide (once working) a check methodology for the financial performance of level of effort and indirect tasks where the units being measured are consistent (ex: OPG FTE's per shift; equipment rentals per period, etc.), it will be challenged to measure differences between planned, actual and earned work hours per the Level 3 Schedule task alignment.</p> <p>Currently a number of manual adjustments are being made by Projects and Modifications and the DR Project teams to the existing reports to make earned value results align. The DR Team needs to focus on providing a comprehensive earned value plan that clearly defines how each category of work will be measured, who will measure it and how it will be reported. This will provide a consistent rule set for each team and a clear set of rules for earned value program deliverables to be</p>	HIGH	<ul style="list-style-type: none"> <li>• The DR Team should thoroughly vet each project's WBS to determine if improvements can be made prior to the Project maturing. These improvements include: Control account alignment with work estimates, cash flows and alignment with the schedule. The project teams should share OPEX regarding WBS alignment and scrubbing.</li> <li>• The DR Team should develop a complete set of rules for the contractors that are required for a reliable and consistent performance and earned value system. Currently, only the RFR Contractor is providing quantity-based performance forecasts.</li> <li>• The DR Team should develop a standard among the project teams for tracking and reporting commodity quantities estimated and actually installed per week; commodity unit rates and earned value analysis techniques. Some of the teams are already performing this analysis and their techniques need to be considered in the development process.</li> <li>• The DR Project Team will have to establish the commodities (quantities) for which it wishes to monitor unit rates and actual quantities installed vs. quantities estimated by task.</li> <li>• The earned value system needs to be based on planned, earned and actual work-hour progress. A comparison of earned vs. planned work hours can be extracted from Primavera P6 based on progression of earning rules. Each contractor should provide its actual work hours expended per the level 3 Schedule line item tasks so that CPI (productivity) can be measured at the appropriate level. . To this end, the DR Team will have to require that the contractors monitor their unit rates, track project actual work hours, and provide status weekly the earned value system and metrics. The RFR and JV team are already working on examples of these techniques and the models they develop</li> </ul>	

	<p>required from the contractors.</p> <p>Currently, OPG measures earned value in dollars per unit completed. This technique requires a documented control system for labor rates as well as commodity unit rates, which creates two control variables in a calculation that only has three components. Forecasting in this scenario becomes ambiguous and lacks credibility, leaving too much room for error in a truly managed project. These potential errors are compounded when rolled into the summary analysis of a control account that contains indirect, material and OPG costs in a dollar based analysis.</p>		<p>should be translated and utilized for performance measurement by the other Project Teams. Where contractors are reluctant to publicize unit rate performance, such can be calculated by the Project Teams once quantities installed and actual hours are reported.</p> <ul style="list-style-type: none"> <li>• The DR Team should perform a tabletop exercise testing the techniques with several different types of work and different contractors prior to completing the earned value system design, which will (1) identify other database functions that are not working properly, especially in the finance system from which the actuals for earned value are retrieved and task alignment; (2) provide a template for reporting key performance indicators; (3) allow for project management to determine the level of needed reporting.</li> <li>• Once the DR Team establishes the earned value system, it needs to finalize the proper reporting techniques to measure and provide visibility of the results. The DR management team needs a system founded on actionable information from which they can make timely and prudent decisions regarding the Project.</li> </ul>	
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	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
5	<p><b>Metrics for Monitoring Level 3 Schedule Development Performance Need Improvement</b></p> <p>The Project Controls team is currently publishing a monthly schedule health chart with the C &amp; C Level 2 Schedule Report that provides some view of the ongoing Level 3 schedule development, and while this is a good start, further communication of the schedule's status would be beneficial.</p> <p>In addition, metrics that show ongoing schedule adherence could encourage greater overall awareness of the schedule and its importance to the Project. These metrics need to be published and the appropriate parties held accountable to meeting established standards and target schedule development dates. Metrics that show ongoing schedule adherence could help breed more overall awareness of the schedule and its importance to the Project.</p>	LOW	<ul style="list-style-type: none"> <li>• Project controls should develop a set of metrics to make visible the status of the development of the execution-phase schedule by the project teams and their respective contractors. These metrics should be straightforward and understandable, and aggregate all of the necessary data should be available in the Project Controls reporting database. The metrics should be objective in nature, and could include, as an example, the number of Level 3 schedules that are resource loaded, the number of projects now loaded into P6, schedule adherence and the like.</li> <li>• Project Controls should report a weekly status by project that includes: the number of tasks currently loaded into the Level 3 Schedule; the status of resource work hour loading of the schedule tasks, the status of key commodity quantities identified per project; and aggregate number of work hours per contractor. The number of Level 3 Schedule tasks reported per week could be broken down to show the number of Engineering tasks, Procurement tasks and Construction tasks.</li> </ul>	

	Observations/Findings	Risk Rating	Recommendations	Management Action Plan
6	<p><b>Refurbishment Scheduling Network Needs Attention:</b></p> <p>As part of Level 3 schedule development and the need for all project partners to operate in a common environment, contractors will need to acquire OPG network access in a timely manner. Currently OPG is experiencing delays in getting this accomplished. As part of this same effort, the user profiles need to be re-visited and potentially modified to match the access needs that are going to be required to execute in a fast paced outage environment once implementation begins. This is already an issue within the Projects and Modifications organization, giving the DR Team an opportunity to implement lessons learned.</p> <p>Also requiring attention is the OPG scheduling database configuration model needed for this complex project. Because the contractors will be required to manage and update their projects inside of the OPG database, their rules of operation will have to be established as early as possible. The number of projects and the controls needed on development schedules, what-ifs and the production environment require a rigid set of parameters to operate. Ownership hierarchy and user rights (profiles) have to be addressed as well. Once set, these all need to be integrally tested in tabletop reviews to ensure not only that the system functions properly but that all users know how to function in the system environment.</p>	MEDIUM	<ul style="list-style-type: none"> <li>Through working sessions with IT, the DR Team should prepare processes and procedural guidance that enables timely access to the OPG P6 schedule environment for required individuals.</li> <li>The team should review user profiles for adequacy with the contractors and IT and modify as needed, and develop operational parameters for control of the database environments by the proper personnel to ensure that changes can be made around the clock with minimal communication.</li> <li>Once all operational parameters have been set, the access process is timely, profiles are appropriate and an effective number of schedules have been provided in the database, users should perform tabletop exercises to properly test and vet any issues that may exist in the system. The proper stakeholders should be included in this process along with the proper OPG and contractor personnel. Several different projects and work scopes should be tested as well as all types of schedule change and update scenarios.</li> </ul>	

## Attachment B

### Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

In our Initial Project Assessment of August 2013, BMcD/Modus summarized our conclusions and recommendations for the DR Project in a concluding table. Below, we have revisited these initial issues, risks and recommendations as a way for NOC to see the Project's progress since our Initial Assessment.

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
Scope	The DR Project's scope exceeds the commitments made to the BOD and Shareholder.	<ul style="list-style-type: none"> <li>Continue the process of reducing and optimizing the Project's scope.</li> <li>Reach a consensus on the scope as expeditiously and reasonably as possible so as to reduce the DR Team's work load and unneeded churn.</li> <li>Once the scope recommendations are adopted, the team will need to re-review the schedule to ensure the logic network is sound.</li> </ul>	<ul style="list-style-type: none"> <li>Scope reduction was accomplished via Blue Ribbon Panel review and results were incorporated in 4c Cost Estimate</li> <li>Scope remains an issue with BOP work – some of the design solutions proposed under ESMSA contracts have been excessively complex</li> <li>Options Review Board and strengthening of Gating process required to root-out remaining potential scope busts</li> <li>4d Cost Estimate may result in another round of required scope reductions</li> </ul>
Engineering	The schedule and pace of procurement related activities may not support a high-quality estimate at RQE.	<ul style="list-style-type: none"> <li>Review strategic considerations for procurement of remaining scope.</li> <li>Consider early "shoulder to shoulder" work by EPC design partners to expedite the start of detailed engineering and constructability reviews</li> <li>Review and prepare for likely RFIs from EPC vendors during the Planning and Assessing Phase.</li> </ul>	<ul style="list-style-type: none"> <li>Engineering for major bundles (RFR/Turbine Generator/Steam Generator/Fuel Handling) appear to be largely on course</li> <li>BOP start of detailed engineering is currently as much as 12 months behind plan which may impact accuracy of large portion of RQE</li> <li>Concerns expressed by BMcD/Modus in August 2013 regarding risks have largely materialized due to late award/start of BOP work</li> <li>Metrics for tracking engineering earned value need additional work and lack fidelity</li> <li>Constructability and Planning &amp; Assessing reviews are underway with RFR and Turbine Generator but lagging behind detailed engineering for BOP</li> </ul>



## Attachment B

### Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
Project Management	The Project oriented focus has created management silos that could make integrated program management difficult, resulting in contractor/owner interferences.	<ul style="list-style-type: none"> <li>As the Project matures and contracts with vendors are in place, the DR Team should increase the level of program integration.</li> <li>Address the fact that the Execution Phase may require individuals with different skills for OPG to effectively manage the contracts.</li> <li>Clarify reporting lines for matrixed Project Controls Personnel.</li> <li>Actively seek to assemble the Execution Phase team as soon as possible.</li> </ul>	<ul style="list-style-type: none"> <li>Project team development is progressing though with some notable alignment issues</li> <li>Refurbishment management for execution has been strengthened and “projectizing” of functions is progressing</li> <li>P&amp;M is undergoing a fourth leadership transition since July 2013 and stability and direction is urgently required</li> <li>Project Controls standardization across the entire DR Project is a work in progress and will require significant effort</li> </ul>
	The DR Team plans to implement a C&C Schedule at Level 2 for management which could create a number of coordination issues during the Execution Phase.	<ul style="list-style-type: none"> <li>Continue development of the C&amp;C Schedule through the Definition Phase and migrate to a fully integrated Level 3 schedule for the Execution Phase.</li> <li>Redirect the Project Controls Team’s efforts from the C&amp;C Schedule work to that of monitoring the developing Level 3 schedules from the contractors.</li> </ul>	<ul style="list-style-type: none"> <li>Refurbishment has corrected early potential faults in the schedule methodology and will utilize a Level 3 schedule for execution that is currently under development</li> <li>P&amp;M continues to populate the C&amp;C Schedule though the schedules for individual projects require updating and vetting once final scope and engineering is in place</li> </ul>
Schedule Development	The current schedule development depends on mutual agreement and acceptance of quality standards that owners typically demand, creating the risk that contractors will not comply.	<ul style="list-style-type: none"> <li>Clarify and include in commercial contracts OPG’s requirements for schedule development by the contractors.</li> </ul>	<ul style="list-style-type: none"> <li>DR Project chose not to update its contractual requirements though is seeking a high level of definition from contractors, who appear to be in compliance on Refurbishment but not Campus Plan</li> <li>We continue to recommend that OPG update its commercial arrangements for project controls information that will be propounded by the contractors at the time of finalizing the target price contracts for the Execution</li> </ul>



## Attachment B

### Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
Risk Management			Phase
	The current methods for scoring risks are inconsistent and the risk register includes “issues” or “concerns” that needlessly dilute management efforts.	<ul style="list-style-type: none"> <li>• Provide consistent characterization and scoring of risks.</li> <li>• “Concerns” as currently defined should be eliminated from the Risk Management Program.</li> <li>• Ensure that all relevant parties have a seat at the risk table while maintaining a measure of centralized control in the approach to risk identification and tracking.</li> <li>• Consider revising probability scoring to increase granularity and ranking of risks.</li> </ul>	<ul style="list-style-type: none"> <li>• Risk identification is improving in the Refurbishment organization</li> <li>• Scoring and “business as usual” risks are being addressed</li> <li>• Risk Management Program deficiencies are still present and have not been addressed</li> </ul>
	Leadership, training and wide acceptance of the importance of the Risk Management Program is lacking and the Project Controls Risk Group is understaffed.	<ul style="list-style-type: none"> <li>• Consider bringing in an experienced risk management lead with a demonstrated track record who is singularly focused on the risk function.</li> <li>• Review qualifications within the existing risk team.</li> <li>• Elevate Risk Management to a stand-alone functional group with the same level of prominence as the Schedule team.</li> <li>• Provide training with a focus on the overall importance of the Risk Management Program</li> </ul>	<ul style="list-style-type: none"> <li>• The DR Project’s risk management team has been strengthened over the intervening year and has new energized leadership in place</li> <li>• Additional training and risk discussion is still necessary</li> <li>• Reporting of risks needs additional clarification and work</li> </ul>
	The various databases that the Risk Group is populating suffer from a number of IT issues and lack of focus.	<ul style="list-style-type: none"> <li>• IT needs to resolve the outstanding issues as quickly as possible.</li> <li>• Training should include instruction for populating databases.</li> <li>• The AIDA database should be examined and updated if it is to be useful for rate proceedings.</li> </ul>	<ul style="list-style-type: none"> <li>• Database integration issues remain, and still need to be resolved</li> <li>• AIDA still requires examination for usefulness for rate proceedings.</li> </ul>

## Attachment B

### Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
Cost Management	The DR Team is inconsistently applying AACE guidelines and other processes and procedures central to the BOD's understanding of the underlying quality of project cost estimates.	<ul style="list-style-type: none"> <li>Consistently apply AACE guidelines, and where they are not (as in the RFR project estimates), the DR Team should seek to return to a condition of compliance.</li> </ul>	<ul style="list-style-type: none"> <li>AACE guidelines have been addressed in the continued development of the Project's estimates; contractors appear to have a better understanding of the nature of compliance with AACE standards</li> </ul>
	Revised planning assumptions for the 2014 Business Plan are currently being assessed—the business case for these assumptions is centered on the opportunity to reduce risk and increase positive outcome.	<ul style="list-style-type: none"> <li>Document and characterize the information for the BOD and consider meaningful reporting metrics.</li> <li>Should OPG adopt the revised assumptions, review commercial agreements so as to identify potential issues that could be impacted by the revised plan, as well as other issues within contracts that can be improved based on current OPEX.</li> <li>Review, capture and document Unit 2 OPEX information so maximum benefit is derived from this revised plan.</li> </ul>	<ul style="list-style-type: none"> <li>Documentation of major decisions still could be strengthened</li> <li>Discussion of key commercial agreements (in particular RFR) is pending though have been fully considered by DR Team management</li> <li>Metrics are still under review for effectiveness, as is earned value system</li> </ul>
	The 2015 Business Plan Budget review will likely repeat the process for the 2015 Business Plan in which the budget is refreshed.	<ul style="list-style-type: none"> <li>Perform a full project reforecast for the 2015 Business Plan in order to progress the project's cost estimates as far as possible before the date of the RQE.</li> <li>Such a reforecast will provide management with a detailed blueprint for all of the work needed to satisfy the RQE with information related to the budget that should match the DR Project's growing level of maturity.</li> </ul>	<ul style="list-style-type: none"> <li>4d Cost Estimate work is progressing, though we have concerns that it will fall short of a full Project reforecast. BMcD/Modus sees a risk in holding back on full examination of the underpinnings of the 4d Cost Estimate for certain cost centers that have not substantially matured since 4c Cost Estimate</li> <li>DR Team has appointed a manager of the RQE efforts, who should be engaged to find gaps in 4d Cost Estimate</li> </ul>

## Attachment B

### Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
	Contingency calculations need closer alignment with the Risk Management Program.	<ul style="list-style-type: none"> <li>• Actions summarized above</li> <li>• Create a clear and repeatable process for calculating contingency at all levels and for all program participants.</li> </ul>	<ul style="list-style-type: none"> <li>• BMcD/Modus will be reviewing and vetting the process for contingency identification for 4d Cost Estimate</li> <li>• As the Project matures, our expectation is for the DR Team to move toward deterministic risk and contingency identification with monetization of specific known risks</li> </ul>
Management Processes	OPG's new processes and procedures are in some cases conflicting and repetitive.	<ul style="list-style-type: none"> <li>• Look at reducing the number and optimizing the process map.</li> </ul>	<ul style="list-style-type: none"> <li>• The Project Management Plan remains a work progress</li> <li>• BMcD/Modus recommended each project manager revise the bundle management plans to incorporate changes to management principles</li> </ul>
RFR	SNC/Aecon's Class 4 Estimate (by contractual design) does not monetize contingency nor will it until the date of the 2015 Class 2 Estimate; this fogs the budgeting process and could complicate target price negotiations with SNC/Aecon over risk identification.	<ul style="list-style-type: none"> <li>• Consider asking SNC/Aecon to monetize risks at a much earlier stage.</li> </ul>	<ul style="list-style-type: none"> <li>• SNC/Aecon has agreed to provide certain information related to risks for 4d Cost Estimate though the extent to which it is helpful has to be determined</li> </ul>
	The Class 4 Estimate represents perfect performance; thus, it will form the basis for comparison with actual results.	<ul style="list-style-type: none"> <li>• The DR Team needs to document and explain the nature of the Class 4 Estimate so that there is no such confusion.</li> </ul>	<ul style="list-style-type: none"> <li>• The difference between SNC/Aecon's Class 4 and Class 3 estimates needs to be properly characterized</li> <li>• The RFR team, with vetting from BMcD/Modus, provided a prescriptive estimating plan for the RFR Class 3 Estimate that clearly defines the deliverables.</li> </ul>
	Project maturation	<ul style="list-style-type: none"> <li>• The Class 3 Estimate</li> </ul>	<ul style="list-style-type: none"> <li>• The Class 3 Estimate addressed</li> </ul>

## Attachment B

### Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
	specific to the DR Project was not a factor in SNC/Aecon's estimates to date.	<p>preparation should be expedited if possible.</p> <ul style="list-style-type: none"> <li>OPG should seek SNC/Aecon's monetizing of PMT costs.</li> </ul>	<p>these gaps; however, SNC/Aecon did not utilize time well, creating a substantial effort by SNC/Aecon and OPG in a short window of time</p> <ul style="list-style-type: none"> <li>The Class 2 Estimate development must occur at a more predictable pace, as there is less time for SNC/Aecon to prepare it and this estimate will form the basis for target price negotiations.</li> </ul>
	The potential unlapping of the execution of Unit 2 could result in cost increases from SNC/Aecon due to extended overhead and maintaining the workforce for a longer duration.	<ul style="list-style-type: none"> <li>While SNC/Aecon's costs may increase, there are other elements within the contract that should be negotiated that might serve to reduce the overall project's risk.</li> </ul>	<ul style="list-style-type: none"> <li>This remains a work in progress. BMcD/Modus believes it is OPG's intent to close needed gaps in the commercial contract prior to the final Execution Phase negotiations.</li> </ul>
	There are technical improvements that should be reviewed based on OPEX.	<ul style="list-style-type: none"> <li>Study opportunities now that the effort is turning to Darlington.</li> </ul>	<ul style="list-style-type: none"> <li>This is part of Class 3/2 Estimate effort is and under evaluation for the target price</li> </ul>
<b>ThisBOP</b>	The time engineering needs to create MDP packages is delaying the procurement of the work and the commencement of detailed engineering.	<ul style="list-style-type: none"> <li>Accelerate engineering work as necessary / practicable with the OSS vendors.</li> <li>Reduce and optimize BOP scope as soon as reasonably possible to decrease wasted effort.</li> <li>Change procurement method to a packaged approach (see below).</li> <li>Jumpstart detailed engineering by engaging EPC vendors as early as possible in the design process.</li> <li>Eliminate unnecessary duplication of effort between OSS vendors and EPC designers.</li> </ul>	<ul style="list-style-type: none"> <li>MDP preparation was accelerated and was completed ahead of schedule</li> <li>Detailed engineering for BOP work remains a risk; despite changes to the procurement model, assignment of work to ESMSA contractors continues to be delayed or impacted</li> <li>DR Team has initiated a collaborative approach to reviewing and approving engineering product that is intended to eliminate delays in approvals and duplicative effort; results need to be monitored</li> </ul>

## Attachment B

### Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
		<ul style="list-style-type: none"> <li>Review and eliminate OPG delays in approval of design work.</li> </ul>	
	The procurement process for BOP is designed around packaging two large bundles of BOP work and a Secondary Compete process which adds time to the schedule; the outcome of this “competition” is essentially already known.	<ul style="list-style-type: none"> <li>Assign work to ESMSA vendors based on qualifications in smaller bundles.</li> <li>Use the existing ESMSA agreements and eliminate bidding process.</li> </ul>	<ul style="list-style-type: none"> <li>Procurement process has been changed and Secondary Competition has been eliminated</li> <li>The direct award process has been hampered by process delays</li> </ul>
	The ESMSA contractors have experienced performance problems on the Campus Plan work.	<ul style="list-style-type: none"> <li>Ensure that appropriate performance metrics are in place and aggressively address specific performance trends and problems as they arise.</li> <li>Increase flexibility in the assignment of BOP work to give OPG an opportunity to mitigate ESMSA performance issues.</li> </ul>	<ul style="list-style-type: none"> <li>ESMSA performance problems with the Campus Plan Projects have persisted</li> <li>Metrics measuring progress and resource allocation have not been developed</li> <li>Assignment of BOP work is now capability-based</li> <li>DR Team has re-assigned work from non-performing contractor’s scope</li> </ul>
	There is a risk that scope defining inspections and discovery work during the Execution Phase will add scope not currently anticipated to the BOP work.	<ul style="list-style-type: none"> <li>Optimize the BOP work so that an appropriate schedule window exists for performance of scope adders.</li> <li>Increase visibility of this potential risk.</li> </ul>	<ul style="list-style-type: none"> <li>Scope defining inspections thus far have resulted in narrowing of the DR Project’s scope</li> <li>Risk of additional work is decreasing</li> </ul>
Campus Plan	The D20 Storage Facility work has been delayed and the contractor’s performance has been subpar	<ul style="list-style-type: none"> <li>Continue to devote adequate resources to recover the D20 Storage Facility’s schedule.</li> <li>OPEX from this project should be used to guide management of the future Execution Phase</li> </ul>	<ul style="list-style-type: none"> <li>D20 Storage remains a significant threat to Refurbishment</li> <li>Contractor performance and P&amp;M’s failure to actively manage the work have resulted in cost overruns and continued schedule</li> </ul>

## Attachment B

### Update of BMcD/Modus Recommendations from Initial Project Assessment of August 2013

Initial Project Assessment – August 2013			3Q 2014
Issue	Risk/Opportunity	Recommendation	Update/Status
		work.	<p>delays</p> <ul style="list-style-type: none"> <li>OPEX from D2O Storage has been well-studied and was a significant topic of BMcD/Modus's 2Q 2014 Report</li> <li>The DR Team is endeavoring to insert lessons learned into BOP work, though this requires close monitoring</li> </ul>
	Campus Plan work is multi-faceted and schedule driven; the sheer size and timing of the work adds complexity and risk	<ul style="list-style-type: none"> <li>Additional management attention is needed to ensure planning and execution of the work</li> </ul>	<ul style="list-style-type: none"> <li>Management issues with Campus Plan Projects persist</li> </ul>
	The Campus Plan's scope is too large	<ul style="list-style-type: none"> <li>Continue to review the Campus Plan Scope and eliminate unnecessary projects.</li> </ul>	<ul style="list-style-type: none"> <li>Some scope in the Campus Plan Projects was cancelled as part of the Blue Ribbon review—further review and scope reduction may be required.</li> </ul>
<b>OPG Critical Path</b>	OPG-directed work is 25% of the Critical Path of the DR Project.	<ul style="list-style-type: none"> <li>Ensure that this work is given proper focus and resources.</li> </ul>	<ul style="list-style-type: none"> <li>Defueling and Fuel Handling work appear to be progressing after some early delays in awarding contracts and assigning/splitting work with DNGS station.</li> </ul>

**ATTACHMENT 20**

**See Ex. D2-2-8, Attachment 2**





## **Independent Oversight Team - Assessment of OPG Scope Definition and Management Process**

### **Objective and Scope**

Burns & McDonnell Canada Ltd. and Modus Strategic Solutions Canada Company ("BMCD/Modus") have performed an assessment with respect to OPG's scope definition and management process for the Darlington Nuclear Refurbishment Project ("DR Project" or "Project")<sup>1</sup>. With this assessment report, BMCD/Modus considers three questions related to the methodology of the scope identification effort as well as the ongoing scope management process: 1) whether the DR Project Team's scope strategy and scope identification effort is prudent, 2) whether the DR Project Team's recent scope review process is effective, and 3) whether there are effective processes and procedures in place to approve and control scope. Note that our review considered the scope definition process for the DR Project only, and not the Campus Plan Projects. However, some of our recommendations for scope control result from lessons learned from the Campus Plan Projects.

### **Period of Assessment**

This assessment was conducted during the fourth quarter of 2013 and the first quarter of 2014 and builds on prior BMCD/Modus reports. This assessment provides a measure of progress during this time as well as observations and recommendations for further improvement.

### **Overall Assessment Risk Rating: LOW**

### **Background and Methodology**

On August 13, 2013, BMCD/Modus presented its Initial Project Assessment Report ("Project Assessment") based upon our review of the DR Project from February 25 through mid-July, 2013. In our Project Assessment, we reported that between the years of 2009 and 2012, the Darlington Refurbishment Project Team's ("DR Team") overall cost estimate had grown significantly, on the order of approximately 20%. The majority of this cost estimate increase was due to scope growth resulting from OPG's initial scope definition methodology, which was premised on casting a "wide net" and identifying all of the possible scope that could be included in the DR Project.

In our Project Assessment, we noted that this was likely a net positive for the Project as many large capital projects are adversely impacted by late scope identification. We were also concerned with the rigor the DR Team was using to rationalize scope after it was initially considered. Thus, we wanted to gain a more robust understanding of the DR Team's continuing scope strategy and to determine how the current DR Project's scope has been defined and evaluated. To that end, it was necessary to delve into the scope drivers and supporting documents in order to characterize the DR Team's scope definition methodology. This assessment provides our opinion of the DR Team's scope strategy and the identification process.

Also at the time of writing our August 2013 Project Assessment, the DR Team's Scope Review Board ("SRB") was commencing an effort to finalize and align the scope for the DR Project. We

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<sup>1</sup> This report considers the scope management practices specific to the DR Project and does not directly consider the scope definition processes and actions utilized by OPG's Projects & Modifications (P&M) in the development, planning and execution of the pre-requisite Facilities & Infrastructure projects, also known as the "Campus Plan Projects." BMCD/Modus will assess the scope management practices for the Campus Plan Projects in a separate, dedicated Assurance Report.





noted in our report that due to OPG's initial scope strategy, the next challenge for the DR Team would be to weed out scope that was not consistent with the original commitments to the OPG Board of Directors, the Shareholder, and the CNSC. From October 2013 through the end of January 2014, BMCD/Modus continued to monitor the DR Team's scope review process to determine its effectiveness in right-sizing the Project's scope. Whereas our Q4 2013 report provided an interim review, this assessment covers the outcome and closure of that process occurring through early 2014.

Finally, we wanted to understand whether the Project's processes in place today to approve and control scope were effective. Although we have touched on aspects of scope management in our prior reports, we have not provided a complete assessment until this time. In our Q4 2013 report, we discussed how the gate process was similar to those typically found in the industry but that execution within the process could be improved. To gain a complete picture of the scope management process, we attended a number of Gate meetings and reviewed several gate packages. We have engaged key team members in in-depth interviews and have reviewed a large sample of the documentation the DR Team developed and maintained through this process.

This assessment report covers the Refurbishment project scope and scope management processes and, although mentioned, does not directly address P&M's or the station's management processes; these will be addressed in future reports. Our assessment does not make a qualitative judgment regarding the nature of the Project's scope, only the DR Team's process for such assessment. Additionally, we have not fully assessed the change management process which will also be addressed in future reports.

### **Due Diligence**

To support this assessment, we performed the following due diligence:

#### **Interviewed the following individuals:**

Neil Mitchell, VP Refurbishment Engineering Controls

Brian Coulas, Director - Design Engineering

Walter Arnsby, Assistant Outage Manager

Cindy Sawyer, Section Manager - Outages

Gary Rose, Director - Planning and

Roy Martin, Director - Nuclear Safety

Paul Pasquet, Senior Vice President

Bill Bacon, Consultant



**Attended the following meetings:**

Various Scope Status monthly meetings between September 2013 and March 2014

Various Gate Review Board meetings between September 2013 and March 2014

Various Project and Program Status meetings between September 2013 and March 2014

**Reviewed the following documents:**

Darlington Refurbishment Project Charter – D-PCH-09701-10000-001

Darlington NGS Integrated Implementation Plan – NK38-REP-03680-10185-R000

CNSC RD-360 – Life Extension of Nuclear Power Plants

Darlington Scope Request Database, dated February 5, 2014

Darlington Nuclear Refurbishment - Scope Review - Closure Report – NK38-REP-09701-0467871-R000 LOF

Refurbishment Program Scope Management Plan – NK38-Plan-90701-10067-0002-R001

Darlington Nuclear Refurbishment Program Scope Control – NK38-INS-09701-10001-R005

Darlington Refurbishment Scope Strategy And Plan – NK38-PLAN-01060-10008-R001

Darlington NGS Refurbishment Project Reference Plan - Scope Definition – NK38-PLAN-01060-10003

Nuclear Projects Scoping Process – N-MAN-00120-10001-SCOPE-R000

Nuclear Projects Gated Process – N-MAN-00120-10001-GRB-R001

Nuclear Projects Records And Document Management

CNSC Correspondence Related to the Integrated Safety Review

Darlington Refurbishment Program – Program Scope Review Board – Terms of Reference – NK38-PLAN-09701-10003-R002

Gate Packages, including RFR, BOP, Turbine Generator, RFR Island Support Annex and D20 Building

HOS metrics included in the monthly Program Status Reports and presented at the Scope Status meetings

A variety of project progress reports

**Overall Assessment**

In our Project Assessment in August 2013, BMCD/Modus noted that OPG's methodology had cast a wide net in identifying all of the DR Project's potential scope. Our additional analysis of the underlying scope drivers generally confirms our Project Assessment's conclusions (see Observations 1 and 2 below) though expands on that initial review to examine how the scope was ultimately pared down. Our review showed that the DR Team has continued to refine this approach as the project progresses. For example, the DR Team performed several scope reduction efforts culminating in the Scope Review Board's latest scope reduction exercise completed in the first quarter of 2014. These earlier scope reviews included:

- An assessment performed in 2012 to determine the scope that could be removed from Refurbishment if OPG were willing to accept future outages extended by up to 150 days;
- A scope prioritization process performed in April, 2013 that identified scope items that could be removed from Refurbishment based upon their low level of importance; and,
- An assessment based upon operational past experience performed in July, 2013 that identified scope that could potentially be removed from Refurbishment scope.

These reviews were utilized as inputs to the DR Team's final assessment performed in late 2013 and completed in early 2014 during which the team evaluated each Darlington Scope Request (DSR) against four criteria and dispositioned them into one of eight categories. Four of these categories constitute scope to be



performed within the refurbishment and life extension windows and four of these categories represent scope that is not required or will be performed under the station OM&A, projects or capital spares budgets. This effort reduced the DR Project scope by 254 DSR's for a total estimated reduction of ~\$179M.

Coupled with the above scope reviews, we found that the initial scope identification effort was effective in identifying the universe of potential scope items while reducing unnecessary scope as the project progressed and matured. Further, our review showed that the scope approval process for the DR Project generally conforms to Construction Industry Institute recommended practices for front-end planning and incorporates a gated approval process, requiring greater levels of definition as time progresses. This is typical for large and complex projects; however, we believe that extra care should be taken in the gate review process to prevent a recurrence of scope growth as the project progresses toward the Release Quality Estimate (RQE). In addition to the gate process, the Health of Scope process has shown to be an effective scope monitoring tool, providing a good metric of the DR Project's progression of scope definition.

Overall, BMCD/Modus finds the DR Team has taken a balanced approach to the development of the DR Project scope. The initial scope identification effort incorporated scope beyond that of refurbishment and life extension, potentially increasing the budget and project complexity. However, to even this out, the DR Team has continuously monitored and repeatedly tested the included scope through scope reviews and de-scoping exercises. Additionally, the DR Team has monitored scope definition through the gate review process and Health of Scope (HOS) metrics. We believe the DR Team has struck an important balance between overly limiting scope (and risking scope growth during execution) and being overly-inclusive (and risking excessive project budgets).

The assessment Observations listed below and discussed herein reflect our overall opinions on certain topics as well as matters where improvements may need to be addressed or are already being implemented.

Observation 1: The DR Project Team's scope strategy was effective in identifying a wide range of potential scope.

Observation 2: The scope identification process was thorough and utilized a significant number of source documents to identify potential scope items.

Observation 3: The Scope Review Board needs a more challenging attitude in order to be effective in controlling scope.

Observation 4: The scope reviews performed on the project are not well documented and little formal project record exists related to their outcomes.

Observation 5: Despite the scope definition process being sound, the development of engineered solutions needs improvement.

## **Signatures**

Prepared by: Mark Cira  
Mark Cira

Date: 5/12/14

Prepared by: \_\_\_\_\_  
Geoff Thomas

Date: 5/12/14

#	Observations	Risk Rating	Recommendations	Management Action Plan
1	<p><b>The DR Project Team's scope strategy was effective in identifying a wide range of potential scope.</b></p> <p>The DR Team adopted a very conservative initial scope strategy in order to incorporate operating experience (OPEX) from Pickering, Wolsong, Pt. Lepreau, and other similar projects. Several of these projects saw large amounts of scope growth during the execution phase due to poor initial project definition. OPG's strategy was to identify this scope early on, in the definition phase, which led to significant scope growth from 2009 to 2012 and allowed some scope into the DR Project that would otherwise be excluded. We believe this strategy was prudent and will ultimately be beneficial in reducing the potential for scope growth during the execution phase.</p> <p>During the 2009 to 2012 period, the DR Team recognized that increased scope had the potential to jeopardize the DR Project by exceeding the OPG Board of Director's requirements and increasing the Project's complexity. To mitigate this risk and the potential cost and schedule impact of this extra scope, the DR Team completed several scope reviews to remove non-refurbishment related scope items. The scope reviews performed, culminating in the SRB's final scope review completed in early 2014, provided a forum for challenging the validity of the DR Project scope.</p>	None	<ul style="list-style-type: none"> <li>None.</li> </ul>	

#	Observation	Risk Rating	Recommendation	Management Action Plan
2	<p><b>The scope identification process was thorough and utilized a significant number of source documents to identify potential scope items.</b></p> <p>The DR Project Team used a significant number of sources to identify both the regulatory and non-regulatory driven scope.</p> <p>OPG's methodology has cast a wide net in identifying all of the DR Project's potential scope while its analysis of the underlying scope drivers has taken into consideration the many process frameworks that define the regulatory and non-regulatory Project scope. As a result, the DR Team and all of the stakeholders should be confident that the Darlington NGS scope needs have been properly addressed to satisfy the mandate of the project charter.</p>	None	<ul style="list-style-type: none"> <li>None</li> </ul>	

#	Observations	Risk Rating	Recommendations	Management Action Plan
3	<p><b>The Gate Review process needs a more challenging attitude in order to be effective in controlling scope.</b></p> <p>There are a number of processes in place that are intended to manage scope including the gate process. Our review of the gate process reveals some room for improvement.</p> <p>The scope reviews performed by the DR Team described in Observation No.1 took a much harder look at whether a scope item was truly required for refurbishment. The gate process appears to apply a much less critical eye towards challenging scope.</p> <p>Since 3Q 2014, the DR Team has made some improvements to the gate process. Leo Saagi, Director of Finance was added to the gate review board as a third-party reviewer. This addition should increase the level of scrutiny placed on project teams as they come to the gate meetings. Moreover, the DR Team has established two new controls: (1) the Options Review Board, which is an opportunity to challenge the method for accomplishing the work based on a more mature plan; and (2) Readiness Schedule review, which will impose outage-style readiness requirements as the work progresses to execution. Critical to both of these controls is timing; these reviews need to occur before detailed design and planning occur so that changes can be economically made.</p>	MEDIUM	<ul style="list-style-type: none"> <li>• Adopt a more challenging attitude in reviewing and approving gate packages.</li> <li>• As the Gate Review process evolves more to a readiness review for the remaining and approved scope, the focus should shift to the schedule and constructability of the identified scope.</li> <li>• The DR Project's planning efforts should borrow from RFR which has tested certain processes for planning, estimating, scheduling and identifying solutions for its work scope.</li> </ul>	

#	Observations	Risk Rating	Recommendations	Management Action Plan
4	<p><b>The scope reviews performed on the project are not well documented and little formal project record exists related to their outcomes.</b></p> <p>With the exception of the scope review completed in early 2014, we see little formal documentation that the prior reviews took place and the decisions made based upon those reviews.</p> <p>Additionally, any scope items that pose a potential risk of increasing scope, for example, items awaiting scope-defining inspections, should be clearly identified and tracked in a transparent way to limit the risk of surprises.</p>	LOW	<ul style="list-style-type: none"> <li>• OPG should formally document the output from the prior scope reviews to complete the project record for rate proceedings.</li> <li>• Track any remaining scope risks, including those resulting from future scope-defining inspections, in a transparent manner so that there are no surprises.</li> </ul>	

#	Observations	Risk Rating	Recommendations	Management Action Plan
5	<p><b>Despite the scope definition process being sound, the development of engineered solutions needs improvement:</b></p> <p>B&amp;McD Modus has evaluated the performance of the Facilities and Infrastructure (“F&amp;I” or “Campus Plan”) projects. The Campus Plan work provides important OPEX related to OPG’s utilization of the project management strategies developed for the DR Project. In particular, we have found that some of the scope growth in the Campus Plan projects was caused by the following:</p> <p>OPG’s design requirements often caused confusion, misalignment and very complicated solutions driven by the perceived need to over-design all components due to the fact Darlington is a nuclear facility. As an example, based on the guidance from the original MDP, the dehumidification of the turbine deck would have cost upwards of ten times more than OPG has spent in the past performing the same work on laid-up fossil units. In order to be rationally resolved, these issues needed to be identified and discussed with the vendors prior to the start of engineering.</p> <p>The performance specifications in some packages provided the vendors with limited guidance, and in such cases, vendors will usually take the most conservative route.</p> <p>OPG often relied on the vendors to suggest more creative solutions to their issues when OPG’s team knew the best (or preferred) course to take based upon</p>	MEDIUM	<p>We acknowledge that OPG has implemented the following:</p> <ul style="list-style-type: none"> <li>• OPG has recently implemented a revised strategy based upon the active management of the ESMSA engineering work. As this new approach takes root, the DR Team needs to examine the assumptions and engineered solutions for many of the Darlington Scope Requests (“DSRs”)</li> <li>• The DR Team Senior Leadership has initiated a new control, a monthly Options Review Board (“ORB”), the intent of which is to re-review the approaches the project teams are taking to determine if the means and methods in the plan are appropriate, cost effective and still required.</li> </ul> <p>These could both be very effective in combatting the engineering issues that have occurred to date causing unforeseen scope and budget increases. However, their effectiveness will rest in the execution. Therefore, we encourage OPG to perform a self assessment on these two items before the end of this year to determine whether tweaks need to be made.</p> <ul style="list-style-type: none"> <li>• OPG should also consider additional scrutiny of scope solutions when project estimates during engineering are trending upwards, including: <ul style="list-style-type: none"> <li>○ Developing a “Rough Order of Magnitude” (ROM) test – ROM estimates of the engineered solutions should progress as the scope definition progresses and if the ROM estimate exceeds predefined control limits, triggers a review of the considered solutions.</li> <li>○ Refreshing the view of net present value and/or other project selection criteria.</li> <li>○ Questioning whether scopes of work that are driven by regulatory requirements and have experienced significant estimate increases</li> </ul> </li> </ul>	



	<p>OPG's own operating history and culture. This was evident with the polar crane package inside the plant. OPG left it to the vendors to discern what was needed. The vendors decided to replace all of the cranes, even though OPG's team determined only refurbishment, not replacement, was required.</p>		<p>are still cost effective. If not, request relief from the CNSC.</p> <ul style="list-style-type: none"> <li>○ Review the lessons learned from scope creep that occurred with the F&amp;I projects to determine whether additional controls are necessary.</li> </ul>	
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# **Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program**

**For the Quarter ending September 30, 2014**



Mike White  
CALM Management Consulting, Inc.  
October 9, 2014

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## **1. Minister Summary**

This report provides a quarterly review of trends, accomplishments and challenges related to the Darlington Nuclear refurbishment project.

### Changes from the Previous Quarter

The most significant changes from last quarter are:

- Art Rob replaced Terry Murphy as Vice President of the Projects & Modifications organization.
- The CNSC approved OPG's request for a one-year extension to the Darlington operating license to December 31, 2015. This extension results in a change in the milestone for the CNSC approval of the Integrated Implementation Plan (IIP) from December 31, 2014 to December 31, 2015. OPG is in discussion with the CNSC to ensure there is good alignment on the expectations for the IIP schedule and management of any changes to it.
- Work has started in the review of the individual work windows for the execution of the Unit 2 refurbishment outage. This work is identifying potential conflicts and sequencing issues for the development of the level 3 execution schedule.
- Recognition of the need to improve the performance by ESMSA contractors in the execution of the Campus Plan and Safety Improvement projects has been recognized by OPG senior management. Several actions are in progress.
- The Joint Venture successfully implemented a recovery plan for the design and manufacture of the prototype tooling. Although there are a remaining few tools to be delivered to the mock-up, they do not represent a barrier to the testing schedule at the mock-up.
- The draft 4d cost estimate calculated by the end of the quarter was within the bounding estimate of \$10B (including contingency and management reserve, but excluding interest and escalation). The final 4d estimate will be presented to the OPG Board in mid November. The realization of the assumptions and opportunities to close this variance will need to address through the Release Quality Estimate (RQE) process, which has a milestone date of October 15, 2015.

### Refurbishment Program Challenges

One objective of this oversight is to identify performance trends that require refurbishment management's attention to prevent the trends becoming significant issues. These are identified as Refurbishment Program Challenges. In general, refurbishment

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management is aware of these performance trends. These challenges have been reviewed with OPG refurbishment management, responses with specific actions will be developed and managed by refurbishment management, and this report will monitor the effectiveness of the implementation of these actions until the challenge is closed. This process will be followed for future refurbishment program challenges that are identified.

The current refurbishment program challenges are:

- The initial inputs provided by the individual projects and functions resulted in a total cost that exceeded the business case value of \$10B. Refurbishment management took actions to challenge these inputs, resulting in the 4d estimate remaining within the \$10B bounding estimate. The current challenge is for the sustainability of the assumptions and opportunities that are the basis for final 4d estimate during the development of the Release Quality Estimate (RQE).
- The management of engineering workload challenge is based on on-going weaknesses in the use of schedules and work down curves for the large amount of detailed design engineering work, the lack of monitoring effective quality indicators to identify and correct adverse performance trends, and benchmarking and management of the future cost of engineering.
- Without improvement in the contract management of the Campus Plan and Safety Improvement projects and ESMSA contractors, there is a challenge in having some of the projects completed when they are required. In addition, at least one of the ESMSA vendors has been awarded work for the Balance of Plant and Shutdown/Layup projects.

Conclusion on Readiness:

Although there are specific challenges that OPG needs to successfully overcome, they continue to have established the framework that is needed to be ready to successfully execute the refurbishment of the four Darlington units beginning with the first unit in October 2016. The basis for this conclusion is provided in Section 9.

A review (section 8) of the alignment of OPG's strategies, contracts, actions and decisions shows good alignment with the Ministry's principles for refurbishment that were described in the 2013 Long Term Energy Plan. The one gap area is the cooperation between the two nuclear operators. This will remain a gap until Bruce Power is further along in its planning for the refurbishment of its units.

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**2. Purpose of Report**

In February, 2013 CALM Management Consulting, Inc (CALM) was retained to provide independent oversight of the Darlington Refurbishment Project on behalf of the Ministry of Energy (MOE). This agreement includes a monthly report to the MOE to identify progress in preparations for the refurbishment of the Darlington nuclear units as well as potential challenges to the successful planning and completion of the project. In this case, as with similar projects, success is defined as the preparation and execution of 100% of the correctly identified project scope safely, on schedule, within budget and with quality. The monthly reports include the following areas:

- Changes from Previous Month
- Accomplishments and Progress
- Darlington Nuclear Refurbishment Scorecard
- Basis for Scorecard Ratings
- Refurbishment Program Challenges

In addition to these routine monthly reports, it is beneficial to review performance trends and to provide insights into additional areas. This is accomplished through a quarterly report that, in addition to the contents of the monthly report, provides a review in the following areas:

- Status of the individual projects
- A review of the issues identified by the independent external oversight team that reports to the OPG Board
- Insights into the leadership team and the cultures which it is developing
- A review of the efforts to meet the principles that were provided in the ministry's 2013 Long Term Energy Plan
- A review of the overall state of readiness

It is the belief of the MOE's Independent Oversight Advisor that the importance of the Refurbishment Program Challenges that are identified in Section 5 deserve consideration by OPG Refurbishment management. It is the intention to identify such challenges when they represent an early trend rather than wait until they become a significant issue. It is recognized that management may be taking actions to address these challenges and there may only be small gaps. However, it is appropriate that the

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Minister of Energy is aware of the strategy and/or actions to address the identified challenges and that the effectiveness of actions be monitored until closure of the challenge.

**3. Darlington Nuclear Refurbishment Scorecard**

**Darlington Nuclear Refurbishment Scorecard – September 2014**

	Current Month	Previous Month	Trend	Notes
<b>Safety and Regulatory Approvals</b>				
Personnel Safety	✓✓	✓	→	Good safety performance within the ore projects and minor incidents in the Campus Plan projects.
Radiological Safety	✓	✓	→	
Regulatory Approvals	✓	✗	→	Work in progress with CNSC to manage the IIP commitments
<b>Project Management Controls</b>				
Risk Management	✓	✓	→	
Scope Management	✓	✓	→	
Cost Management	✗	✗	→	Addressed high initial inputs to 4d estimate
Milestone Compliance	✗	✗	→	
Release Quality Estimate	✓	✓	→	
<b>Project Execution</b>				
Time Management	✓	✗	→	
R&FR Project Performance – Cost, Schedule & Quality	✓	✗	→	
Campus Plan Performance – Cost, Schedule & Quality	✗✗	✗✗	→	Schedules and cost estimates revised
Safety Improvement Opportunities Performance – Cost, Schedule & Quality	✗✗	✗✗	→	Schedules and cost estimates revised

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	<b>Current Month</b>	<b>Previous Month</b>	<b>Trend</b>	<b>Notes</b>
Engineering Performance – Cost, Schedule & Quality	xx	xx	→	Lack of work down curves and quality metrics.
Contractor Management	x	x	↗	Contracts issued for BoP and some S/D and Layup projects
Quality Management	✓	x	↗	Action plan in place.
Procurement Management	✓	✓	→	
Resource Management	x	x	→	
<b>Learning and Oversight</b>				
Operating Experience & Corrective Action	✓	✓	→	
Oversight	x	x	→	Missed opportunity to identify degrading trends before being a significant issue.

### 3.2 Basis for Scorecard Ratings

#### Personnel Safety - WHITE

Field performance in the R&FR project and manufacturing of refurbishment core project materials shows good safety performance. There has been a number of low level safety events associated with Campus Plan projects work. There has been a trend of incidents associated with vehicles.

#### Radiological Protection - WHITE

After the completion of the D1411 outage, there has been limited refurbishment work in radiological areas. The project is moving towards the development of ALARA plans for individual projects (such as R&FR) and the development of the RP services strategy. ALARA plans are likely 6 months to a year before they can be reviewed.

#### Regulatory Approvals – WHITE

Although acceptance of the Integrated Implementation Plan (IIP) will not occur until the renewal of the Darlington Nuclear Operating license for a 14 year period, scheduled for the end of 2015. In the meantime, there is indication that CNSC staff is in agreement



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with the content of the IIP, and OPG is working with CNSC staff to develop and implement a process for the management of changes to the IIP; either in terms of content or schedule. The other regulatory risk is the current court challenge to the Refurbishment project's Environmental Assessment.

**Risk Management – WHITE**

The Risk Management program has identified Nuclear Refurbishment Key Risk Areas, which are the result of an aggregate analysis of the risk registry. They have management sponsors who are responsible to monitor the progress of the individual risks associated the area for the development and implementation of mitigating action plans. These Key Risk Areas are:

- Availability/Retention of Key Staff (identified as a Red risk)
- Cost and Estimating Management (identified as a Red risk)
- Completion of Unit 2 Prerequisites (identified as a Yellow risk)
- Regulatory Approvals (identified as a Yellow risk)
- Fuel Handling Reliability (identified as a Yellow risk)
- Vendor Default/Continuity Planning (identified as a Yellow risk)
- Integrated Schedule Development (identified as a Yellow risk)
- Timely Procurement of Materials (identified as a Yellow risk)
- Completion of Engineering (identified as a Yellow risk)
- Integration with External Organizations (identified as a Yellow risk)

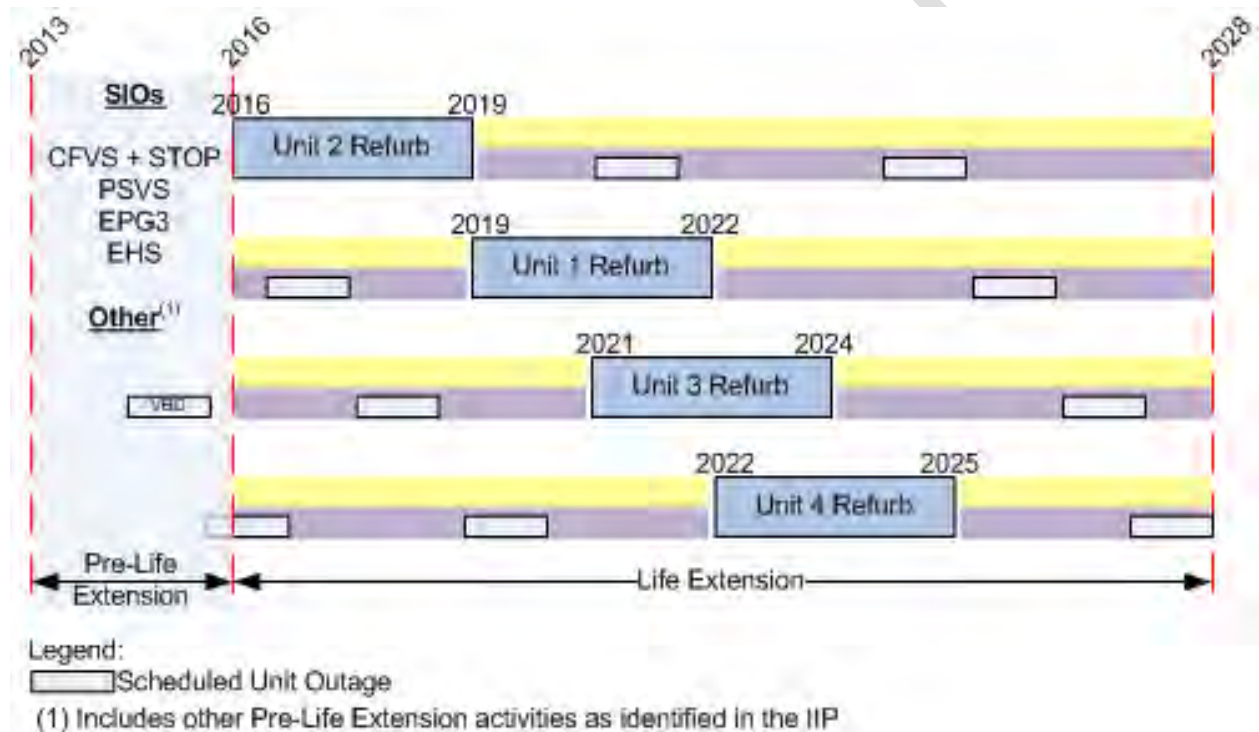
This identification of the Key Risk Areas is a positive step towards managing the known risks associated with the refurbishment program. The challenge now will be the necessary focus on these key risk areas to ensure that the post mitigation risk is low or acceptable with allocated contingency funding. With quarterly Risk Oversight Committee meetings, there would be 8 remaining senior management touches of these key risks to ensure they are sufficiently addressed prior to the start of the Unit 2 refurbishment outage.

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Scope Management - WHITE

The current strategy for the scope of the refurbishment outage relies strongly on the concept of 'life extension window'. The life extension window starts with the shutdown of the first refurbishment unit (Unit 2) and ends upon the completion of the first planned outage after the refurbishment of the last unit (Unit 4). This represents the twelve-year period from 2016 to 2028. This provides two planned outages, in addition to the refurbishment outage, to complete each unit's life extension commitments. The strategy is shown below.



This strategy is appropriate to maintain control scope of the actual refurbishment outage. On-going monitoring of any scope creep into the refurbishment outage will identify any deterioration of this performance. The currently approved dates and durations for each unit are summarized in the following table.

Unit	Start of Refurbishment Outage	Finish of Refurbishment Outage	Duration (months)	Overlap on Previous Unit
D2	October 2016	September 2019	36	
D1	October 2019	September 2022	36	0
D3	March 2021	February 2024	36	19
D4	October 2022	September 2025	36	17
Total Unit Outage Months (4 units)			144	
Refurbishment Window			108	

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Cost Management - YELLOW

Project to date total cost as of the end of August 2014 is \$1,284M, which is \$100M below the plan of \$1,348M. The \$100M below plan consists of delays in Balance of Plant, Shutdown, Layup & Services projects, and delays in progressing design engineering for Campus Plan and Safety Improvement projects.

Refurbishment management conducted challenges of the initial inputs from project bundles and functions through September to obtain a 4d estimate that is within the bounding cost estimate provided in the original 2009 business case. This estimate will be presented to the OPG Board in November 2014.

For the next year, the focus on costs for refurbishment management is to maintain cost estimates within the 4d estimate while completing the Release Quality Estimate by the milestone of October 15, 2015.

Cost challenges remains as one of the challenges for the refurbishment program, and thus more details are provided in Section 5, Most Significant Challenges.

Milestone Compliance – YELLOW

There are a large number of milestones associated with the refurbishment project. Refurbishment has not identified a single subset that it monitors on a routine basis. The monthly performance report has identified multiple versions of milestones that represent different levels of importance. This report will monitor progress for specific milestones that are critical to the start of the first unit's refurbishment. These are related to the completion of the Release Quality Estimate in October 2015. In addition, general compliance with milestones will be reviewed. There was one RQE milestone date within this quarter, the completion of Modification Design Requirements. The milestone was met in Q4, 2013. On the other hand, there were several missed low level milestones associated with the Balance of Plant, Shutdown/Layup and Services projects. These were a result of the delays in implementing their contracting strategy.

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**Release Quality Estimate Milestones**

<b>Milestone</b>	<b>TCD</b>	<b>Status</b>
MDRs Complete	August 15, 2014	These were completed in Q4, 2013 with a live 0 value of about 15 as discovery work is identified.
U2 Work Order Scope Definition complete	October 15, 2014	
Program Health Review complete	October 15, 2014	
U2 Outage Planning Organization complete	October 15, 2014	
U2 Pre-Outage Metrics prepared	October 15, 2014	
U2 Long Lead Materials identified	November 15, 2014	
Release 4D Estimate completed	November 13, 2014	
Integrated Implementation Plan (IIP) approved by the CNSC	December 31, 2014	This milestone is tied to the renewal of the Darlington Operating License for an extended duration, which has been moved to December 31, 2015. This delay impacts this milestone.
U2 Level 1 Rev B execution schedule issued	April 15, 2015	U2 Level 1 Rev A execution plan has been issued and is being revised as more details on work execution are provided.
U2 Design complete	May 15, 2015	
Success Plan Presentation	July 15, 2015	
U2 Design Documents complete	August 15, 2015	
U2 Work Order Scope Freeze	October 15, 2015	Scope is frozen at the higher level of Scope forms.
RQE & Release 5 Release issued	October 15, 2015	

**Release Quality Estimate - WHITE**

A plan to develop the Release Quality Estimate has been developed, with critical milestones identified. These are provided in the section Milestone Compliance. An RQE Risk Workshop was held in June to identify potential risks to meeting the individual milestones and thus the overall RQE milestone. The 4d estimate has been drafted with finalization and presentation to the OPG Board by November 13, 2014.

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Time Management - WHITE

Time management has improved during the third quarter. Improvements include:

- With the exception of the D<sub>2</sub>O Storage project, the Campus Plan and Safety Improvement projects have schedules that provide a reasonable level of confidence.
- The August refurbishment integrated performance report provides an overall schedule performance index (SPI) of 0.96 (which is a Green rating).
- The SPIs for the Campus Plan and Safety Improvement projects are provided as 0.95 (increased from 0.91) and 0.0.73 (an increase from 0.65), respectfully.
- Another indicator of completion of work is the number of work packages completed in a month versus the planned number. This has improved from 27 of 94 (29%) in July to 93 of 109 (49%).
- Work is continuing to refine the Level 1 execution plan for the Unit 2 refurbishment outage.

Re-tube & Feeder Replacement Project Performance - WHITE

In December 2013, the Joint Venture (JV) reported challenges in meeting its schedule for the design and production of prototype tooling. A recovery plan was developed and implemented to get back to acceptable performance by the end of September, 2014. The JV reported an SPI of 0.96 as of the end of August, 2014. By the end of September, there were 8 remaining tools out of more than 800 individual tools that were designed and manufactured. Each remaining tool has a recovery plan to completion and none of the remaining tools impacts critical path. This performance demonstrates R&FR's ability to identify an adverse trend before it becomes a crisis, work with the JV in the development of a recovery plan and have the JV successfully implement the plan.

The manufacturing of the major components is on schedule. To reduce the risk associated with single source for the pressure tubes and end fittings, OPG has had the JV obtain two manufactures for each of these major components. This will result in the manufacture of two sets of pressure tubes during the definition phase of the project. However, the second set will be used for the second refurbished unit.

Although progress is good on the R&FR project, there are several challenges that will need to be effectively addressed prior to the start of the Unit 2 refurbishment outage. These include:

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- The design and construction of the Retube Waste Processing Building (RWPB) are undergoing similar issues as the Campus Plan projects associated with the potential of underground services, as well as the management of potentially contaminated soil and water. The original target completion date of October 2016 is at risk and a revised date of January 2017 has been proposed. This new date provides very little buffer until the building will be needed to process fuel channels.
- The case for the R&FR mock-up was made on the opportunity it provides in the verification of tooling, the validation of associated procedures, optimizing the duration of each removal/install sequence, optimizing the radiological protection procedures and requirements, and the training of staff. The mock-up will need to be effectively used to realize this opportunity.
- The cost of the R&FR project represents a single largest contribution to the cost of the refurbishment Darlington Nuclear units. The JV's class 3 estimate resulted in an initial input into the 4d estimate significantly higher than the 4c estimate. This was reduced in for the 4d estimate through a number of opportunity assumptions. These need to be realized in the development of the JV's class 2 estimate and then the refurbishment's Release Quality Estimate.
- The R&FR project management organization conducts oversight of the deliverables associated the deliverables of the JV and its subcontractors. There is considerable oversight of the development of Class 2 estimate, including the OPG independent external oversight team and a third party hired by the JV. There currently is no plan to conduct a broad based assessment of the R&FR project's readiness for refurbishment. Given the operating experience from previous refurbishment projects and the critical nature of the project to the overall success of Darlington's the refurbishment, the benefit of such an assessment should be reviewed.

**Campus Plan Performance - RED**

The performance of the Campus Plan projects continues to be a significant challenge to OPG and is describe in details provided in section 5.

**Safety Improvement Opportunity (SIO) Projects Performance – RED**

The performance of the SIO projects continues to be a significant challenge to OPG and is describe in details provided in section 5.

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Engineering Performance - RED

Management of the upcoming engineering workload continues to be a significant challenge, with details provided in Section 5.

Contractor Management - YELLOW

The main challenges related to Contractor Management are captured with the issues related to the Campus Plan and SIO projects, and Engineering Performance

The R&FR, Fuel Handling and Turbine Generator projects have a routine senior management steering committee meeting to review performance, as well as periodic executive oversight committee meetings that include the Chief Executive Officers of OPG and the contractors' companies.

Although contracts have been awarded, the remaining core projects have not sufficiently progressed to provide good insight of performance. The challenge will be to obtain improved performance using the ESMSA contractors as compared with the Campus Plan and SIO projects. [REDACTED]

[REDACTED] As a result, contractor management is rated Yellow.

Quality Management - WHITE

With the current EPC contracting strategy, OPG needs to develop the capability to manage the quality of work performed by its contractors. Refurbishment management's response to this need challenge is through a combination of project management activities, oversight activities by the project management team, supply chain procurement audits and assessments, and audits conducted by teams within the refurbishment organization and other OPG organizations. Through an Oversight Steering Committee, management has started the shift from a focus on doing oversight activities to their quality and lessons learned. This shift is too early to the performance improvement for the next performance level. There is currently an initiative to integrate the various quality management activities and risk management into a single platform in order to more easily implement the program and review the results.

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Procurement Management – WHITE

With the exception of the radiation protection services contract, all major contracts have been awarded. The late awarding of the contracts for the Balance of Plant and Shutdown/Layup projects will challenge the vendors and OPG to meet the completion of engineering milestone. The long lead materials for the R&FR project have been ordered for Unit 2. The Supply Chain is engaged in assessing and monitoring the procurement process used by the main contractors of a project in selecting and managing subcontractors. The results of this process are evident in improvements in the quality management of subcontractors demonstrated by the R&FR Joint Venture and ESMSA contractor, ES Fox. In addition, the Supply Chain provides a monthly report on the status of quality issues and restrictions for each of the main vendors.

Resource Management - YELLOW

The availability/retention of key project staff is identified as one of the program's Key Risk Areas. It consists of:

- The possibility of limited skilled trade resources and supervision for project execution as its highest program risk. Currently the trades unions predict that there may be a total shortfall of approximately 50,000 personnel during the duration of the Darlington refurbishment. They have also identified poor progress in increasing the number of journeypersons in several trades. The current rate of individuals moving from the apprenticeship program to become is a journeyperson is 18% - 20%. It is recognized by all parties that this must improve. The Darlington VP of Execution is leading an initiative that includes the unions, OPG and its main contractors to address this potential shortfall.
- The potential that project leadership and specialized resources are not in place when required. There are a number of initiatives under development to reduce the significance of this risk. Refurbishment management is constrained its ability to implement the corporate policies and procedures that have been developed for operating facilities and small projects for this mega project.
- The possibility of an insufficient number of Authorized Staff for both station and refurbishment needs. This is being addressed through a combination of increased number of candidates for the associated positions as well as challenging the extent of the need for such staff once the unit is defueled and isolated through the bulkhead.



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- The potential of an insufficient number of qualified radiation protection coordinators to support project execution. This should be addressed through the awarding of the radiation protection services contract.

Corrective Action Program and Use of Operating Experience – WHITE

There have been no changes to the performance in the areas of the Corrective Action Program and Operating Experience. OPG has implemented several high level lessons learned from previous refurbishment projects; including Browns Ferry, Pickering A and Bruce A. These include the need for detailed planning and preparations prior to the start of execution of the project, the need for an integrated schedule, the project reporting to the Chief Executive Officer and the use of a reactor mock-up to verify re-tube tooling and train staff. In addition, there has been an improvement in the identification and distribution of lessons learned throughout the refurbishment organization. These are reviewed by the refurbishment leadership team in its monthly Corrective Action Review Board meeting. There is one area of operating experience for which the manner that the project has implemented is unclear. That area is the review and incorporation of appropriate Significant Operating Experience Reports and equivalent. These are reports issued by WANO (World Association of Nuclear Operators) and INPO (Institute of Nuclear Power Operations) related to significant adverse trends within the industry and they provide both the causes and required actions by individual plants.

The Corrective Action Program is in place and is being used. The majority of issues adverse to quality have been identified in the engineering activities. This is not surprising since engineering represents the most active function at this time. Although the refurbishment CAP program is good, the program implemented by the Projects and Modifications (P&M) organization has several known weaknesses. This should be a concern to the refurbishment organization since the Campus Plan and SIO projects are being managed by the P&M organization and thus conditions adverse to quality are managed through its CAP.

OPG Oversight – YELLOW

The effectiveness of the OPG independent external oversight team (BMcD/Modus) to identify adverse performance trends is adversely impacted by the a certain loss of independence resulting from their providing detailed advice, direction and support to the refurbishment management team.

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**4. Accomplishments and Progress**

The following accomplishments were achieved during the third quarter:

1. Project to date total cost as of the end of August 2014 is \$1,284M, which is \$100M below the plan of \$1,348M. The \$100M below plan consists of delays in Balance of Plant, Shutdown, Layup & Services projects, and delays in progressing design engineering for Campus Plan and Safety Improvement projects. The project's CPI is 1.01 and SPI is 0.96. These values include the available information for the Campus Plan and safety Improvement Opportunity projects.
2. Work on the 4d estimate has resulted in the current value being within the bounding estimate of \$10B (2013\$). This estimate is an important input for the Release Quality Estimate (RQE). The sustainability of the 4d estimate as compared with the initial inputs from the project bundles and functions is essential for the successful development of the RQE.
3. Actions continue to address the performance issues related to the engineering and execution of the Campus Plan and Safety Improvement projects. The key actions include:
  - a) Collaboration between OPG and the ESMSA contractors in the conceptual design, schedule development, cost estimate and planning.
  - b) Resident engineers located with the ESMSA engineering contractors to provide real time resolution of questions and timely review and approval of engineering products.
  - c) Weekly progress meetings with senior ESMSA and OPG management. Currently this is focused on Black & McDonald projects, with ES Fox being started on July 16<sup>th</sup>. At that time each contractor will be reviewed every second week. This oversight will include a monthly CEO meeting with OPG and the two ESMSA contractors.
  - d) Cost estimates and level 3 schedules have been submitted for these projects, with the exception of the D<sub>2</sub>O storage building.
4. Work has started on the Joint Venture's class 2 estimate. The process and schedule have been established for its completion by the milestone of June 15, 2015.
5. Good progress was made in the development of a province-wide nuclear projects agreement with the EPSCA unions. All but two trade unions have agreed with

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the agreement. The agreement will be for 32 years in order to cover OPG and Bruce projects and has a clause for no strikes and no lockouts.

6. Although Joint Venture did not complete 100% (over 96%) of the tooling prototypes by September 30, there progress in implementing the tooling recovery plan (starting in December 2013) is considered a successful demonstration of the ability to identify and respond to an adverse performance trend before it becomes a crisis.
7. The CNSC accepted the OPG request to extend the operating license for Darlington Nuclear Station for one year, extending it to December 2015.

**Refurbishment Program Challenges**

Throughout the life of refurbishment program specific challenges have been, and will be, identified that in the belief of the Independent Advisor to the Minister of Energy should have actions by OPG Refurbishment Management to address them, before they become significant issues. The currently identified Refurbishment Program are related to program cost controls, the management of engineering workload, and contractor management of the Campus Plan and Safety Improvement Opportunity projects.

Cost Challenge

The initial inputs provided by the individual projects and functions resulted in a total cost that exceeded the business case value of \$10B. Refurbishment management took actions to challenge these inputs, resulting in the 4d estimate remaining within the \$10B bounding estimate. The current challenge is for the sustainability of the assumptions and opportunities that are the basis for final 4d estimate during the development of the Release Quality Estimate (RQE).

The initial inputs provided for the 4d estimate resulted in a total project cost that was \$2.235B greater than the 4c estimate as of August 11, 2014). This was exclusive of interest and escalation. In response to this challenge, senior refurbishment management established an enhanced process to review the inputs in the development of the class 4d estimate. This included initial challenge meetings of each project and function by a mid-management team to identify potential savings. This was followed by further challenges by senior management on the assumptions and bases made for each function and project.

The process that was used to challenge the individual inputs from the projects and functions has resulted in a current 4d refurbishment program total cost of \$7,653M or \$7,500M (\$2013) plus contingency and management reserve, and excluding interest and escalation. This is within the \$10B bounding estimate. The sustainability of the basis of

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the 4d cost estimate through the development of the Release Quality Estimate will be monitored by the MOE Independent Oversight Advisor through:

- Identify any additional changes to the 4d estimates for each of the project bundles and functions.
- Review refurbishment management's basis document 4d estimate for the project bundles and functions.
- Monitor the progress of the resulting actions to realize the assumptions and opportunities credited in the above basis.
- Monitor the progress of reviewing the generic issues (opportunities) identified by OPG through this challenge process and the progress of implementing any resulting beneficial actions.
- Monitor the incorporation of the basis document from the 4d estimate into the development of the Release Quality Estimate (RQE).

Management of Engineering Workload

The challenge associated with the management of the large engineering workload has been identified in monthly reports to the MOE since June 2013. This was based on several observations; including the underestimation of the scope of work for the Modification Design Requirements (N-2013-01589), the initial rejection of the Plant Condition Assessment submission to the CNSC because of quality issues (N-2013-20839), the start of construction of Campus Plan projects without design engineering being nearly completed, a cumbersome OPG review and approval process for engineering deliverables resulting in delays, increased costs and rework, several examples of design rework in Campus Plan and Safety Improvement projects, rework and cost increases in the re-tube waste containers resulting from errors in shielding calculations, and the delay in awarding contracts in the Shutdown/Layup and Balance of Plant contracts resulting in a challenge to meet the May 2015 milestone for the completion of engineering.

In Q2, 2014, refurbishment senior management recognized the issues related to engineering and initiated interim actions and a root cause investigation. The focus of the improvement actions is the implementation of a collaborative approach to planning (preliminary engineering, scope definition and cost/schedule estimations) and detailed design engineering. This has resulted in examples of shorter review cycles for approval of an engineering package by the Design Authority.

However, there has not been sufficient progress in the management of the engineering workload to remove the current challenge. The continuation of this challenge is based on on-going weaknesses in the management of engineering scheduled work to ensure

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overall ability to complete the workload, monitoring quality of the engineering work to identify and correct adverse performance trends, and management of the cost of engineering.

Schedule Issues. There is currently no detailed schedule or work down curve at the individual detailed design engineering package level for the total engineering workload. This is required to manage the progress of engineering to meet the engineering complete milestone. The scope of engineering includes the core refurbishment projects, the Campus Plan projects and the Safety Improvement Opportunity projects. Revising detailed design engineering milestones for Campus Plan and SIO projects has been frequently done. The engineering complete forecast date for the Retube Waste Processing Building (RWPB) for the R&FR project is now July 15, 2015 versus the contract date of March 15, 2015. During September 5 of 15 engineering packages were completed for the Auxiliary Heating System project. Refurbishment management is working to develop a detailed engineering schedule and work down curve at the individual engineering change package level.

Quality Issues. Engineering is currently being conducted without effective quality performance indicators. Engineering errors are considered latent errors because they normally do not show the consequence until construction, commissioning or operations. That is the basis for the need for quality indicators that measure breakthrough events (such as rejection by the regulator or Design Authority), significant rework events, events involving cost increases and significant comments. Without effective quality indicators, senior management is not able to monitor the current performance and trend in this area. It is recognized that engineering is currently working on an indicator. During Q3, 2014 examples of quality issues have been identified that would be inputs into a quality indicator; including:

- D<sub>2</sub>O storage building project documents were submitted to the TSSA (regulator for pressure boundary approvals) that were immediately returned because signatures were not on the documents, some documents were missing and some assumptions were not verified by the component's manufacturer. (SCR N-2014-22003)
- An engineering design package for the D<sub>2</sub>O storage project had 47 deficiencies when submitted to OPG. This was considered a breakthrough event by the design agency's senior management. (N-2014-22018)
- After installation of a transformer associated with the RFRISA project it was identified that the grounding design may not be acceptable, since it may directly connect the station grounds to the site facilities grounds. (N-2014-

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22830) Although identified as a potential issue in mid July, resolution has not been secured by August month end. A High Impact Team has been formed to determine the adequacy of the current design. If the design is found to be unacceptable, there will be considerable rework in both the design and construction of the facility. If it is found to be acceptable, it is a significant near miss.

- A package for the Containment Filtered Venting System (CFVS) was submitted to the TSSA regulator requesting a code relaxation. The package was returned because it was not complete.
- The design of STOP has to be reworked since it did not include the need for anchors within containment. This was discovered after the design was approved and installation work plans under development.

Cost Issues. Although each project has the budget for its engineering, there is no source for the aggregate cost of future engineering for the refurbishment project. Although not essential to manage the refurbishment project, the total cost estimate for engineering would be a useful benchmark comparison to determine value of the current engineering direction and opportunities to reduce overall engineering costs.

Contractor Management of the Campus Plan and Safety Improvement Projects

Without improvement in the contract management of the Campus Plan and Safety Improvement projects, there is a challenge in having some of the projects completed when they are required. This challenge has been identified in the monthly reports to the MOE since April 2013. For example, there is sufficient in the readiness of the Auxiliary Heating System project (current AFS of June 2, 2015) to be ready for the 2015 Vacuum Building Outage (April 2015) that the station has done sufficient refurbishment of the current Boiler House to credit it for the outage. There is sufficient uncertainty in the D<sub>2</sub>O Storage Building being completed by the start of the Unit 2 refurbishment outage (current completion date is January 2017) that senior refurbishment management has initiated contingency planning. Both of these represent prudent decisions. However, the fact that they are needed reinforces the challenge associated with managing the contractors associated with these projects.

OPG senior management has taken actions to address the ESMSA performance related to these projects. These include:

- A new VP of P&M organization was brought in July, 2014.

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- The performance review of the Campus Plan and Safety Improvement projects is intended to be included in the Refurbishment Project's monthly oversight meeting – although this has not been fully implemented.
- There are weekly oversight meetings between OPG senior project management and ESMSA contractors' senior management to review the status of the projects and issues that need to be resolved.
- There has been improvement in the conduct of the daily project meeting; although there is detailed execution schedule and integration is limited.
- The collaborative approach to planning and engineering has made inroads in shortening the duration for the review and approval process for engineering products. However, engineering delays are still very common and quality issues results in a fair amount (although not measured) of rework.
- Detailed schedules and cost estimates have recently been completed for the Campus Plan and Safety Improvement projects. The D<sub>2</sub>O storage project is still under review.

A common observation is that the CPI and SPI values produced by OPG in its monthly program monitoring are significantly different (and poorer performance) than those provided by the ESMSA contractors in the bi-weekly reports for the oversight meetings. Because of the large variance, they have CPI/SPI performance is not included in this report.

The need for improvement in the management and performance of the ESMSA contractors is needed to increase the confidence that the projects will be completed to the revised schedule and completed when required. In addition, work for the core refurbishment projects has been awarded to one of the ESMSA contractors as well as the Joint Venture (beyond the R&FR and Turbine Generator projects). Improved performance in the execution of the Campus Plan and Safety Improvement projects will provide some confidence in the planning and execution of these core refurbishment projects.

## **5. Status of Individual Projects**

The Darlington Refurbishment Program consists of seven individual projects and a number of infrastructure projects (also called Campus Plan) and Safety Improvement Opportunity projects:

- Re-tube and Feeder Replacement (RFR)
- Fuel Handling/Defueling (FH)
- Turbine Generator and Controls (TG)

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- Steam Generator and Auxiliary Systems (SG)
- Balance of Plant (BOP)
- Islanding
- Shutdown, Layup and Services
- Campus Plan
- Safety Improvement Opportunities Projects

**5.1 Re-tube and Feeder Replacement Project**

The Re-tube and Feeder Replacement (RFR) project represents the largest scope and cost component of the Darlington Refurbishment Project. The RFR project will define the project's critical path and thus duration. As demonstrated by the schedule delays, cost overruns and performance issues in previous CANDU refurbishment projects, the RFR project also represents the largest risk to the project being completed on schedule and on cost. Thus, understanding the lessons learned from these previous refurbishments and the risks for this project is essential for developing the RFR project plan, schedule and cost estimates. The RFR project consists of the removal and replacement of 480 pressure tubes, 480 calandria tubes, 960 end fittings and 960 feeder pipes for each of the Darlington four units. This requires the development, testing, manufacturing and maintenance of specialized tooling; the generation and verification of specialized procedures; and the training of the staff that will perform the field work. The project also includes the construction of a realistic reactor mock-up for the purposes of tooling testing, procedure verification and staff training.

In March, 2012, OPG awarded the RFR contract to the SNC Lavalin/Aecon Joint Venture Agreement (JV Agreement). The contract is for the Definition Phase of the RFR project from early 2013 through mid-2016. The value of the contract is estimated to be over \$650 million. As of the end of August, 2014, the project has spent \$399M.

The accomplishments for this quarter are:

- The tooling schedule recovered from the low SPI of 0.71 in December, 2013 to 0.99 as of the end of September.
- The tooling prototype complete milestone of September was not met as a result of eight smaller tools not being manufactured. There is a schedule to meet this milestone in November. With more than 95% of the tools manufactured, this delay will have no impact on critical path.



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- Tool Performance Guarantee (TPG) testing at the mock-up has started.
- The March 30, 2015 milestone for the completion of modification engineering is at risk due to a few modifications. However, a recovery plan has been developed, and the risk will not likely have an impact on critical path to the start of unit 2's refurbishment outage.
- The long lead materials, such as end fittings, pressure tubes and feeder piping) have been ordered and delivery dates are planned to be met.
- The completion of the RWPB is tentatively scheduled for January 2017. This date leaves little room for delays; as it is very close to the date it will be needed to receive re-tube waste for processing.
- Work on the class 2 estimate (cost and schedule) has started. The process includes detailed involvement of OPG through the process as well as on-going independent audit of the process by Berkeley Research Group.

## **5.2 Fuel Handling/Defueling Project**

This project consists of two main subprojects – the defueling of the reactor to start the outage and the refurbishment of the fuel handling equipment and associated systems. An initial contract has been awarded to GE-Hitachi for equipment supply and technical support during the planning and execution of the defueling subproject.

The most significant risk with this project is the reliability of the fuel handling equipment. At the current performance level, the equipment is challenged to meet current operational demands to fuel four operating units. However, the reliability will need to improve to meet the required duration to defuel the reactor, for installation of the bulkhead, and to support the fuel handling refurbishment schedule. Darlington station and refurbishment management initiated an upgrade project in the first quarter of 2013. Work progressed as planned during the third quarter of 2014. In particular, the coarse drives for each of the fuel machine trolleys have been repaired.

Although progress has been made on this project, the reliability of the fuel handling equipment remains as a significant concern for the project's executive steering committee, which includes the CEO of OPG and senior executive of GE Hitachi. A requirement for demonstration of the ability to fuel three units with two fuel handling trolleys for a long duration has been established. This is to simulate the required performance of the machines during the defueling of Unit 2.

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**5.3 Turbine/ Generator Project**

The scope of the Turbine/Generator includes:

- Steam Turbines and Turbine Auxiliaries: inspections, repairs, and/or replacements of generator components (including generator stator rewind) and a number of generator auxiliaries,
- Steam Turbines and Turbine Auxiliaries: inspections, repairs, and/or replacements of High Pressure (HP) and Low Pressure (LP) turbine components and a number of turbine auxiliaries;
- Moisture Separator Reheater (MSR): inspection, overhaul, and/or replacements of MSR internals and auxiliaries (e.g. strainers, valves);
- Turbine Control Upgrade: replacement of the obsolete analogue Steam Turbine Electronic Control (STEC) System, includes entire Turbine Supervisory System with modern design (digital system); and
- Generator Excitation Upgrade: replacement of the analog Generator Excitation system controls with a digital design and a set of additional Generator Excitation and Protection equipment to resolve obsolescence issues.

A contract was awarded to Alstom for the design and delivery of the digital controllers as well as technical support during the execution of the project. The design work by Alstom is progressing on schedule.

The TG engineering integration and field installation vendor (SNC/Aecon Joint Venture) has submitted a class 3 cost estimate and a level 4 schedule for field execution. They are under review by the OPG project team. There are likely opportunities to reduce proposed costs by building on the available synergy from having the JV perform field execution for both the RFR and TG projects. This should result in a reduction in the number of project management personnel and the use of trades' staff on both projects.

The decision to swap the unit 1 and unit 3 refurbishment outages has a potential cost increase as does the decision to defer the installation of Unit 2's digital controllers to a future outage. Both of these decisions are prudent based on Unit 3 fuel channel life considerations and reduction of overall risk for the Unit 2 outage.

**6.4 Steam Generators**

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The Steam Generator Engineer Procure Construct (EPC) contract has been awarded to a consortium of Babcock & Wilcox Canada and Candu Energy Inc. The project consists of maintenance activities and modifications to meet the requirements of its Life Cycle Management Plan. This includes:

- Tube sheet water lancing to address possible degradation from sludge accumulation
- Installation of access ports to improve secondary side inspection capabilities for future inspection outages
- Primary side tube cleaning to improve overall thermal efficiency, increase neutron overpower margin and reduce radiation fields
- Divider plate leakage characterization to establish a baseline for cross flow between the cold and hot legs of the SGs
- Primary and secondary side ultrasonic, eddy current and visual inspections

Currently engineering work and testing are progressing as scheduled.

#### **5.4 Balance of Plant Project**

The Balance of Plant (BOP) scope consists of plant modifications and maintenance work in the following areas:

- Pre-refurbishment work
- Safety and Control Systems
- Reactor component systems
- Conventional Systems
- Common Systems

The changes to the contracting strategy for the BOP delayed the awarding of the contracts and the start of engineering. Although improvements are in progress to address the performance problems associated with the ESMSAs' execution of the Campus Plan and SIO projects, the use of the ESMSA contractors remains a risk, even though reduced. The risk is further reduced through the requirement for a separate project team for the BOP work than for the Campus Plan and SIO work. In addition,

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The impact of the late implementation of the strategy is a large risk to meeting the May 2015 milestone for the completion of engineering.

#### **5.5 Station Readiness Projects**

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There are a number of core refurbishment projects that are critical to support the refurbishment of the unit, but do not provide refurbishment of equipment. These are:

- Islanding projects. These projects are required to establish the physical and administrative separation of the refurbished unit from the operating plant, as well as separate a number of common areas for the duration of the refurbishment outage.
- Shutdown/Layup projects. These projects are in place to shutdown and layup individual systems at different stages and for different durations through the unit's refurbishment outage. This is required to protect the systems against corrosion and other damage mechanisms when not in normal operation.
- Services projects. These projects provide the needed services to support the unit's refurbishment outage. Such services include electrical, breathing air, service air, instrument air, and water.

In general, the Islanding projects are making use of the other contracts that align with its work in the same or adjacent area. For example, the EPC contract for the installation and removal of the bulkheads has been awarded to the R&FR Joint Venture. This is a sound decision since the JV has the most to gain from the timely installation of the bulkheads, there is elimination of coordination issues in the vault, and the required capabilities for the two projects are similar.

Since the strategy to perform the Shutdown/Layup and Services projects is the same as for the BOP projects (use of the ESMSA contractors), the issues, response and risks that were identified under BOP also exist for these projects.

## **5.6 Campus Plan and Safety Improvement Opportunities Projects**

The Campus Plan represents a number of infrastructure projects to support the refurbishment of the Darlington units. In addition, the campus plan includes the Safety Improvement Opportunity projects that OPG committed to the Canadian Nuclear Safety Commission (CNSC) through the Environmental Assessment process. The Campus Plan projects are being executed by the two ESMSA contractors and managed by the Projects and Modifications (P&M) organization on behalf of Darlington Refurbishment and include the following projects:

- D<sub>2</sub>O Storage Building
- Low Pressure Service Water Line Relocation
- Water and Sewer Upgrades

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- New Maintenance Facility
- Auxiliary Heating System
- Refurbishment Island Annex
- Power and Electrical
- OSB Refurbishment
- Emergency Power Generator #3 (Safety Improvement Opportunity)
- Powerhouse Steam Venting System (Safety Improvement Opportunity)
- Containment Filtered Venting System (Safety Improvement Opportunity)

These projects must be completed prior to the first unit's outage. The sheer amount of work associated with these projects represents a risk to the refurbishment project. It has taken close to a year for refurbishment management to recognize the severity of the challenge. The external oversight team identified significant issues related to the Campus Plan projects (specifically the D<sub>2</sub>O Storage Building and the Auxiliary Heating System) in its May 13<sup>th</sup> report to the OPG Board. This represented the accumulation of an adverse trend that was identified in early 2013 to a significant issue that was identified in early 2014, with the start of being address during the second quarter and has continued through the third quarter. The main actions that have been initiated in response to the issue are:

- Collaboration between OPG and the ESMSA contractors in the conceptual design, schedule development, cost estimate and planning.
- Resident engineers located with the ESMSA engineering contractors to provide real time resolution of questions and timely review and approval of engineering products through detailed design engineering.
- Weekly progress meetings with senior ESMSA and OPG management. Each contractor is reviewed every second week. In addition, this oversight includes a routine CEO meeting with OPG and the two ESMSA contractors.
- Development of improved cost estimates and execution schedules (Level 3) for refurbishment projects performed by the ESMSA vendors. This includes the projects managed by the Projects & Modifications organization – Campus Plan and Safety Improvement projects. With the exception of the D<sub>2</sub>O storage project, theses have been done.

In conclusion, the Campus Plan and Safety Improvement projects are behind schedule and thus poise a risk to the start of Unit 2's refurbishment outage. OPG refurbishment

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management has initiated actions to drive improvement in the performance of the ESMSA contractors.

**6. Oversight of the Darlington Refurbishment Program**

Both OPG and the Ministry of Energy (MOE) understand the need for a successful refurbishment for the Province, the company and the industry. In line with that importance, the Minister of Energy established the role of independent advisor and OPG established the role of an external independent oversight team reporting to the OPG Board. This team consists of individuals from the companies Burns & McDonnell and Modus.

The OPG external independent oversight team issued its Q3 report to the OPG Board in August 2014. A summary of the issues and status identified in the report and alignment with the MOE's reports is provided in the following table:

<b>OPG External Oversight Assessment</b>	<b>MOE Assessment</b>	<b>Comments</b>
Campus Plan projects remain significant risks to the overall refurbishment project.	Both the Campus Plan and Safety Improvement projects are identified as Refurbishment Program challenges.	Consistent alignment between the two groups.
RQE development is on schedule, with the 4d cost estimate being an essential step to RQE. Variances with 4c will need to be explained.	The challenge to maintain the cost within the bounding estimate of \$10B is identified as a Refurbishment Program challenge. The 4d retained the bounding estimate. Focus will be placed on the resolution of the variances between the initial inputs and final 4d estimate.	Slightly different focus between the two groups focus on variances; 4c vs. 4d and initial inputs into 4d and final 4d estimate.
In general good progress in the R&FR project, with the exception of the delays in the RWPB, which is facing similar problems as the Campus Plan projects.	In general good progress in the R&FR project, with the exception of the delays in the RWPB, which is facing similar problems as the Campus Plan projects.	Good alignment between the two groups.

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<b>OPG External Oversight Assessment</b>	<b>MOE Assessment</b>	<b>Comments</b>
The planning of engineering work has moved to green based on OPG taking a more active role in direction and managing the work at engineering studios, the bottoms-up estimating for engineering activities and increased focus on engineering activities.	Remains as a program challenge and red rating due to the lack of a detailed engineering schedule or work down curve at the EC level, lack of metric to measure quality of deliverables and not fully understanding the cost of engineering. The lack of effectively managing the engineering workload challenges meeting the engineering complete with quality.	There is not alignment between the two groups in the progress made in the engineering function.
Concern remains over the ESMSA contractors' performance and the ability to execute the BOP work.	Concern remains over OPG's performance in managing the work of the ESMSA contractors to meet high performance standards related to safety, quality, cost and schedule.	There is good alignment in this area.

**7. Alignment with the Principles of the Long Term Energy Plan**

The MOE's 2013 Long Term Energy Plan identified seven principles by which it expects OPG and Bruce Power to follow in the development and execution of their respective units. The following table provides observations which demonstrate alignment by OPG as well as opportunities for additional alignment.

<b>Principle</b>	<b>Observations of Alignment</b>	<b>Possible Opportunities</b>
1. Minimize commercial risk on the part of ratepayers and government.	<p>The majority of DNR contracts are fixed/firm price with the remaining tied to cost and schedule performance.</p> <p>Commercial risk is mitigated through the use of stakeholder review committees and approval processes to support commercial controls at several phases of each</p>	Incentives in the RFR contract were developed and established on the basis of four unit performance, allowing the RFR contractor to make-up cost overruns and schedule delays to the first unit on subsequent units. However, the LTEP prioritizes the urgency of a success on Unit 2.

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Principle	Observations of Alignment	Possible Opportunities
	<p>project.</p> <p>Risk management process includes commercial risk.</p> <p>Commercial individuals embedded on each project team to manage commercial risk.</p>	
2. Mitigate reliability risks by developing contingency plans that include alternate supply options if contract and other objectives are at risk of non-fulfillment.	<p>One DNR contingency action contributing to this principle is the decision to start the second unit after unit 2, rather than overlapping the units. In addition, the effort to improve the reliability of fuel handling equipment reduces the chance that fueling of the operating units will be reduced during the defueling of the refurbishment unit.</p>	
3. Entrench appropriate and realistic off-ramps and scoping.	<p>Each contract has an off-ramp for termination. Reimbursement limited to reasonably incurred costs.</p> <p>A scope review by senior management was completed in Q4/13 to reduce scope to work required for life extension or can only be done in drained/defueled state.</p> <p>Management acknowledges the potential of an off-ramp being implemented and used in communications with staff.</p> <p>The yearly release strategy and gating process for funding individual project initiatives has wide visibility and adherence within the DR Team.</p> <p>The contract with SNC/Aecon includes provisions that allow OPG to take over the tooling and the mock-up at the conclusion of the Definition Phase if the parties are unable to negotiate the target price contract for the Execution Phase.</p>	<p>Ensuring the scope that is required for life extension, though performed outside of the DR Project, is staffed, funded and executable.</p>



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Principle	Observations of Alignment	Possible Opportunities
4. Hold private sector operator accountable to the nuclear refurbishment schedule and price.	Not included in this oversight.	
5. Require OPG to hold its contractors accountable to the nuclear refurbishment schedule and price.	<p>Schedule accountability is built into each contract. The contractor is required to provide a detailed schedule for planning (and later execution). This schedule is reviewed monthly during planning phase.</p> <p>Cost accountability is built into contracts to establish target cost and incentives/disincentives.</p> <p>Monthly senior level meetings OPG are improving its oversight to monitor performance.</p> <p>Each OPG project team includes Project Controls member to monitor and report cost and schedule performance.</p> <p>OPG has chosen to perform the work in the Execution Phase on a target price basis which increases the contractors' transparency. This will enhance OPG's ability to resolve issues as they arise.</p> <p>There is an executive steering committee for major projects that includes the CEOs and senior executives of OPG and he contracted vendors.</p>	<p>The estimating process has undergone changes as a result of the significant variances between the contractors' estimates and OPG's estimates.</p> <p>The RQE will require work to reduce the assumptions by contractors that contribute to potential higher than planned contract values.</p>
6. Make site, project management, regulatory requirements and supply chain considerations, and cost and risk containment the primary factors in developing the implementation plan.	<p>Site and regulatory requirements are the inputs to the defined scope.</p> <p>The program is being managed in accordance with PM Institute standards and INPO project principles.</p> <p>Cost estimate process used Association for Advanced Cost</p>	<p>Improve the ability to identify and address adverse trends in performance in a timely and effective manner.</p> <p>The station and refurbishment project are developing an agreement on the condition that the unit will be turned over to the project and the condition it will be</p>

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Principle	Observations of Alignment	Possible Opportunities
	<p>Engineering (AACE) best practices. Cost estimate is understood by team and the cost ceiling is routinely communicated to staff.</p> <p>Risk management is recognized as a key element of success, a program is in place, but its implementation requires improvement.</p>	<p>returned to the station.</p>
<p>7. Take smaller initial steps to ensure there is opportunity to incorporate lessons learned from refurbishment including collaboration by operators.</p>	<p>To fully incorporate lessons learned from the first unit's (Unit 2) refurbishment, the second unit's (Unit 1) start has been delayed until the completion of the first unit.</p> <p>If appropriate, other units may be able to be delayed to continue this risk reduction. However, this will likely result in an overall increase in cost.</p> <p>To reduce risk for the first unit, the decision was made to install its digital controller in a future outage.</p> <p>To prevent the risk associated with single source suppliers of key reactor components, OPG has qualified second vendors for key components. This will help Bruce Power with an associated materials risk.</p> <p>OPG and Bruce Power are working successfully to develop a long term agreement with the trades union to ensure uninterrupted execution of the projects.</p> <p>Bruce Power VP of projects is scheduled to visit Darlington refurbishment for benchmarking.</p>	<p>The opportunity to seek out opportunities with Bruce Power has not been fully started, and will not likely be seen until Bruce Power develops its plan and schedule for refurbishment of its units.</p>

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**8. State of Readiness**

The Nuclear Refurbishment program is fully into its Definition Phase to support the successful execution of Unit 2, starting in October 2016. There are several areas that provide high confidence that the organization is tracking to a high state of readiness by this time; including:

- Regulatory approvals have been received for the Environmental Assessment, Integrated Safety Review, and the Global Assessment Report. Although there have been recently identified actions required for the approval of the Integrated Implementation Plan (IIP), they do not represent a significant risk to the project. Since the IIP and Darlington's request for a 14-year license are together, OPG has decided to request the CNSC for a one-year extension to its current license. This should provide sufficient time to address the outstanding issues.
- Scope for life extension and the work required to be performed during the refurbishment outage are defined and approved. The remaining challenge is to identify the period to perform non-refurbishment outage work that is required for life extension.
- Project management processes and oversight monitoring are in place for the project. These include schedule performance, cost performance, scope control and risk management. The final cost estimate (Release Quality Estimate (RQE) that is scheduled for October 2015) needs to be consistent with the business case justifying the project.
- The project management and support organization is in place for the Definition Phase and assembly of the execution organization has started.
- Contracts are in place for the Definition Phase to ensure planning is complete prior to Unit 2 breaker open. This includes the completion of engineering, the purchase orders for parts and materials, work procedures, and the establishment of execution contracts.
- To date, over 95% of the non project scheduled work is being completed. This includes on-line work and outage work. However, work that is planned and is not ready is not scheduled. As a result, this is not the best performance indicator of completing work to be ready for the refurbishment outage. Starting next quarter the percentage of planned work that is completed will be reported.
- There is a draft Level 1 plan for Critical Path of the execution phase of the program. This can be reviewed, along with its basis, to identify initial risks for execution.

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- The Class 3 estimate for the Re-Tube and Feeder Replacement project has been issued by the Joint Venture to OPG. This project represents the largest element of the Refurbishment program, both in terms of cost and duration. The process to review and challenge assumptions to obtain a more accurate Class 2 estimate (due in June 2015) has started.
- The 4d estimate has been drafted with final estimate to be presented to the OPG Board in mid November.

However, there are challenges that OPG need to address to increase the state of readiness to a comfortable level. These include:

- The variances between the initial inputs and the final 4d estimate need to be realized in a manner to assure the sustainability of the estimate during the development of the Release Quality Estimate.
- Management of the detailed design engineering workload to ensure that the May 2015 milestone for engineering to be completed is met with quality products.
- The current performance of the ESMSA contractors has resulted in a risk that some work required for the start of refurbishment may not be completed. OPG is working with senior management of the ESMSA vendors to implement actions to improve performance and meet milestones.
- The initiative to improve the reliability of fuel handling equipment needs to start making progress in the development and implementation of detailed plans in order to obtain confidence that defueling and bulkhead installation will meet their Critical Path Duration.

Although there are specific challenges that OPG needs to successfully overcome, they continue to have established the framework that is needed to be ready to successfully execute the refurbishment of the four Darlington units beginning with the first unit in October 2016.

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# **Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program**

**For the Quarter ending December 31, 2014**



Mike White  
CALM Management Consulting, Inc.  
January 5, 2015

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## **1. Minister Summary**

This report provides a quarterly review of trends, accomplishments and challenges related to the Darlington Nuclear refurbishment project.

### Changes from the Previous Quarter

The most significant changes from last quarter are:

- The release 4d estimate was approved by the OPG Board of Directors at its November meeting. The release was for \$1,124M to complete the 2015 planning activities for a cumulative release of \$2,732M. The bounding cost estimate for the project remains within \$10B (2013B). The breakdown of this estimate, its evolution since 2009 and resulting impact on LUEC is shown in the following table.
- Collaboration with Bruce Power to share operating experience, strategies, processes and negotiating with Building Trades Unions has started.
- Work has started on the Joint Venture's class 2 estimate for the RFR project. There is increased monitoring by the OPG/JV Steering Committee. It is the intention for the committee to provide reconciliation of outstanding issues as they are identified. The target for its completion is April, 2015.
- The application to the Federal Court for a judicial review of the Darlington Refurbishment Environmental Assessment was dismissed.
- The SNC/Aecon Joint Venture has been signed onto the ESMSA master agreement.
- An on-boarding facility for nuclear projects has been established at Darlington Energy Complex.

### Refurbishment Program Challenges

One objective of this oversight is to identify performance trends that require refurbishment management's attention to prevent the trends becoming significant issues. These are identified as Refurbishment Program Challenges. In general, refurbishment management is aware of these performance trends. It is the expectation that OPG refurbishment management takes actions to address these trends.

The current refurbishment program challenges are:

- The assumptions and opportunities that were the basis of the 4d cost estimate

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need to be sustained through the development of the Release Quality Estimate.

- The management of engineering workload challenge is based on on-going weaknesses in the use of schedules and work down curves for the large amount of detailed design engineering work, and the lack of monitoring effective quality indicators to identify and correct adverse performance trends.
- With the acceptance of performance weaknesses the contract management of the Campus Plan and Safety Improvement projects and ESMSA contractors, there is a need for refurbishment management to take concrete actions to address the individual lessons learned to prevent similar performance in the core refurbishment projects.

**Conclusion on Readiness:**

Although there are specific challenges that OPG needs to successfully overcome, there is the established framework that is needed to be ready to successfully execute the refurbishment of the four Darlington units beginning with the first unit in October 2016. The basis for this conclusion is provided in Section 9.

A review (section 8) of the alignment of OPG's strategies, contracts, actions and decisions shows good alignment with the Ministry's principles for refurbishment that were described in the 2013 Long Term Energy Plan. The previously identified gap related to the cooperation between the two nuclear operators has been addressed through on-going meetings among representatives to build on operating experience and alignment on common issues.

## **2. Purpose of Report**

In February, 2013 CALM Management Consulting, Inc (CALM) was retained to provide independent oversight of the Darlington Refurbishment Project on behalf of the Ministry of Energy (MOE). This agreement includes a monthly report to the MOE to identify progress in preparations for the refurbishment of the Darlington nuclear units as well as potential challenges to the successful planning and completion of the project. In this case, as with similar projects, success is defined as the preparation and execution of 100% of the correctly identified project scope safely, on schedule, within budget and with quality. The monthly reports include the following areas:



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- Changes from Previous Month
- Accomplishments and Progress
- Darlington Nuclear Refurbishment Scorecard
- Basis for Scorecard Ratings
- Refurbishment Program Challenges

In addition to these routine monthly reports, it is beneficial to review performance trends and to provide insights into additional areas. This is accomplished through a quarterly report that, in addition to the contents of the monthly report, provides a review in the following areas:

- Status of the individual projects
- A review of the issues identified by the independent external oversight team that reports to the OPG Board
- Insights into the leadership team and the cultures which it is developing
- A review of the efforts to meet the principles that were provided in the ministry's 2013 Long Term Energy Plan
- A review of the overall state of readiness

It is the belief of the MOE's Independent Oversight Advisor that the Refurbishment Program Challenges that are identified in Section 5 deserve consideration by OPG Refurbishment management. It is the intention to identify such challenges when they represent an early trend rather than wait until they become a significant issue.

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**3. Darlington Nuclear Refurbishment Scorecard**

**3.1 Darlington Nuclear Refurbishment Scorecard – December 2014**

	Current Month	Previous Month	Trend	Notes
<b>Safety and Regulatory Approvals</b>				
Personnel Safety	✓	✓	↘	
Radiological Safety	✓	✓	→	
Regulatory Approvals	✓	✓	↗	Work continues with CNSC to manage the IIP commitments, The court challenge to the refurbishment EA was not accepted.
<b>Project Management Controls</b>				
Risk Management	✓	✓	→	
Scope Management	✓	✓	→	
Cost Management	x	x	↗	The 4d estimate was completed and accepted by the OPG Board.
Milestone Compliance	x	x	→	
Release Quality Estimate	✓	✓	→	The RQE plan has been issued.
<b>Project Execution</b>				
Time Management	✓	✓	→	
R&FR Project Performance – Cost, Schedule & Quality	✓	✓	→	
Campus Plan Performance – Cost, Schedule & Quality	xx	xx	↗	
Safety Improvement Opportunities Performance – Cost, Schedule & Quality	xx	xx	↗	
Engineering Performance – Cost, Schedule & Quality	xx	xx	→	
Contractor Management	x	x	↗	Contracts issued for BoP and some S/D and Layup projects

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	Current Month	Previous Month	Trend	Notes
Quality Management	✓	✓	→	
Procurement Management	✓	✓	→	
Resource Management	x	x	→	
<b>Learning and Oversight</b>				
Operating Experience & Corrective Action	✓	✓	→	
Oversight	✓	✓	→	External oversight is consistent with the expectations of the OPG Board.

### 3.2 Basis for Scorecard Ratings

#### Personnel Safety - WHITE

During December, incidents related to lifting and rigging occurred in the RFR project and the installation of VD10 for the CFVS project. Lifting and rigging is the subject of an industry WANO Significant Operating Event Report. During November, a number of safety events occurred during field execution of the prerequisite projects. The most significant was a subcontractor worker traversing a beam without fall protection and thus exposed to a 45 foot fall (N-2014-30652). This occurred on work at the D<sub>2</sub>O Storage Building project, with subcontractor supervision observing and taking no action. It was classified as a High MRPH (Maximum Reasonable Potential for Harm) and resulted in the station safety light being changed from Green to Red. Another incident involved a contractor working on a 480 V panel without the required personnel protective equipment (D-2014-31024). These events combined with previous vehicle events indicate the beginning of an adverse trend in personnel safety.

#### Radiological Protection - WHITE

After the completion of the D1411 outage, there has been limited refurbishment work in radiological areas. The project is moving towards the development of ALARA plans for individual projects (such as R&FR) and the development of the RP services strategy. ALARA plans are likely 6 months to a year before they can be reviewed.

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Regulatory Approvals – WHITE

Although acceptance of the Integrated Implementation Plan (IIP) will not occur until the renewal of the Darlington Nuclear Operating license for a 14 year period, scheduled for the end of 2015. In the meantime, there is indication that CNSC staff is in agreement with the content of the IIP, and OPG is working with CNSC staff to develop and implement a process for the management of changes to the IIP; either in terms of content or schedule. The other regulatory risk is the current court challenge to the Refurbishment project's Environmental Assessment.

Risk Management – WHITE

The Risk Management program has identified Nuclear Refurbishment Key Risk Areas, which are the result of an aggregate analysis of the risk registry. They have management sponsors who are responsible to monitor the progress of the individual risks associated the area for the development and implementation of mitigating action plans. These Key Risk Areas and their current ratings (by management) are:

- Availability/Retention of Key Staff (identified as a Red risk and improving)
- Cost and Estimating Management (identified as a Yellow risk and improving)
- Completion of Unit 2 Prerequisites (identified as a Yellow risk and degrading)
- Regulatory Approvals (identified as a Yellow risk and stable)
- Fuel Handling Reliability (identified as a Yellow risk and improving)
- Vendor Default/Continuity Planning (identified as a Yellow risk and stable)
- Integrated Schedule Development (identified as a Yellow risk an stable)
- Timely Procurement of Materials (identified as a Yellow risk and stable)
- Completion of Engineering (identified as a Yellow risk and improving)
- Integration with External Organizations (identified as a Yellow risk and improving)

This identification of the Key Risk Areas is a positive step towards managing the known risks associated with the refurbishment program. Although there is some discussion of the risks at the individual manager level, senior management review of the mitigating actions is done through the Risk Oversight Committee, which meets quarterly. This means there will be approximately 7 opportunities for the management team to review the health of these key risks prior to the start of the Unit 2 refurbishment outage.

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Scope Management - WHITE

The current strategy for the scope of the refurbishment outage relies strongly on the concept of 'life extension window'. The life extension window starts with the shutdown of the first refurbishment unit (Unit 2) and ends upon the completion of the first planned outage after the refurbishment of the last unit (Unit 4). This represents the twelve-year period from 2016 to 2028. This provides two planned outages, in addition to the refurbishment outage, to complete each unit's life extension commitments.

This strategy is appropriate to maintain control of the scope of the first refurbishment outage. On-going monitoring of any scope creep into the refurbishment outage will identify any deterioration of this performance. The currently approved dates and durations for each unit are summarized in the following table.

Unit	Start of Refurbishment Outage	Finish of Refurbishment Outage	Duration (months)	Overlap on Previous Unit
D2	<b>October 2016</b>	September 2019	36	
D1	October 2019	September 2022	36	0
D3	March 2021	February 2024	36	19
D4	October 2022	<b>September 2025</b>	36	17
<b>Total Unit Outage Months (4 units)</b>			144	
<b>Refurbishment Window</b>			108	

Cost Management - YELLOW

Project life to date total cost as of the end of November 2014 is \$1,504M, which is \$91M below the plan of \$1,596M. The below plan consists of delays in Balance of Plant, Shutdown, Layup & Services projects, and delays in progressing design engineering for Campus Plan and Safety Improvement projects.

The release 4d estimate was approved by the OPG Board of Directors at its November meeting. The release was for \$1,124M to complete the 2015 planning activities for a cumulative release of \$2,732M. The bounding cost estimate for the project remains within \$10B (2013B). The breakdown of this estimate, its evolution since 2009 and resulting impact on LUEC is shown in the following table.

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<b>2014\$</b>	<b>2009</b>	<b>2013 (release 4c)</b>	<b>2014 (release 4D)</b>
Project Estimate	n/a	\$7,223M	\$7,635M
Contingency	n/a	\$2,133M	\$2,135M
Management Reserve	n/a	\$844M	\$430M
TOTAL	\$10,970M	\$10,200M	\$10,200M
Levelized Unit Energy Cost (LUEC)	8.9¢	7.7¢	7.8¢

The \$7,635M cost estimate for the refurbishment project incorporates a number of assumptions and opportunities that refurbishment management need to realize through various contract negotiations for execution and in the staffing of the various OPG functions. These represent the basis for the release 4d estimate. The current cost challenge is the sustainability of the basis for the release 4d estimate during the development of the Release Quality Estimate (RQE). This is discussed in more detail in the section on refurbishment challenges.

One positive cost reduction action recently taken by OPG refurbishment management is to initiate new contracts with the OSS vendors. Both vendors have submitted new proposals that provide a reduction in the costs of their services.

**Milestone Compliance – YELLOW**

As a measure of the management of milestones, this report will on the completion of the milestones associated with the Release Quality Estimate milestone of October 2015. There was one milestone in December, the acceptance of the Integrated Improvement Plan (IIP) by the CNSC. OPG management has stated that this acceptance has been verbally received with a letter expected by the end of December. As a result, this milestone rating has changed from Yellow to White with a further change upon verification that the letter was received.

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**Release Quality Estimate Milestones**

<b>Milestone</b>	<b>TCD</b>	<b>Status</b>
MDRs Complete	August 15, 2014	These were completed in Q4, 2013 with a live 0 value of about 15 as discovery work is identified.
U2 Work Order Scope Definition complete	October 15, 2014	This milestone was met.
Program Health Review complete	October 15, 2014	This milestone has been moved to May 2015.
U2 Outage Planning Organization complete	October 15, 2014	This milestone was met.
U2 Pre-Outage Metrics prepared	October 15, 2014	This milestone was not met. A mitigation plan is under development to minimize any impact on downstream milestones.
U2 Long Lead Materials identified	November 15, 2014	This milestone was revised to February 15, 2015
Release 4D Estimate completed	November 13, 2014	This milestone was met with the presentation at the Board's November meeting.
Integrated Implementation Plan (IIP) approved by the CNSC	December 31, 2014	OPG management stated that the letter will be received by the end of December, 2014.
U2 Level 1 Rev B execution schedule issued	April 15, 2015	U2 Level 1 Rev A execution plan has been issued and is being revised as more details on work execution are provided.
U2 Design complete	May 15, 2015	
Success Plan Presentation	July 15, 2015	
U2 Design Documents complete	August 15, 2015	
U2 Work Order Scope Freeze	October 15, 2015	Scope is frozen at the higher level of Scope forms.
RQE & Release 5 Release issued	October 15, 2015	

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Release Quality Estimate - WHITE

A draft RQE development flowchart that identifies the required milestones to support the completion of Critical milestones for the Release Quality Estimate (RQE) has been revised. The organization to lead the development of the RQE is in place. The management plan for the RQE project was issued at the end of November, along with the schedule for its implementation. The 4d estimate has been completed and accepted by the OPG Board at its November meeting. A key component of the development of the RQE is the development of the Class 2 estimates for the Re-tube & Feeder Replacement and Turbine Generator projects. These are being performed by the Joint Venture with close monitoring and involvement by OPG. The milestone date for the acceptance is May 2015, although the schedule has an early finish in mid April. The milestone for the submission of the RQE is October 2015.

Time Management - WHITE

Work continues to progress well for the start of Unit 2's refurbishment outage. Current performance includes:

- The November refurbishment schedule performance index (SPI) is 0.96, excluding the D<sub>2</sub>O storage and CFVS projects. This value includes a significant contribution from the function groups (close to 25%), which are level of effort and thus do not have schedules. The SPIs for the three project groupings are:
  - Core bundles have an SPI of 0.98.
  - The Safety Improvement Opportunity projects have an SPI of 0.96, excluding the CFVS project, with its schedule under revision.
  - The Campus Plan projects have an SPI of 0.88 excluding the D<sub>2</sub>O Storage project, with its schedule under revision.
- Another indicator of completion of work is the number of activities completed in a month versus the planned number. This information provides a gross indicator of the organization's ability to complete planned work. As can be seen from the following table, the project has not been very successful in completing activities that are planned for each month.



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<b>Month</b>	<b>Number of Planned Activities</b>	<b>Number Completed</b>	<b>% Completed</b>
July	94	27	29%
August	190	93	49%
September	264	107	41%
October	197	113	57%
November	170	71	42%

- Work is continuing to refine the Level 1 execution plan for the Unit 2 refurbishment outage.

**Re-tube & Feeder Replacement Project Performance - WHITE**

The benefits of the mock-up started to be realized during the fourth quarter. Examples to date include:

- A dimensional discrepancy in the Re-Tube Platform (RTP) was identified and corrected.
- Validation of non-interference was validated, which removed one Temporary Modification (TMOD) from the vault. The removal of this TMOD results in a critical path savings of a few days.
- Panel locations and cable lengths have been verified.
- Tool Performance Guarantee (TPG) tests have started. Pressure tube (PT) cuts have been performed using the remote controls and the PT cutter. The cut was consistently performed within 20 minutes, which is about a factor of 3 better than the TPG.
- Tool integration testing has started and will be used in the development of the Class 2 estimate.

The tooling qualification testing continues and is currently on schedule. It is an important input into the RFR Class 2 estimate, which has an early target completion date of mid April, 2015. However, the use of the tooling represents about 30% of RFR's critical path time. The remainder is the movement, set-up and dismantle of the tools. Although this

is recognized as an important variable and will be incorporated into the Class 2 estimate, it is unclear the extent to which it will be conducted using the mock-up prior to the submission of the Class 2 estimate.

Refurbishment and Joint Venture management recognizes the importance of the Class 2 estimate in the development of the Release Quality Estimate. As a result, the Berkeley Research Group has been hired to provide independent oversight of the Class 2 process and its implementation. In addition, OPG and the JV are in the process of establishing an Expert Panel to review the quality of the inputs into the process. The first meeting is planned for January 2015. Both of these activities will be monitored and reported in these reports.

The design and construction of the Retube Waste Processing Building (RWPB) are undergoing similar issues as the Campus Plan projects associated with the potential of underground services, as well as the management of potentially contaminated soil and water. A detailed schedule has not been accepted by OPG project management.

Campus Plan Performance – RED and Safety Improvement Opportunity (SIO) Projects Performance – RED

Campus Plan and SIO projects continue to struggle in meeting cost estimates, schedules and high performance standards. Without additional improvement and focus on the execution of the Campus Plan and Safety Improvement projects, there is a challenge in having some of the projects completed when they are required. OPG senior management has taken some actions to address the ESMSA performance related to these projects. These focus on the collaborative front end planning and engineering environment, biweekly status meeting for the projects executed by each ESMSA contractor, and the development of detailed execution schedules. These actions have had limited effect in the execution of the projects.

OPG management has not communicated specific actions to improve performance related to contractor management of the Campus Plan and Safety Improvement projects. However, number of initiatives would likely be required to obtain and demonstrate sustained performance improvement. These include:

- The alignment of OPG and ESMSA performance metrics, including Schedule Performance Indicator, Cost Performance Indicator, Earned Value, and Available for Service (project completions) dates.
- The effective use of the P6 schedule in the daily schedule review meetings (PCC meeting).

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- The ability to identify and address project issues that delay field execution in a timely and effective manner. The response to safety, quality and productivity issues will be the main focus in this review.
- The effectiveness of OPG field execution oversight.
- The interface and integration among contractors and between contractors and the station.

The challenge associated with the Campus Plan and SIO projects is currently focused on the need for refurbishment to take concrete actions from the lessons learned from these projects.

Engineering Performance - RED

Management of the upcoming engineering workload continues to be a significant challenge, with details provided in Section 5.

Contractor Management - YELLOW

The main challenges related to Contractor Management are captured with the issues related to the Campus Plan and SIO projects, and Engineering Performance

The R&FR, Fuel Handling and Turbine Generator projects have a routine senior management steering committee meeting to review performance, as well as periodic executive oversight committee meetings that include the Chief Executive Officers of OPG and the contractors' companies.

Although contracts have been awarded, the remaining core projects have not sufficiently progressed to provide good insight of performance. The challenge will be to obtain improved performance using the ESMSA contractors as compared with the Campus Plan and SIO projects. [REDACTED]

[REDACTED]. As a result, contractor management is rated Yellow.

Quality Management - WHITE

With the current EPC contracting strategy, OPG needs to develop the capability to manage the quality of work performed by its contractors. Refurbishment management's response to this need challenge is through a combination of project management

activities, oversight activities by the project management team, supply chain procurement audits and assessments, and audits conducted by teams within the refurbishment organization and other OPG organizations. Through an Oversight Steering Committee, management has started the shift from a focus on doing oversight activities to their quality and lessons learned. This shift is too early to the performance improvement for the next performance level. There is currently an initiative to integrate the various quality management activities and risk management into a single platform in order to more easily implement the program and review the results.

#### Procurement Management – WHITE

With the exception of the radiation protection services contract, all major contracts have been awarded. The late awarding of the contracts for the Balance of Plant and Shutdown/Layup projects will challenge the vendors and OPG to meet the completion of engineering milestone. The Supply Chain conducted an audit of the processes in place for Alstom to procure critical parts in support of the Turbine Generator project. The audit identified four findings:

- The need to use tracking tools for the OEM parts which are to be delivered by the vendor associated with Unit 2 refurbishment.
- Additional progress of schedule activities/level of detail to monitor the overall progress of procurement/manufacturing of OEM parts associated with Unit 2 refurbishment.
- Update the Project Management Plan to reflect oversight related to monitoring/tracking of OEM parts associated with the above items.
- Increase oversight efforts for the integration of the installation vendor (the Joint Vendor) as well as the OEM vendor to ensure that the actual need dates for the parts are accommodated/considered in oversight activities.

In themselves, these findings do not represent challenges or risks to Alstom supplying the necessary quality parts. The bigger concern is the fact these issues are identified within a company that is recognized within its field as providing quality parts and materials in a timely manner. If OPG standards for procurement processes and oversight are not met within Alstom, it is likely that a number of parts suppliers will have more significant issues identified in audits of their procurement process.

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**Resource Management - YELLOW**

The availability/retention of key project staff is identified as one of the program's Key Risk Areas. It consists of:

- The possibility of limited skilled trade resources and supervision for project execution as its highest program risk. Currently the trades unions predict that there may be a total shortfall of approximately 50,000 personnel during the duration of the Darlington refurbishment. They have also identified poor progress in increasing the number of journeypersons in several trades. The current rate of individuals moving from the apprenticeship program to become a journeyperson is 18% - 20%. It is recognized by all parties that this must improve. The Darlington VP of Execution is leading an initiative that includes the unions, OPG and its main contractors to address this potential shortfall.
- The potential that project leadership and specialized resources are not in place when required. There are a number of initiatives under development to reduce the significance of this risk. Refurbishment management is constrained its ability to implement the corporate policies and procedures that have been developed for operating facilities and small projects for this mega project.
- The possibility of an insufficient number of Authorized Staff for both station and refurbishment needs. This is being addressed through a combination of increased number of candidates for the associated positions as well as challenging the extent of the need for such staff once the unit is defueled and isolated through the bulkhead.
- The potential of an insufficient number of qualified radiation protection coordinators to support project execution. This should be addressed through the awarding of the radiation protection services contract.

**Corrective Action Program and Use of Operating Experience – WHITE**

There have been no changes to the performance in the areas of the Corrective Action Program and Operating Experience. OPG has implemented several high level lessons learned from previous refurbishment projects; including Browns Ferry, Pickering A, Bruce A, and Watts Bar. In 2012, refurbishment management made a presentation to the OPG Board on how they addressed the US Inspector General's findings from the investigation of Watts Bar Unit 1 cost overruns and schedule delays. It is not clear if OPG management has revisited the health and current effectiveness of the stated response to these issues. There is an additional area of operating experience for which it is unclear the extent to which refurbishment management has implemented. That area

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is the incorporation of appropriate Significant Operating Experience Reports and equivalent. These are reports issued by WANO (World Association of Nuclear Operators) and INPO (Institute of Nuclear Power Operations) related to significant adverse trends within the industry and they provide both the causes and required actions by individual plants. This is presently under review and results will be provided in Q1, 2015.

The Corrective Action Program is in place and is being used. The majority of issues adverse to quality have been identified in the engineering activities. This is not surprising since engineering represents the most active function at this time. Although the refurbishment CAP program is good, the program implemented by the Projects and Modifications (P&M) organization has several known weaknesses. This should be a concern to the refurbishment organization since the Campus Plan and SIO projects are being managed by the P&M organization and thus conditions adverse to quality are managed through its CAP.

OPG Oversight – WHITE

OPG's independent oversight team (Modus/Burns & McDonnell) reports to the Nuclear Oversight Committee of the OPG Board of Directors. They conduct their oversight in accordance to an approved plan and provide quarterly reports to the Board.

#### **4. Accomplishments and Progress**

The following accomplishments were achieved during the fourth quarter:

- Project life to date total cost as of the end of November 2014 is \$1,504M, which is \$91M below the plan of \$1,596M. The below plan consists of delays in Balance of Plant, Shutdown, Layup & Services projects, and delays in progressing design engineering for Campus Plan and Safety Improvement projects.
- The release 4d estimate was approved by the OPG Board of Directors at its November meeting. The release was for \$1,124M to complete the 2015 planning activities for a cumulative release of \$2,732M. The bounding cost estimate for the project remains within \$10B (2013B). The breakdown of this estimate, its evolution since 2009 and resulting impact on LUEC is shown in the following table.

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- Collaboration with Bruce Power to share operating experience, strategies, processes and negotiating with Building Trades Unions has started.
- Work has started on the Joint Venture's class 2 estimate for the RFR project. There is increased monitoring by the OPG/JV Steering Committee. It is the intention for the committee to provide reconciliation of outstanding issues as they are identified. The target for its completion is April, 2015.
- The application to the Federal Court for a judicial review of the Darlington Refurbishment Environmental Assessment was dismissed.
- Regulatory documents required by the CNSC for undertaking a project to extend the life of a nuclear plant have been submitted to and mostly accepted by the CNSC (Environmental Assessment, Integrated Safety Review, Global Assessment Report, and Integrated Implementation Plan).
- The SNC/Aecon Joint Venture has been signed onto the ESMSA master agreement.
- OPG held a four-day open house at the Darlington Energy Complex that included tours of the Re-tube and Feeder Replacement mock-up. Approximately 3,500 people attended, including members of the public, local business community, employees and their families, retirees and vendor partners. There was very positive feedback on the event.
- Refurbishment scope has been defined to the component level (Health of Scope 4).
- An on-boarding facility for nuclear projects has been established at Darlington Energy Complex.

## **5. Refurbishment Program Challenges**

Throughout the life of refurbishment program specific challenges have been, and will be, identified that in the belief of the Independent Advisor to the Minister of Energy should have actions by OPG Refurbishment Management to address them, before they become significant issues. The currently identified Refurbishment Program are related to maintaining the assumptions and basis for the 4d cost estimate into RQE, the management of the engineering workload, and implementing concrete actions to address lessons learned from the Campus Plan and SIO projects.

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**4d Cost Estimate Challenge**

The 4d cost estimate was presented and accepted by the OPG Board at its November meeting. The estimate is within the \$10B (2013\$), or \$10.2B (2014\$) bounding estimate. The breakdown is \$7.635B for the project, \$2.135B for Contingency and \$0.43B for Management Reserve. The \$7.7B cost estimate for the refurbishment project incorporates a number of assumptions and opportunities that refurbishment management need to realize through various contract negotiations for execution and in the staffing for the various OPG functions. The current cost challenge is the sustainability of the 4d cost estimate basis (including assumptions and opportunities) during the development of the Release Quality Estimate (RQE).

The sustainability of the basis of the 4d cost estimate through the development of the Release Quality Estimate will be monitored by the MOE Independent Oversight Advisor through:

- Review refurbishment management's basis document 4d estimate for the project bundles and functions.
- Monitor the progress of the resulting actions to realize the assumptions and opportunities credited in the above basis.
- Monitor the progress of reviewing the generic issues (opportunities) identified by OPG through this challenge process and the progress of implementing any resulting beneficial actions.
- Monitor the incorporation of the basis document from the 4d estimate into the development of the Release Quality Estimate (RQE).

OPG refurbishment management has documented its basis for the 4d cost estimate in early December. The following observations are made regarding the documented basis of the 4d cost estimate based upon an initial cursory review:

- The documented basis is a combination of the assumption log and department Functional Plans.
- There are over 390 assumptions in the assumption log. These are provided for individual projects, with very few rolled up to the refurbishment program level. During a meeting to review the issuance of the 4d cost estimate basis, it was stated that a review of all assumptions would be made to determine those that impact the overall program.
- The assumption log does not have an associated financial value associated with each assumption. This will make it more difficult to monitor their sustainability. However, there is some documentation on the reductions for individual projects and functions during the development of the 4d cost estimate.



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- The R&FR project has good documentation to support its 4d cost estimate, from which the cost associated with assumptions can be determined.
- The Functional Plans identify a number of shared responsibilities and resources with the station. It is not clear if the associated transition plans have been revised to demonstrate station acceptance of these changes. There should be a schedule and plan to obtain alignment between the station and refurbishment organizations on the actual support to be provided by the station during the refurbishment outage.
- The RQE plan provides guidance on the development of the estimate. However, there is not a clear expectation that the RQE process will monitor the sustainability of the assumptions and opportunities that resulted in the 4d cost estimate.

In conclusion, the recent submissions associated with the 4d estimate require further work to ensure that the key assumptions, opportunities and bases are clearly identified for monitoring their health and sustainability during the development of the Release Quality Estimate.

**Management of Engineering Workload**

The challenge associated with the management of the large engineering workload has been identified in monthly reports to the MOE since June 2013. In Q2, 2014, refurbishment senior management recognized the issues related to engineering and initiated interim actions and a root cause investigation. The focus of the improvement actions has been the implementation of a collaborative approach to planning (preliminary engineering, scope definition and cost/schedule estimations) and detailed design engineering. This has resulted in examples of faster response for requested information and shorter review cycles for approval of an engineering package by the Design Authority.

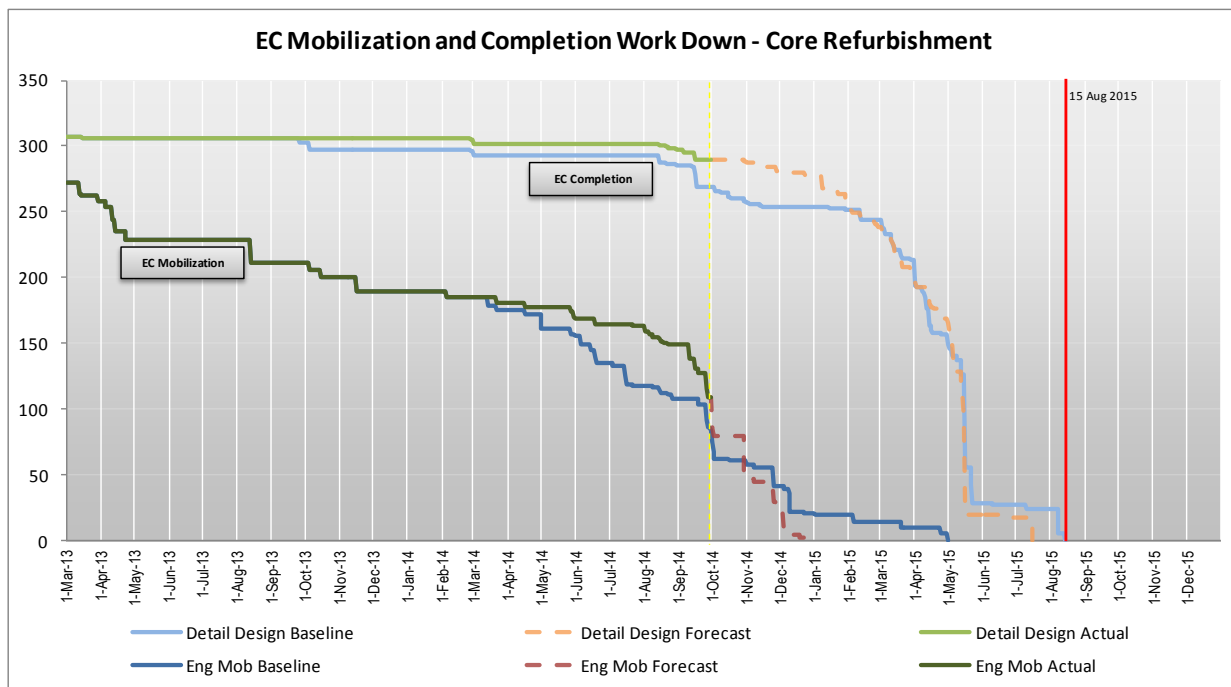
However, there has not been sufficient progress in the management of the engineering workload to remove the current challenge. This is based on on-going weaknesses in the management of engineering scheduled work to ensure overall ability to complete the workload, as well as monitoring the quality of engineering work to identify and correct adverse performance trends. The Nuclear Oversight Committee (NOC) of the OPG Board of Directors has also expressed concern over the ability to complete the large amount of engineering work by the engineering complete milestone of May 2015.

In response to this concern, a detailed design package work down curve was presented to the NOC at its November meeting. This diagram shows that the large majority of

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engineering packages (225 of 300) will be completed between March 1 and May 15, 2015. The NOC has sufficient concern over the detailed engineering schedule that it has requested an update in January 2015.



It is noted that this curve represents the completion of engineering work associated with the core refurbishment projects. It does not include the remaining engineering work for the Campus Plan and Safety Improvement Opportunity (SIO) projects. This engineering work will require some of the same resources that will be used for the engineering for the core refurbishment projects. Since there is not a similar work down curve for the Campus Plan and SIO projects, it is not possible to assess the impact of this parallel work load. However, it is not trivial. At the December 19<sup>th</sup> engineering project meeting, a table was provided identifying the number of engineering packages managed by the refurbishment organization as 244 and the number managed by the Projects & Modifications (P&M) organization for the nuclear refurbishment as 421. In addition, there are an unknown number of station projects that are managed by the P&M organization that must be completed prior to the start of the Unit 2 refurbishment outage. One example for which assistance has been requested from refurbishment engineering is PHT LRV Modifications to address waterhammer issues. The total engineering effort for the first six months of 2015 includes the work for the core refurbishment projects, the Campus Plan projects, the SIO projects, and other prerequisite projects. The core refurbishment projects have a work down curve for the engineering packages, but the others don't - thus not permitting an assessment of the aggregate engineering workload.

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By its nature, the large engineering workload in a relatively short period of time introduces a challenge to maintain high levels of quality. The monitoring and trending of engineering quality are critical for a large project. During Q4, refurbishment engineering has developed an engineering quality dashboard of nine sections that include both quality results and quality enablers. One key indicator of quality is the number of engineering Event Free Day Resets (EFDRs) during the period. During the first three quarters of 2014, there were 4 EFDRs declared, while in Q4, there have been 5 declared. The likely cause of the increase in number is improvement in sensitivity of quality issues rather than degradation in quality. To provide a consistent measure of quality performance, a single quality indicator has been developed for the quarterly report to the ministry.

Engineering Quality Indicator =  $100 - 15 \times (\text{L1 events (rejection by external approving authority + rework after field installation)}) - 10 \times (\text{L2 events (rejection by internal approving authority + rework during field installation + other event free day reset)}) - 5 \times (\text{L3 events (other rework (greater than \$10K)})} + 1 \times (\text{GC (documented good catches prior to submission for OPG review to maximum of 10)})$ . The following values are used for the colour rating:

Green: >80

White: 65 – 79

Yellow: 50 – 64

Red: <50

Month	Index	Rating	Basis
October 2014	65	White	1 L1 event and 2 L2 events
November 2014	36	Red	2 L1 events, 1 L2 event, 5 L3 events and 1 GC
December 2014	70	White	1 L1 event, 1 L2 event and 1 L3 event
Q4/14	57	Yellow	

The Q4 indicator is 57, which represents a potential concern for quality. OPG management correctly states that its engineering change control (ECC) process is consistent with industry practices. However, the ECC process is one aspect of quality engineering. With the EPC contracting model is used for projects, an equivalently critical

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process is the owner acceptance of design agency products. It is not clear that OPG's owner acceptance is fully aligned with industry practice. Given the cost impact and latent risk of engineering errors, it is recommended that OPG request WANO/INPO to perform a review of its engineering processes, specifically its owner acceptance of design agency products.

In conclusion, further management focus is required to support the timely completion of quality engineering packages.

**Incorporating Lessons Learned from the Campus Plan and Safety Improvement Projects**

With the acceptance of performance weaknesses the contract management of the Campus Plan and Safety Improvement projects and ESMSA contractors, there is a need for refurbishment management to take concrete actions to address the individual lessons learned to prevent similar performance in the core refurbishment projects.

The challenges associated with the Campus Plan and Safety Improvement Opportunity projects are well acknowledged by OPG senior refurbishment management, with routine updates to the Nuclear Oversight Committee (NOC) of the OPG Board of Directors. This challenge has been identified in the monthly reports to the MOE since April 2013. OPG is managing these projects for their completion prior to the start of Unit 2's refurbishment outage. Where completion is challenged (such as the D<sub>2</sub>O storage building project), an alternative project is under development to accomplish the requirement for Unit 2. Because of the increased oversight by the NOC and management's increased focus on these projects, it is felt there is no need to continue the specific challenge related to the performance of these projects. The performance will continue to be monitored and reported in the report's scorecard.

These projects have had a number of lessons learned that need to be effectively addressed by the refurbishment organization for the successful refurbishment of the Darlington units. Some of these are recognized by OPG senior management because they have resulted in direct impact on cost overruns and schedule delays. However, there are several that observations and monitoring of the daily activities of these projects. With the exception of refurbishment maintenance and work management, the monitoring of daily performance of these is not performed by refurbishment management. However, if refurbishment manager does not take concrete actions to prevent these (or similar) lessons learned these observations will have negative contributions to the ability for a successful refurbishment outage. These lessons learned and OPG's current ability to prevent a recurrence in performance is summarized in the following table.

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<b>Lesson Learned</b>	<b>Basis</b>	<b>OPG actions and effectiveness</b>	<b>Likelihood of recurrence</b>
Poor cost estimates	OPG recognizes that several of these projects were started and continued without the appropriate level of cost estimate.	There is increased rigour in the cost estimates for the core projects and revised estimates for these projects. This includes collaborative front end planning for a better understanding of the scope of work and the use of third party estimates for comparison.	Low
Poor execution schedules	Many of these projects started and continued without detailed schedules for engineering and field activities. There is an effort to recover this problem as the projects are in progress.	OPG is supporting the vendors in the development of detailed schedules. There is a requirement for detailed schedules as part of the gate review process. Currently there are struggles obtaining detailed schedules for engineering deliverables.	Medium
Completion of engineering prior to the start of field execution	These projects have started prior to the completion of engineering. Currently there are examples of design engineering delaying field execution in these projects. This will likely continue through the completion of these projects.	This is one of the high level lessons learned that OPG addressed through its infrastructure and milestones for the refurbishment project. That is the basis for having the engineering complete milestone a year prior to the start of the Unit's refurbishment outage. Even with the current challenges in managing the engineering workload, there is sufficient float to complete engineering by the start of execution.	Low

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<b>Lesson Learned</b>	<b>Basis</b>	<b>OPG actions and effectiveness</b>	<b>Likelihood of recurrence</b>
Availability of parts when required	On several occasions there have been issues in obtaining the parts to support field execution. This has resulted in some delays and in some cases the acquisition of parts from the OPG warehouse. The ESMSA vendors have not been totally successful in managing the procurement process.	There are milestone for the identification of long lead materials (February 2015). However, the identification of parts will be done through the completion of engineering and start of assessing. A recent audit of the Alstom procurement process identified weaknesses in the tracking of materials and oversight of subcontractors. There is no reason to believe that this issue is isolated.	Medium
Quality and timeliness of CWP	Once engineering is complete, the information is converted to a Comprehensive Work Package (CWP) that is used for field execution. It is not uncommon to have the field execution delayed while waiting for the completion, review and approval of the CWP. In response to the problem with ESMSAs have with the development and approval of CWPs, refurbishment maintenance personnel have supported these projects.	Although the RFR project has started to generate CWPs, it is for the purpose of the class 2 estimates. The capability of the ESMSA to generate CWPs has not improved.	Medium

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<b>Lesson Learned</b>	<b>Basis</b>	<b>OPG actions and effectiveness</b>	<b>Likelihood of recurrence</b>
Integration with the station work management process	The P&M organization has had trouble integrating its work through the station's on-line and outage processes. This has resulted in an overreliance on the use of scope injection, which frequently is rejected. The station has stated that the acceptance of work injection will be further curtailed in 2015.	Between the need to perform prerequisites in support of the start of the outage, the work to be coordinated prior to islanding of the unit and the return of the unit to service at the end of refurbishment there will be a significant amount of integration with the station and its processes. There are no specific actions to address this potential integration issue.	High
Coordination among contractors for common issues and processes	Several projects have had process issues with daylighting, dewatering, removal of contaminated soil, management of associated totes and RP support. Rather than have a lead in the management of such common processes, each project was left to its own to resolve the issues. This resulted in some delays and likely some increase in costs.	There will be common processes that will be used by multiple vendors; such as scaffolding, lifting and rigging, FME. A lack of coordination among contractors in such common processes increases the potential of delays and issues.	High

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<b>Lesson Learned</b>	<b>Basis</b>	<b>OPG actions and effectiveness</b>	<b>Likelihood of recurrence</b>
Effectiveness of PCC and POD meetings	The PCC and POD are not effective at meeting the objective of driving the projects to maintain schedule, to coordinate among projects, to prioritize issues and resources and to identify and resolve issues before they impact field execution. This weakness includes the use of metrics and schedules at the daily POD meeting. For example, for many projects schedule performance is reported as 'on track' rather than use the schedule. Frequently the first indication of a risk was when the report states that the milestone will be missed.	The need for a PCC is recognized. However, its organizational structure, responsibilities and procedures are still under development. Because there is little understanding by refurbishment organization of the PCC and POD performance issues, there is little reason to believe that it will be more effective at this point.	High
Requirements to restart work when stop work order is initiated	There have been events after which OPG P&M or station management has stopped work. However, there no guidance provided to management on determining the criteria to restart work. This results in a reduction in the timeliness and sometimes effectiveness of the actions to restart work.	There is currently nothing in place.	High



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<b>Lesson Learned</b>	<b>Basis</b>	<b>OPG actions and effectiveness</b>	<b>Likelihood of recurrence</b>
Management of subcontractors	These projects have had issues with the performance of subcontractors. Issues have included the delivery of engineering products in a timely manner, some engineering quality problems, timely delivery of parts, some quality issues related to parts manufacture, field execution rework and safety performance.	Similar issues have started with the management of subcontractors for core refurbishment projects.	High
Not effectively using station processes	There are a number of station processes which are required to be used by the contractors, but are not effectively implemented. These include work management processes, work protection, work authorization, event free challenge process, etc. Refurbishment operations and maintenance is assisting in facilitating the ESMSA contractors through some of these processes.	It is assumed that the contractors and subcontractors will have processes similar to the OPG processes. This is believed to be a contractual requirement. Processes have not been fully aligned or equivalent in the few cases that have been tested. For example, during Q4 there have been incidents involving lifting and rigging with both the Joint Venture and ES Fox. The initial Turbine Generator FME plan was rejected.	Medium

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<b>Lesson Learned</b>	<b>Basis</b>	<b>OPG actions and effectiveness</b>	<b>Likelihood of recurrence</b>
Not responding to adverse trends in a timely and effective manner	These projects have had several issues. The organization has not been effective at identifying and addressing them in a timely and effective manner to reduce their impact on safety, quality, cost and schedule delays. This is a particular concern because this issue is similar to the cause of the Pt LePreau calandria tube insertion production and quality event.	Currently the refurbishment project organization does not have the processes to support the timely and effective response to an adverse trend in performance.	High

## 6. Status of Individual Projects

The Darlington Refurbishment Program consists of seven individual projects and a number of infrastructure projects (also called Campus Plan) and Safety Improvement Opportunity projects:

- Re-tube and Feeder Replacement (RFR)
- Fuel Handling/Defueling (FH)
- Turbine Generator and Controls (TG)
- Steam Generator and Auxiliary Systems (SG)
- Balance of Plant (BOP)
- Islanding
- Shutdown, Layup and Services
- Campus Plan
- Safety Improvement Opportunities Projects

## **6.1 Re-tube and Feeder Replacement Project**

The Re-tube and Feeder Replacement (RFR) project represents the largest scope and cost component of the Darlington Refurbishment Project. The RFR project will define the project's critical path and thus duration. As demonstrated by the schedule delays, cost overruns and performance issues in previous CANDU refurbishment projects, the RFR project also represents the largest risk to the project being completed on schedule and on cost. The RFR project consists of the removal and replacement of 480 pressure tubes, 480 calandria tubes, 960 end fittings and 960 feeder pipes for each of the Darlington four units. This requires the development, testing, manufacturing and maintenance of specialized tooling; the generation and verification of specialized procedures; and the training of the staff that will perform the field work. The project also includes the construction of a realistic reactor mock-up for the purposes of tooling testing, procedure verification and staff training.

The benefits of the mock-up started to be realized this quarter. Examples to date include:

- A dimensional discrepancy in the Re-Tube Platform (RTP) was identified and corrected.
- Validation of non-interference was validated, which removed one Temporary Modification (TMOD) from the vault. The removal of this TMOD results in a critical path savings of a few days.
- Panel locations and cable lengths have been verified.
- Tool Performance Guarantee (TPG) tests have started. Pressure tube (PT) cuts have been performed using the remote controls and the PT cutter. The cut was consistently performed within 20 minutes, which is about a factor of 3 better than the TPG.
- Tool integration testing has started and will be used in the development of the Class 2 estimate.

The tooling qualification testing continues and is currently on schedule. The strategy is summarized in the following diagram.



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- Establishment of a war room for the generation and review of CWP's in a timely manner.
- Have an OPG alignment meeting to establish a common understanding of the review process and turnaround times.
- Identify the key points and strategy for senior management oversight.

The OPG-JV Oversight Committee will monitor the progress of the Class 2 estimate as well as provide the initial reconciliation of differences in inputs into the estimate. This reconciliation effort will be highly active during the first quarter of 2015 in order to support the submission of mid April.

The design and construction of the Retube Waste Processing Building (RWPB) is required to be in-service by April or May of 2017 to support the RFR critical path. It is currently scheduled to be ready in January 2017, which provides little float between the planned and needed dates. The project is undergoing similar issues as the Campus Plan projects associated with the potential of underground services, as well as the management of potentially contaminated soil and water. In addition, it has several tie-ins with station services (civil, mechanical, electrical and instrumentation & control) and will require a large number of caissons. In the December oversight meeting the JV identified that approvals were being sought to extend the engineering completion date and schedule relief. In addition, a number of issues/opportunities were identified in meeting schedule and cost estimates. These included the engineering process to be followed and the quality requirements for the temporary building. The VP-Execution identified several actions to support the timely resolution of issues:

- Have the RFR team identify all issues to the senior management team and conduct a weekly meeting to address progress in their resolution.
- Establish weekly meetings with the station to identify and obtain needed support.
- Determine if it is possible to have building constructed as 'owner-only', which reduces the complexity of the engineering and quality processes.
- Include an RWPB dashboard in the monthly oversight meeting.

## **6.2 Fuel Handling/Defueling Project**

This project consists of two main subprojects – the defueling of the reactor to start the outage and the refurbishment of the fuel handling equipment and associated systems. An initial contract has been awarded to GE-Hitachi for equipment supply and technical support during the planning and execution of the defueling subproject.

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The most significant risk with this project is the reliability of the fuel handling equipment. At the current performance level, the equipment is challenged to meet current operational demands to fuel four operating units. However, the reliability will need to improve to meet the required duration to defuel the reactor, for installation of the bulkhead, and to support the fuel handling refurbishment schedule. Darlington station and refurbishment management initiated an upgrade project in the first quarter of 2013. Some work was accomplished through 2014, the most significant being the repair of the coarse drive for the trolleys. The Fuel Handling Equipment Reliability Index (ERI) showed improvement during the first three quarters of 2014, but then showed a negative trend in October and November, as seen in the below table. Although the trend is not a significant concern, the amount of work that is required to have confidence in the performance of the fuel handling equipment during the defueling of the reactor is significant for the next 18 months. This was recognized by the Executive Steering Committee at its Q4 meeting, in that they requested a detailed plan be developed for the recovery of the fuel handling equipment for the Q1, 2015 meeting. The draft plan was presented at the December 17<sup>th</sup> Fuel Handling Equipment Reliability Committee meeting. A number of the elements are identified at risk. The highest risk is associated with the return to service of the Service Area Rehearsal Facility (SARF). It has been idle for several years, and requires considerable work for it to be able to be used to support the defueling project.

	<b>Q1/14</b>	<b>Q2/14</b>	<b>Q3/14</b>	<b>Oct-14</b>	<b>Nov-14</b>
<b>ERI</b>	67%	71%	74%	70%	62%

The project has decided to replace the fuel trolley track system with the identical track. This reduces the cost and complexity of the work, including the elimination of the need to perform modification engineering.

### **6.3 Turbine/ Generator Project**

The scope of the Turbine/Generator includes:

- Steam Turbines and Turbine Auxiliaries: inspections, repairs, and/or replacements of generator components (including generator stator rewind) and a number of generator auxiliaries,
- Steam Turbines and Turbine Auxiliaries: inspections, repairs, and/or replacements of High Pressure (HP) and Low Pressure (LP) turbine components and a number of turbine auxiliaries;

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- Moisture Separator Reheater (MSR): inspection, overhaul, and/or replacements of MSR internals and auxiliaries (e.g. strainers, valves);
- Turbine Control Upgrade: replacement of the obsolete analogue Steam Turbine Electronic Control (STEC) System, includes entire Turbine Supervisory System with modern design (digital system); and
- Generator Excitation Upgrade: replacement of the analog Generator Excitation system controls with a digital design and a set of additional Generator Excitation and Protection equipment to resolve obsolescence issues.

A contract was awarded to Alstom for the design and delivery of the digital controllers as well as technical support during the execution of the project. The design work by Alstom is mainly on schedule on schedule, with some delays in the controllers that are not being included in unit 2's refurbishment.

The TG engineering integration and field installation vendor (SNC/Aecon Joint Venture (JV)) has submitted a class 3 cost estimate and a level 4 schedule for field execution. The JV has started the work for the Class 2 estimate, which has a milestone of the end of March. OPG senior management has communicated the expectation of efficiency gains (and thus cost reductions) since the JV has both the RFR and TG projects. The one small complication in the development of the Class 2 estimate is the fact that Unit 2's refurbishment does not include the modifications (including digital controllers). This results in reduced certainty in the overall Class 2 estimate.

This project is unique in that it includes one company (Alstom) providing the design and manufacture of equipment and technical expertise during the actual TG refurbishment and modifications, and one company (the Joint Venture) providing the interface engineering and the construction. This unique model requires increased oversight and integration by OPG, since the two companies are not fully integrated for the project.

#### **6.4 Steam Generators**

The Steam Generator project had its first senior management oversight meeting on November 24, 2014. Although the format of the meeting package was not aligned with the oversight meeting packages of the other projects, it did cover safety, quality, schedule and cost.

The Engineer Procure Construct (EPC) contract has been awarded to a consortium of Babcock & Wilcox Canada and Candu Energy Inc. The project consists of maintenance activities and modifications to meet the requirements of its Life Cycle Management Plan. This includes:

- Tube sheet waterlancing to address possible degradation from sludge accumulation

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- Installation of access ports to improve secondary side inspection capabilities for future inspection outages
- Primary side tube cleaning to improve overall thermal efficiency, increase neutron overpower margin and reduce radiation fields
- Divider plate leakage characterization to establish a baseline for cross flow between the cold and hot legs of the SGs
- Primary and secondary side ultrasonic, eddy current and visual inspections

Progress to date includes the completion and OPG acceptance of:

- Project Management Plan
- Project Controls Plan
- Engineering Plan
- Site Infrastructure Layout Plan

The status of the individual subprojects is:

- Access Port
  - Deliverables for project mobilization have been completed and accepted.
  - Detailed design report submitted.
  - Design review for Access Port Tooling completed.
- Waterlancing
  - Deliverables for project mobilization have been completed and accepted.
  - Design reviews completed for waterlancing tools
- Primary side cleaning
  - Deliverables for project mobilization have been completed and accepted.
  - Optimization test phases 1 and 2 of 4 complete
  - Preliminary engineering completed for all subsystems, with the exception of waste collection
- Primary side layup
  - Baseline schedule accepted by OPG
  - Design plans for manway cover completed and accepted

The contract is mainly fixed price. The overall SPI, as of the end of October is 0.89.

#### **6.4 Balance of Plant Project**

The Balance of Plant (BOP) scope consists of plant modifications and maintenance work in the following areas:

- Pre-refurbishment work
- Safety and Control Systems
- Reactor component systems
- Conventional Systems



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- Common Systems

The changes to the contracting strategy for the BOP delayed the awarding of the contracts and the start of engineering. All 13 engineering contracts have been awarded, with a large number being awarded to ES Fox. To reduce the potential of having similar engineering issues as it has in the Campus Plan and Safety Improvement projects, ES Fox has engaged a number of engineering companies as subcontractors, rather than rely on a single company. These projects are too early in the engineering phase to assess the effectiveness of this strategy.

The impact of the late implementation of the strategy is a risk to meeting the May 2015 milestone for the completion of engineering.

## **6.5 Station Readiness Projects**

There are a number of core refurbishment projects that are critical to support the refurbishment of the unit, but do not provide refurbishment of equipment. These are:

- Islanding projects. These projects are required to establish the physical and administrative separation of the refurbished unit from the operating plant, as well as separate a number of common areas for the duration of the refurbishment outage.
- Shutdown/Layup projects. These projects are in place to shutdown and layup individual systems at different stages and for different durations through the unit's refurbishment outage. This is required to protect the systems against corrosion and other damage mechanisms when not in normal operation.
- Services projects. These projects provide the needed services to support the unit's refurbishment outage. Such services include electrical, breathing air, service air, instrument air, and water.

In general, the Islanding projects are making use of the other contracts that align with its work in the same or adjacent area. For example, the EPC contract for the installation and removal of the bulkheads has been awarded to the R&FR Joint Venture. This is a sound decision since the JV has the most to gain from the timely installation of the bulkheads, there is elimination of coordination issues in the vault, and the required capabilities for the two projects are similar.

Since the strategy to perform the Shutdown/Layup and Services projects is the same as for the BOP projects (use of the ESMSA contractors), the issues, response and risks that were identified under BOP also exist for these projects.

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**6.6 Campus Plan and Safety Improvement Opportunities Projects**

The Campus Plan represents a number of infrastructure projects to support the refurbishment of the Darlington units. In addition, the campus plan includes the Safety Improvement Opportunity projects that OPG committed to the Canadian Nuclear Safety Commission (CNSC) through the Environmental Assessment process. The Campus Plan projects are being executed by the two ESMSA contractors and managed by the Projects and Modifications (P&M) organization on behalf of Darlington Refurbishment and include the following projects:

- D<sub>2</sub>O Storage Building
- Low Pressure Service Water Line Relocation
- Water and Sewer Upgrades
- Auxiliary Heating System
- Refurbishment Island Annex
- Power and Electrical
- OSB Refurbishment
- Emergency Power Generator #3 (Safety Improvement Opportunity)
- Powerhouse Steam Venting System (Safety Improvement Opportunity)
- Containment Filtered Venting System (Safety Improvement Opportunity)

These projects must be completed prior to the first unit's outage. The sheer amount of work associated with these projects represents a risk to the refurbishment project. It has taken close to a year for refurbishment management to recognize the severity of the challenge. The external oversight team identified significant issues related to the Campus Plan projects (specifically the D<sub>2</sub>O Storage Building and the Auxiliary Heating System) in its May 13<sup>th</sup> report to the OPG Board. This represented the accumulation of an adverse trend that was identified in early 2013 to a significant issue that was identified in early 2014, with the start of being address during the second quarter and has continued through the third quarter. Although there have been several actions in response to the performance issues, there remains a significant effort required for the completion of the projects prior to the start of the Unit 2 refurbishment outage. Key aspects of the current status include:

- [REDACTED]  
[REDACTED] In addition, OPG is directly managing the civil

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construction work while a revised plan and alternative contracting strategy is developed and implemented. OPG is also developing a contingency plan for the storage of the heavy water for the Unit 2 refurbishment outage. Because of the current status of the project, there is a need for a superseding business case for the project, along with a detailed cost estimate and schedule. This is expected to be provided to the OPG Board for approval in January 2015.

- Design engineering for EPG3 project (SIO project) was completed and accepted by the Design Authority in December 2014. The installation of the fuel lines has been delayed. It requires close integration with the station, which has been challenging during Q4. With the station's Vacuum Building Outage in the first half of 2015, the project will have a struggle to obtain the required support to accomplish key activities. The most significant risk for the project is the required station commitment and resources to conduct the commissioning of EPG3 after its construction and installation. The current schedule has an in-service date of September 2015.
- The AHS (Campus Plan project) project made good progress in the civil construction of the building in Q4. Engineering delays have resulted in a risk to meeting the completion milestone of July 2015. There was a vendor quality issue in the construction of the system's deaerator. Although it was identified by ES Fox in a pre shipment inspection, it does highlight the need for a strong inspection and quality program for all parts and materials.
- Installation work for the Powerhouse Steam Venting System (PSVS, an SIO project) started in Unit 2 in early December. This project is on schedule to meet the Available for Service (AFS) milestone of October 2015.
- The Shield Tank Overpressure Protection (STOP, an SIO project) has engineering complete and is on schedule to meet its AFS milestone of April 2016.
- The Containment Filtered Venting System project (CFVS, SIO project) had design engineering packages accepted by the Design Authority in December 2014, meeting its milestone for completion of engineering. There were issues related to the first VD10 tie-in. Although there was significant amount of oversight, including the use of OPG's Event Free Challenge process, the tie-in was not started on the scheduled weekend. This was a result of the required valve not being delivered, the realization that a scaffold was needed for installation and the cancelation of the window by the station. In this case, the event free challenge process was not effectively implemented. However, there was not an SCR initiated to ensure lessons were learned and addressed prior to the VD9 tie-in. The second attempt for the tie-in also failed as a result of an inadequately engineered scaffold. The third attempt was successful.

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In conclusion, the Campus Plan and Safety Improvement projects are behind schedule and thus pose a risk to the start of Unit 2's refurbishment outage. OPG refurbishment management continue to drive completion of projects.

## 7. Oversight of the Darlington Refurbishment Program

Both OPG and the Ministry of Energy (MOE) understand the need for a successful refurbishment for the Province, the company and the industry. In line with that importance, the Minister of Energy established the role of independent advisor and OPG established the role of an external independent oversight team reporting to the OPG Board. This team consists of individuals from the companies Burns & McDonnell and Modus.

The OPG external independent oversight team issued its Q4 report to the OPG Board in November 2014. A summary of the issues and status identified in the report and alignment with the MOE's reports is provided in the following table:

<b>OPG External Oversight Assessment</b>	<b>MOE Assessment</b>	<b>Comments</b>
Campus Plan projects continue to have schedule and cost risk (particularly the D <sub>2</sub> O Storage project). There is considerable focus on the D <sub>2</sub> O Storage project because of its magnitude and issues. It is acknowledged that the AHS will not be ready for the VBO outage. P&M's efforts to develop and update Campus Plan projects have had mixed results. These schedules require improvement in critical path definition, logic and resourcing.	The Campus Plan and SIO projects remain rated as Red based on cost overruns, schedule delays, quality issues and some safety performance events.	Consistent alignment between the two groups.

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<b>OPG External Oversight Assessment</b>	<b>MOE Assessment</b>	<b>Comments</b>
Based on the results of the 4d cost estimate, management is committed to not exceeding the \$10B (2013\$) cost.	The current challenge is the sustainability of the assumptions and opportunities identified in the 4d cost estimate.	Both recognition of the need to maintain the total cost within the bounding estimate of \$10B (\$2013).
The concerns of late tooling impacting the quality or timing of the class 2 estimate has been alleviated as a result of the JV's tooling recovery plan. As of the end of September, detailed engineering was 53% complete, with some delays. Class 2 estimate is progressing slowly. There is concern over the design, construction and commissioning of the Retube Waste Processing Building (RWPB).	Good progress in the tooling performance testing, although more effort on the tooling movement, setup, changes and teardown would be useful to determine the overall time for the retube of the reactor. Concerns expressed in the development of the class 2 estimate as well as the design and construction of the RWPB.	Good alignment between the two groups.
The oversight team supports the increased engagement of engineering with the design agencies. The team believes that the majority of engineering work will be completed by May 15, since the work at risk is BOP, Shutdown/Layup and additional facilities, which represents 8% of the total direct cost of the project. The team acknowledges that the current engineering work down curve can be achieved by May 15 <sup>th</sup> , and if the curve is accurate the required effort will overstress OPG engineering resources during the approval cycle.	Remains as a program challenge and red rating due to the immature engineering schedule or work down curve at the EC level, immature quality dashboard, and not reviewing these indicators at a senior management project forum. The lack of effectively managing the engineering workload challenges meeting the engineering complete with quality.	There is not alignment between the two groups in the progress made in the engineering function.

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<b>OPG External Oversight Assessment</b>	<b>MOE Assessment</b>	<b>Comments</b>
Concern for the need of the ESMSA contractors who have recently been awarded contracts to mature rapidly to make up for the initials delays resulting from the changes in OPG's contract strategy.	Concern remains over OPG's performance in managing the work of the ESMSA contractors to meet high performance standards related to safety, quality, cost and schedule.	There is good alignment in this area.

**8. Alignment with the Principles of the Long Term Energy Plan**

The MOE's 2013 Long Term Energy Plan identified seven principles by which it expects OPG and Bruce Power to follow in the development and execution of their respective units. The following table provides observations which demonstrate alignment by OPG as well as opportunities for additional alignment.

<b>Principle</b>	<b>Observations of Alignment</b>	<b>Possible Opportunities</b>
1. Minimize commercial risk on the part of ratepayers and government.	<p>The majority of DNR contracts are fixed/firm price with the remaining tied to cost and schedule performance.</p> <p>Commercial individuals embedded on each project team to manage commercial risk.</p> <p>Project scope has been defined to the component level, and detailed engineering will be completed prior to the start of construction.</p> <p>OPG has invested in a reactor mock-up and training facility, to perform full testing of the tools, processes and procedures, as well as train staff prior to performing work on the actual reactors.</p> <p>The contract with SNC/Aecon includes provisions that allow OPG to take over the tooling and the mock-up at the conclusion of the Definition Phase if the parties are unable to negotiate the target price contract for the Execution Phase.</p>	<p>Incentives in the RFR contract were developed and established on the basis of four unit performance, allowing the RFR contractor to make-up cost overruns and schedule delays to the first unit on subsequent units. However, the LTEP prioritizes the urgency of a success on Unit 2. This will need to be included in the Class 2 estimate for the RFR and TG projects.</p>

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Principle	Observations of Alignment	Possible Opportunities
2. Mitigate reliability risks by developing contingency plans that include alternate supply options if contract and other objectives are at risk of non-fulfillment.	<p>One DNR contingency action contributing to this principle is the decision to start the second unit after unit 2, rather than overlapping the units.</p> <p>In addition, the effort to improve the reliability of fuel handling equipment reduces the chance that fueling of the operating units will be reduced during the defueling of the refurbishment unit.</p>	
3. Entrench appropriate and realistic off-ramps and scoping.	<p>Each contract has an off-ramp for termination. Reimbursement limited to reasonably incurred costs.</p> <p>Each unit requires unit-by-unit approval provide well-defined off-ramps.</p> <p>A scope review by senior management was completed in Q4/13 to reduce scope to work required for life extension or can only be done in drained/defueled state.</p> <p>The yearly release strategy and gating process for funding individual project initiatives has wide visibility and adherence within the DR Team.</p>	Ensuring the scope that is required for life extension, though performed outside of the DR Project, is staffed, funded and executable.
4. Hold private sector operator accountable to the nuclear refurbishment schedule and price.	Not included in this oversight.	
5. Require OPG to hold its contractors accountable to the nuclear refurbishment schedule and price.	<p>Schedule accountability is built into each contract. The contractor is required to provide a detailed schedule for planning (and later execution). This schedule is reviewed monthly during planning phase.</p> <p>Cost accountability is built into contracts to establish target cost and incentives/disincentives.</p>	<p>The estimating process has undergone changes as a result of the significant variances between the contractors' estimates and OPG's estimates.</p> <p>The RQE will require work to reduce the assumptions by contractors that contribute to potential higher than planned contract values.</p>

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Principle	Observations of Alignment	Possible Opportunities
	<p>Monthly senior level meetings OPG are improving its oversight to monitor performance.</p> <p>Each OPG project team includes Project Controls member to monitor and report cost and schedule performance.</p> <p>OPG has chosen to perform the work in the Execution Phase on a target price basis which increases the contractors' transparency. This will enhance OPG's ability to resolve issues as they arise.</p> <p>There is an executive steering committee for major projects that includes the CEOs and senior executives of OPG and he contracted vendors.</p>	
<p>6. Make site, project management, regulatory requirements and supply chain considerations, and cost and risk containment the primary factors in developing the implementation plan.</p>	<p>Site and regulatory requirements are the inputs to the defined scope.</p> <p>The Unit 2 execution organization is being defined and filled. It will likely be fully established in Q2, 2015.</p> <p>There is an agreement between the station and refurbishment on the condition that the unit will be turned over to the project and then returned to the station.</p> <p>The program is being managed in accordance with PM Institute standards and INPO project principles.</p> <p>Cost estimate process used Association for Advanced Cost Engineering (AACE) best practices. Cost estimate is understood by team and the cost ceiling is routinely communicated to staff.</p>	<p>Improve the ability to identify and address adverse trends in performance in a timely and effective manner.</p>



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Principle	Observations of Alignment	Possible Opportunities
	<p>Risk management is recognized as a key element of success, a program is in place, but its implementation requires improvement.</p>	
<p>7. Take smaller initial steps to ensure there is opportunity to incorporate lessons learned from refurbishment including collaboration by operators.</p>	<p>To fully incorporate lessons learned from the first unit's (Unit 2) refurbishment, the second unit's (Unit 1) start has been delayed until the completion of the first unit.</p> <p>If appropriate, other units may be able to be delayed to continue this risk reduction. However, this will likely result in an overall increase in cost.</p> <p>To reduce risk for the first unit, the decision was made to install its digital controller in a future outage.</p> <p>To prevent the risk associated with single source suppliers of key reactor components, OPG has qualified second vendors for key components. This will help Bruce Power with an associated materials risk.</p> <p>Bruce Power and OPG refurbishment organizations have started to cooperate in several areas, summarized below.</p> <p>OPG and Bruce Power have negotiated Project Agreements with the Building Trades Unions.</p>	

OPG and Bruce Power refurbishment management have met on two occasions to develop areas in which they can be mutually supportive. The next meeting is planned for January 2015. The following are areas in which collaboration is being sought by senior management:

- Common dose management initiative aligned with EPSCA.
- Project dose estimates.

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- Use of 10 hour days with staggered starts to permit around the clock coverage.
- Evaluate performing system drain and dry in parallel with bulkhead installation.
- D<sub>2</sub>O storage techniques
- Camera protocols used by Bruce Power in its previous refurbishment outages.
- Balance of Plant preventive maintenance strategy.

## **9. State of Readiness**

The Nuclear Refurbishment program is fully into its Definition Phase to support the successful execution of Unit 2, starting in October 2016. There are several areas that provide high confidence that the organization is tracking to a high state of readiness by this time; including:

- Regulatory approvals have been received for the Environmental Assessment, Integrated Safety Review, and the Global Assessment Report. There has been agreement with the CNSC on the Integrated Improvement Plan, with written acceptance expected by the end of December, 2014.
- Scope for life extension and the work required to be performed during the refurbishment outage are defined and approved. The remaining challenge is to identify the period to perform non-refurbishment outage work that is required for life extension.
- Project management processes and oversight monitoring are in place for the project. These include schedule performance, cost performance, scope control and risk management.
- The 4d cost estimate was submitted to the OPG Board in November, 2014. It maintains the overall cost to be within the bounding case of \$10B (\$2013). The Release Quality Estimate (RQE) (scheduled for October 2015) needs to sustain the assumptions and opportunities that contributed to the basis of the 4d cost estimate.
- The project management and support organization is in place for the Definition Phase and assembly of the execution organization has started.
- Contracts are in place for the Definition Phase to ensure planning is complete prior to Unit 2 breaker open. This includes the completion of engineering, the

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purchase orders for parts and materials, work procedures, and the establishment of execution contracts.

- To date, over 95% of the non project scheduled work is being completed. This includes on-line work and outage work. However, work that is planned and is not ready is not scheduled. As a result, this is not the best performance indicator of completing work to be ready for the refurbishment outage. Starting next quarter the percentage of planned work that is completed will be reported.
- There is a draft Level 1 plan for Critical Path of the execution phase of the program. This can be reviewed, along with its basis, to identify initial risks for execution.
- The Class 2 estimate for the Re-Tube and Feeder Replacement project is under development with a target completion date of April 2015. There are several challenges in meeting this date with the alignment between the JV and OPG, resulting in increased oversight by the project management team and the project steering committee.
- Work is well underway to refine the Level 1 execution plan to better define Critical Path as well as define the non critical path windows with logic ties.

However, there are challenges that OPG need to address to increase the state of readiness to a comfortable level. These include:

- The assumptions and opportunities that make up the 4d cost estimate need to be sustained through the establishment of the Release Quality Estimate.
- Management of the detailed design engineering workload to ensure that the May 2015 milestone for engineering to be completed is met with quality products.
- The current performance of the ESMSA contractors has resulted in a risk that some work required for the start of refurbishment may not be completed. OPG is working with senior management of the ESMSA vendors to implement actions to improve performance and meet milestones.
- Refurbishment management needs to implement concrete actions to prevent the performance issues that occurred during the Campus Plan and Safety Improvement Opportunity projects.
- The initiative to improve the reliability of fuel handling equipment needs to start making progress in the development and implementation of detailed plans in order to obtain confidence that defueling and bulkhead installation will meet their Critical Path Duration.

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Although there are specific challenges that OPG needs to successfully overcome, they continue to have established the framework that is needed to be ready to successfully execute the refurbishment of the four Darlington units beginning with the first unit in October 2016.

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# **Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program**

**For the Quarter ending March 31, 2015**



Mike White  
CALM Management Consulting, Inc.  
April 5, 2015

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## **1. Minister Summary**

This report provides the detailed quarterly review of trends, accomplishments and challenges related to the Darlington Nuclear refurbishment project. The project is reaching a critical phase, with completion of Definition Phase by yearend of 2015 and the start of execution of some core refurbishment projects in the second quarter of 2015. Between now and breaker open the refurbishment organization will be executing projects associated with the Re-tube Waste Processing building, refurbishment support facilities, services and shutdown/layup projects.

Refurbishment management is progressing well towards being in a state of readiness for breaker open. This progress includes:

- The Life to date total cost of the project as of the end of February 2015 is \$1,682M, which is \$135M below the plan of \$1,817M.
- The Release Quality Estimate is currently under development to meet its October 2015 milestone. The RQE will include the cost estimate for the four units, the Level 1 plan for the four units and Level 3 schedule for Unit 2, the refurbishment outage scope for each unit and the execution strategy.
- Regulatory approvals have been received for the Environmental Assessment, Integrated Safety Review, and the Global Assessment Report. There has been agreement with the CNSC on the Integrated Improvement Plan, with written acceptance tied to the Darlington operating license renewal process, scheduled in 2015.
- Scope for life extension and the work required to be performed during the refurbishment outage are defined and approved. The work not performed as part of the refurbishment outage will be executed by the station and Projects & Modifications.
- Although there is a challenge to meet the August milestone, engineering will be complete in sufficient time before breaker open to support downstream activities, such as the order of materials and generation of field execution instructions.
- Scope and responsibilities of functional departments are documented in Functional Management Plans, assumptions on the support needed for each project have been identified and documented, and responsibilities for the transition of the unit between Darlington Operations organization and refurbishment organization have been accepted by both.
- The project management and support organization is in place for the completion

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of the Definition Phase and the transition into the execution phase has started.

- The assembly of the execution organization has started. There is the commitment to hire a construction management company to support the project's execution phase. In addition, an Executive Performance Assurance Group will be established to provide execution oversight.
- Contracts are in place for all projects to complete the engineering and develop the estimate (cost and schedule) required for the RQE.
- The Class 2 estimate for the Re-Tube and Feeder Replacement project is under development. There are several issues that still need to be resolved to OPG's satisfaction. These issues have resulted in an increased, yet appropriate level of oversight by senior refurbishment management and OPG's CEO.
- The RFR full scale reactor mock-up is proving to be a valuable asset in the verification of tool designs and validation of Tooling Performance Guarantee (TPG) durations. Its value will increase in the refining of the procedures for the reactor face series, and the training of re-tube face and feeder replacement personnel.
- Pre-production qualification runs for the major reactor components are well in progress.
- The on-boarding center, fully operational in the first quarter, has significantly improved the time it takes for individuals to complete administrative, security, training and radiation protection tasks in order to obtain site access.

Although OPG is making good progress towards breaker open readiness, there are a number of issues that need to be resolved to increase the comfort level of successful execution. These include:

- Probably the most significant need is for the refurbishment organization to demonstrate effective execution of field work in 2015 and 2016. The current focus on execution is to put the infrastructure (processes, facilities and organization) in place for breaker open. However, the current execution of prerequisites provides an opportunity to ensure contracts are effectively managed and contractors perform to the expected standards. In addition to addressing performance issues as they arise, management needs to incorporate lessons learned from the Campus Plan and SIO projects during this early execution phase.
- However, with the lack of high performance in the Campus Plan and SIO projects and the JV's RWPB, there has been little demonstration of effective management



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of contractors to perform field execution to high performance standards. This demonstration should be led by the core refurbishment execution team, and encouraged prior to breaker open.

- Tied to execution is the fact a good fraction of the work is first time execution for the vendor, very infrequently performed work or first of a kind method. This refurbishment outage is the first time for the Joint Venture to execute a re-tube and feeder replacement. It is the first time in a decade for B&W to clean the Darlington steam generators. And the equipment and process for the handling and reduction of re-tube radioactive waste is first of a kind. OPG has taken a number of actions to mitigate the risk – the most visible being the full-scale reactor mock-up. The need for OPG to have effective oversight and the ability to identify and respond to degrading execution performance is essential for project success.
- There is confidence that the RQE will be completed on time. However, there is a risk that the JV's target price plus requested contingency will exceed the class 4d estimate by a sufficient amount to have a target price not achieved. OPG and the JV are working diligently to resolve a number of remaining issues. A failure to achieve an acceptable target price will require OPG to implement an alternative plan in a relatively short period of time.
- The performance of the fuel handling equipment during the defueling of the reactor will set the stage for the first phase of the refurbishment outage. The station has an initiative to improve fuel handling equipment reliability. This initiative is challenging, and is being monitored by a station oversight committee and the Defueling Project's senior management oversight committee.

In summary, OPG has the infrastructure and framework for execution of the outage at the time of breaker open. The ability to demonstrate successful execution of projects and initiatives during the next 18 months will be needed to provide confidence in the ability to effectively execute the outage.

There have been several upcoming changes within the refurbishment organization identified this quarter. The President and Chief Executive Officer, Tom Mitchell, has notified the OPG Board of Directors of his intention to resign when a replacement is identified. Glenn Jager has been appointed President of OPG Nuclear and Chief Nuclear Officer. This will continue the current situation of one senior executive having responsibility for both nuclear operations and the Darlington Refurbishment Project. In addition, the Director of Operations and Maintenance (DOM) and the Maintenance Manager have notified the organization of their upcoming retirement. The new DOM will be the fourth in just over two years, a challenge to both knowledge retention and consistent direction within that organization.

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The challenges that were identified in the fourth quarter continue to exist, with some change in focus to assist OPG in understanding their significance. These challenges represent performance trends that should be addressed to reduce the possibility of becoming significant issues.

The first challenge is related to the management of the large engineering workload. The milestone for the completion of engineering is August 15, 2015 with an early date of May 15<sup>th</sup>. There is a significant number of engineering packages (over 250) that require to be approved by the Design Authority in this period. Even if the milestone is not met, there will be little impact on the quality of the Release Quality Estimate or the ability to be ready for breaker open. The concern is the potential impact on the quality of the design engineering products from the possible perceived time pressure combined with the robustness of OPG's owner acceptance process to identify quality issues in design products. Since engineering errors are latent in nature (not likely detected until installation, commissioning or operation), it is important that there is strong confidence in the owner acceptance process and its effective implementation. That is the basis for a recommendation that WANO be requested to review OPG's process for rigor and implementation. The Vice President of Refurbishment Engineering has recently expressed concern regarding the current level of design engineering errors. He is planning a stand down for all engineers to reinforce quality expectations, and is considering a request to WANO for a review.

The second challenge is for refurbishment management to implement robust actions to address the many lessons learned from the problems and issues seen in the planning and execution of the Campus Plan and Safety Improvement Opportunity projects. Actions have been implemented for the planning (definition) phase of the project. Actions for the execution phase are still in early development. Although this is sufficient time for breaker open, there is a need to take selective actions to manage the execution of core projects scheduled for 2015 and 2016.

The third identified challenge is related to the Release Quality Estimate. OPG has an infrastructure in place for its development and has hired KPMG to provide an independent assessment of the process and results. The current challenge is to address a number of the issues of which OPG has knowledge and is addressing. In particular, since the RFR project represents the largest component of execution, the ability to reach an acceptable target price with the Joint Venture (JV) is the largest risk. Identified issues are being worked by the RFR project team and the JV, with an appropriate amount of participation and oversight by the senior management of all involved companies.

## **2. Purpose of Report**

This quarterly report provides a more detailed review and expansion of the monthly reports to the Ministry of Energy of OPG management's progress to plan and execute a

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successful refurbishment outage of the Darlington nuclear units. Success is defined as the preparation and execution of 100% of the correctly identified project scope safely, on schedule, within budget and with quality. It is the belief of the MOE's Independent Oversight Advisor that the Refurbishment Program Challenges that are identified in Section 5 deserve consideration by OPG Refurbishment management. It is the intention to identify such challenges when they represent an early trend rather than wait until they become a significant issue.

**3. Darlington Nuclear Refurbishment Scorecard**

**3.1 Darlington Nuclear Refurbishment Scorecard – March 2015**

	Current Month	Previous Month	Trend	Notes
<b>Unit 2 Readiness for Breaker Open</b>				
Safety Performance and Preparations for Unit 2	x	x	→	
Regulatory Approvals	✓	✓	→	
Risk Management	✓	✓	→	
Release Quality Estimate	x	x	→	
Cost Management	✓	✓	→	
Unit 2 Refurbishment Core Projects Readiness	✓	x	↗	
Unit 2 Execution Readiness	✓	✓	→	
Unit 2 Return to Service Readiness	✓	✓	→	
Unit 2 Execution Schedule Development	✓	✓	→	
Unit 2 Scope Control	✓	✓	→	
Resource Management	x	x	↘	
<b>Field Execution</b>				
Performance of Campus Plan & Safety Improvement Opportunity Projects	x	xx	↗	

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	Current Month	Previous Month	Trend	Notes
Unit 2 Prerequisite Work	x	x	→	
<b>Learning and Oversight</b>				
Operating Experience & Corrective Action	✓	✓	→	
Oversight	✓		→	

**Basis for Scorecard Ratings**

Safety Performance and Preparations for Unit 2– YELLOW

Execution of the Campus Plan and Safety Improvement Opportunities (SIO) projects has had a number of safety events during the last quarter of 2014 and first quarter of 2015. The trend includes events related to lifting and rigging; work at heights and vehicle movement. P&M management has initiated an adverse trend investigation in response to these events. In addition, the contractors have taken actions to improve safety performance, including strengthening field observation and coaching and reinforcement of standards during pre-job briefings and supervisory turnover.

During the first quarter OPG decided to cancel the request for proposal for radiation protection service and perform it themselves. OPG has high standards in radiation protection and the program to support them. The challenge for OPG is to establish the infrastructure to be prepared to train with RFR and execute RP services, as well as have radiation protection oversight of the effectiveness of the services.

Regulatory Approvals – WHITE

The CNSC provided a letter to OPG stating that the revised Integrated Implementation Plan (IIP) meets the intent of CNSC regulatory document RD-360. The CNSC staff accepts OPG's IIP Revision 001 with implementation of specific changes that were documented in the letter. The changes are required to be made in the document's revision for submission to the CNSC in support of the 2015 licensing renewal for the Darlington nuclear plant. The IIP represents OPG's commitment to the CNSC in response to findings of the Environmental Assessment and Integrated Safety Review.

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Risk Management – WHITE

There was one Risk Oversight Committee meeting during the first quarter of 2015. The Risk Management program has identified Nuclear Refurbishment Key Risk Areas, which are the result of an aggregate analysis of the risk registry. They have management sponsors who are responsible to monitor the progress of the individual risks associated the area for the development and implementation of mitigating action plans. These Key Risk Areas and status are:

- Availability/Retention of Key Staff (identified as improved from Red to Yellow risk)
- Cost and Estimating Management (identified as improved from Red to Yellow risk)
- Completion of Unit 2 Prerequisites (remained as a Yellow risk)
- Regulatory Approvals (remained as a Yellow risk)
- Fuel Handling Reliability (remained as a Yellow risk)
- Vendor Default/Continuity Planning (remained as a Yellow risk)
- Integrated Schedule Development (remained as a Yellow risk)
- Timely Procurement of Materials (remained as a Yellow risk)
- Completion of Engineering (remained as a Yellow risk)
- Integration with External Organizations (remained as a Yellow risk)

There has been some improvement in the development and implementation of mitigating actions to reduce the individual risks associated with these key areas.

During the first quarter there has been an increased focus on the development of the contingency funding for both program and project risks. This work is required to support the generation of the Release Quality Estimate. The methodology for quantifying the contingency value for risks was assessed by Palisades Corporation, the provider of the software that OPG is using for contingency funding determination. The assessment concluded that the documentation and methodology to build the Contingency Calculation inside the Risk Management process are consistent with quantitative risk management best practices that Palisade aligns with during its consulting engagements. The report also states that the execution of the model needs optimization, and some improvements could be made to increase the accuracy of this result. The report provided a number of recommendations to support this improvement.

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Release Quality Estimate (RQE) - YELLOW

OPG has created a strong focus during the first quarter to meet the October 2015 milestone for the RQE submission. The RQE has four major deliverables:

- The cost estimate for the refurbishment of four units, including contingency. This requires a detailed understanding of the basis and assumptions for the outages and the associated risks.
- A schedule for the four units – detailed for level 2 and high level for the remaining units.
- Confirmation of the scope of the project and specifically Unit 2. This not only includes the scope of the refurbishment outage but also the commitments to the CNSC tied to the unit's return to service but assigned to the station.
- The Execution Strategy for Unit 2. This includes many items that have not been effectively implemented during execution of the Campus Plan (CP) and Safety Improvement Opportunity (SIO) projects. These are described in the challenge for incorporating lessons learned from the CP and SIO projects.

The project has a dedicated team and plan for the generation of the RQE. Key deliverables that will be monitored for the Minister of Energy are:

- The refurbishment team will develop and document the RQE Basis and significant assumptions. The first draft of the RQE basis scheduled for April 1<sup>st</sup>.
- Ongoing resolution and finalization of issues related to assumptions and the Basis of the Estimate is scheduled for June 1<sup>st</sup>.
- Design Authority approval of engineering deliverables for modifications by August 15<sup>th</sup>, with an early date to support the development of RQE by May 15<sup>th</sup>.
- The submission of the Joint Venture's Class 2 estimate for the RFR project is scheduled to be submitted to OPG by April 10<sup>th</sup>, with OPG acceptance/rejection by June 15<sup>th</sup>. The date for submission has been revised to May 8<sup>th</sup>.
- Completion of individual core project estimates by June 30<sup>th</sup>.
- Department Functional Management Plans completion of revision by May 1<sup>st</sup>.
- Department functional estimates of costs by May 15<sup>th</sup>.
- Execution Strategy Plan initial draft to be issued for review by March 15<sup>th</sup> with final issuance by May 1<sup>st</sup>.

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- Level 3 schedule to be submitted for Unit 2 refurbishment outage by June 30<sup>th</sup>, along with Level 1 for the remaining outages.
- Unit 2 cyclic outage scope freeze, cost estimate and schedule scheduled for April 1<sup>st</sup>, with the Level 1 schedule submitted July 15<sup>th</sup>. Although this is being done as part of the refurbishment project, it is the routine outage required for the maintenance of equipment and systems not in the refurbishment scope.
- RQE data freeze date, including scope, cost estimate, schedule and strategy, is June 30<sup>th</sup>, with the completion of the report by October 15<sup>th</sup>. It is submitted to the OPG Board of Directors in November. During July through September, the project will develop resource and cash flow reports, validation of project and function estimates and contingency analysis will be performed.
- OPG has scheduled an external 3<sup>rd</sup> party review of RQE starting in March.

The current status of the development of RQE includes:

- Scope validation for individual projects planned for the refurbishment outage was completed by February 27<sup>th</sup>. The Life Extension work that has been moved from the outage to the station will need to be managed by OPG to ensure all life extension work is completed.
- KPGM has been selected to perform the independent review of the RQE process and results. This review started in March and will continue until the RQE is submitted.
- The Joint Venture (JV) is working towards Class 2 estimates for the RFR and Turbine Generator projects. These represent about 70% of the overall cost of the core projects. There will be obstacles to obtain an estimate that is acceptable to OPG. Examples are provided in Section 6, Refurbishment Program Challenges.
- Reviews of the program basis for the refurbishment outage (and thus RQE) and the key assumptions made by the projects and functions have been started. Defining the basis is essential for the development of the cost estimate. Decisions need to be made in several areas including:
  - The source of funding for life extension projects that are not included in the nuclear refurbishment outage requires to be identified.
  - The condition of the unit that is turned over to refurbishment organization and the returned condition need to be defined in detail. This includes the action and responsibility on the discovery of emergent work that is directly

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related to the refurbishment projects and emergent equipment conditions that are outside the scope of the core projects.

- The duration of the outage and the state of the unit (synchronization, commercial operation, full power) for return to the operations organization.
- The start of Unit 3's outage as related to the completion of Unit 2's outage.
- Shift structure for critical path for each phase of the outage. There currently is a question regarding the RFR shift structure.
- An initial RQE scorecard has been developed.
- Monthly management alignment meetings have been initiated to provide direction and alignment to the organization (projects and functions) on the RQE requirements, schedule and progress.

The sheer magnitude of the RQE effort, its overall importance to the approval for the start of the Unit 2 refurbishment and the relatively short schedule has resulted in this being identified as a challenge. The Yellow rating is reflective of the need for monitoring, not current performance.

Cost Management - WHITE

For the purpose of this scorecard, cost management has been separated from the risks associated with the basis and assumptions for the refurbishment project, which are captured under the RQE element. Life to date total cost of the project as of the end of February 2015 is \$1,682M, which is \$135M below the plan of \$1,817M.

The release 4d estimate was approved by the OPG Board of Directors at its November meeting. The release was for \$1,124M to complete the 2015 planning activities for a cumulative release of \$2,732M. The bounding cost estimate for the project remains within \$10B (2013B). The breakdown of this estimate, its evolution since 2009 and resulting impact on LUEC is shown in the following table.



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<b>2014\$</b>	<b>2009</b>	<b>2013 (release 4c)</b>	<b>2014 (release 4D)</b>
Project Estimate	n/a	\$7,223M	\$7,635M
Contingency	n/a	\$2,133M	\$2,135M
Management Reserve	n/a	\$844M	\$430M
TOTAL	\$10,970M	\$10,200M	\$10,200M
Levelized Unit Energy Cost (LUEC)	8.9¢	7.7¢	7.8¢

Unit 2 Refurbishment Core Projects Readiness - WHITE

The readiness of the core projects is a measure of the completion of engineering, the ordering of parts and materials, the generation of Comprehensive Work Packages (CWPs) to execute the work in the field, and the development of Class 3 estimates (Class 2 for the RFR and TG projects). Design engineering has a challenge to meet the early milestone of May 15<sup>th</sup>, with the quality for the successful completion of the project. However, that challenge is with respect to meeting an early target date for the August milestone. Engineering is progressing at a rate that it will be a risk to breaker open, even if the milestone is not met. Strategy for the procurement of parts and materials is in progress for some projects, but under development for Balance of Plant and Shutdown/Layup. The generation of CWPs and cost estimates requires the same focus as the completion of design engineering deliverables. This includes the needs to be incorporated into schedules and monitoring through work down curves.

Unit 2 Execution Readiness - WHITE

In recognition of the challenge of the refurbishment project and to increase the overall project execution capability, OPG is seeking a contractor partner to provide project execution management support and oversight services. Selection of a partner is expected in early April.

The execution strategy is currently under development as one of the four elements of RQE. There are several decisions that need to be made for execution; including the providing of common services and consumable materials, the demonstration of equivalency with OPG programs (such as FME, lifting and rigging, control of chemicals),

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and the interface with Darlington operations during the start of the outage prior to unit islanding.

There currently is some overlap in the areas of responsibility for the Execution organization and the Operations and Maintenance organization. Refurbishment senior management should review the structure of the organizations to determine if cost savings, efficiency gains and improved effectiveness can be obtained through their amalgamation.

There were execution problems during the initial stages of the Campus Plan and Safety Improvement Opportunity projects. The focus of refurbishment execution planning is breaker open. However, execution has started with the RWPB and will increase significantly through the remainder of 2015 and through 2016 until breaker open, with shutdown/layup, services, refurbishment support and islanding projects. Refurbishment management should consider a staged implementation of its execution organization, processes, meetings and facilities to both enhance the execution of these projects and correct performance weaknesses prior to breaker open.

Unit 2 Return to Service Readiness - WHITE

OPG refurbishment management recognizes the need to start the strategy to perform commissioning of systems and return the unit back to service upon the completion of each unit's refurbishment. This is seen in a Return to Service section reporting to the Refurbishment Director of Operations and Maintenance, as well as an associated functional management plan. It is recognized that the strategy is still in early development and will require a step change in detail to support the development of the RQE, as compared to the Class 4D estimate. This work is currently in progress.

Unit 2 Schedule Development - WHITE

Progress is being made with the further refinement of the Level 1 refurbishment outage schedule. The current focus is on reviewing vertical slices of the critical path sequences in order to identify constraints on non-critical path windows being performed in parallel at specific times. This will support the goal of minimizing the likelihood that Balance of Plant work will become critical path towards the end of the refurbishment outage. In addition, the development of a detailed schedule (Level 3) for Unit 2 execution is in progress. The revised Level 1 plan and Level 3 schedule are deliverables for the RQE.

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Unit 2 Scope Control - WHITE

The scope for the Unit 2 refurbishment outage is well defined, and is controlled by an established process and Unit Scope Control Board. This controls any desire to add additional work to the outage as well as drop necessary work. It is expected that some scope addition will occur as a result of discovery work associated with the core projects, as well as corrective maintenance on components that are planned to be operating during the outage. Some of this work will need to be done, and the RQE contingency funds will recognize this reality. The work performed within the core refurbishment projects is not the only source of work to be performed during the outage period. Additional work will be done as a result of:

- The Unit 2 cyclic outage will be performed during the unit's refurbishment outage. Its scope includes corrective maintenance and preventive maintenance activities that are not included in the core refurbishment projects, but necessary for the continued health of the asset. The scope of this outage is in the process of being defined and controlled through a separate scope control process. Its scope and associated estimate are required to support the submission of the RQE.
- There will be a number of projects managed by Projects and Modifications that will be conducted during the refurbishment outage period. They are not associated with the refurbishment outage and thus will not be part of RQE. However, the scope of work needs to be fully defined and controlled to prevent impact on the core refurbishment project.
- Although not funded by the refurbishment project or part of its scope, the station organization has a number of work activities for which it is responsible and has a CNSC commitment for completion prior to Unit 2 start-up. These will be managed through established station processes.

The first Unit Scope Review Board meeting was conducted in February. There were fourteen AISC projects brought to the meeting for consideration to be included in the refurbishment outage. Two were accepted into the outage. Four were withdrawn by the station. The remainder required further information to be provided for a decision to be made. The main lesson from the meeting was the need for the station and sponsor of the work to be better prepared with the supporting information. However, an expectation that the engineering for these projects must meet the refurbishment milestone for engineering complete has the potential to result in work important for long term operation may not be done. Few (if any) of these projects will have the engineering completed by August 2015. The importance of completing all engineering prior to the start of the outage is recognized. However, the early engineering milestone was set to support the development of the RQE. Since these projects are not part of the refurbishment scope

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and not included in the RQE, the need for such an early date is not justified, particularly if it results in not performing important work. This potential risk will be monitored.

**Resource Management - YELLOW**

The availability/retention of key project staff is identified as one of the program's Key Risk Areas. It consists of:

- The possibility of limited skilled trade resources and supervision for project execution as its highest program risk. Currently the trades unions predict that there may be a total shortfall of approximately 50,000 personnel during the duration of the Darlington refurbishment. They have also identified poor progress in increasing the number of journeypersons in several trades. The current rate of individuals moving from the apprenticeship program to become a journeyperson is 18% - 20%. It is recognized by all parties that this must improve. The Darlington VP of Execution is leading an initiative that includes the unions, OPG and its main contractors to address this potential shortfall.
- The potential that project leadership and specialized resources are not in place when required. There are a number of initiatives under development to reduce the significance of this risk. Refurbishment management is constrained its ability to implement the corporate policies and procedures that have been developed for operating facilities and small projects for this mega project. The realization of this risk started in the first quarter and is expected to continue through this year. The Refurbishment Director of Operations and Maintenance, the Manager of Maintenance and Section Manager of Maintenance have given notice that they are leaving by June. In addition, the Outage Work Control Manager has accepted another position within OPG. This represents a challenge to project leadership and the retention of project knowledge.
- The possibility of an insufficient number of Authorized Staff for both station and refurbishment needs. This is being addressed through a combination of increased number of candidates for the associated positions as well as challenging the extent of the need for such staff once the unit is defueled and isolated through the bulkhead.
- The potential of an insufficient number of qualified radiation protection coordinators to support project execution.

OPG refurbishment management is developing and implementing actions to ensure its leadership team is in place for the current outage and future leaders are identified and

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developed for the program's sustainability. However, the recent trend of key individuals leaving OPG or the project represents a degrading trend in this area.

**Performance of Campus Plan & Safety Improvement Opportunity Projects - YELLOW**

Although the performance of the Campus Plan and Safety Improvement Opportunity projects continues to be a challenge to OPG, several improvements have been noted through the first quarter. Noted improvements include:

- The ESMSA contractors have embraced the concept of observation and coaching of field activities, including paired observations. They are able to discuss the benefits of specific observations at the bi-weekly status review meetings. The nuclear industry has embraced this technique as a contributor to improving human performance during field execution.
- Projects & Modification (P&M) senior management recognizes the importance of effective response to a stop work decision as well as improving performance to reduce their frequency. The first step is to clearly establish the responsibilities between station and P&M, as well as within the P&M organization. This work is currently in progress.
- P&M and the ESMSA contractor have started to plan for commissioning activities for several projects, including the AHS, EPG3 and CFVS. The commissioning of these projects requires the support of and coordination with the station, including Unit 0 operator resources, as well an understanding of the testing provided by the equipment suppliers and contractors. This planning supports the ability to integrate the commissioning with station work activities, which has been a challenge in the past.
- The ESMSA contractor has been transparent with its problems and proposed resolutions with a number of subcontractors. This provides OPG management with increased understanding of the issues and confidence that they will be addressed to support the current schedule.
- The Project Control Centre's (PCC) daily Plan of the Day meeting has transformed into a daily update of the schedule. This change was made in early March and the resulting behaviours have resulted in an increased focus on schedule, as well as the identification of issues and needed help for their resolution.
- Both P&M and ESMSA management have recognized an adverse trend in safety behaviours and have initiated actions. P&M management have initiated an adverse trend investigation to identify the causes of these behaviours. ESMSA

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management has providing sessions for its personnel to learn of personal consequences of fatalities. P&M and ESMSA management are working to build on each organization's initiatives. This represents the start to a long journey in improving field behaviours, but the chances of success are greatly improved through this joint effort.

- The ESMSA contractor successfully used the lessons learned from installation of VD 10 in CFVS project in the recently installed VD 9. Specific lessons learned included the procurement of materials in sufficient time not to delay installation, the required coordination with the station and the handing of the valve (including the need for engineered scaffolding). The most significant lesson learned and improvement was in the execution of the event free challenge meetings during the planning and preparation of the installation.

The current completion milestones and changes from the January presentation to the OPG Board's Nuclear Oversight Committee for these projects are identified in the following table.

<b>Project</b>	<b>Need Date</b>	<b>Current Forecast</b>	<b>Float to Need Date (months)</b>	<b>Notes (changes highlighted in bold)</b>
Auxiliary Heating Steam		Aug. 2015		This project is not tied to the start of Unit 2 refurbishment. As a result, the need date has been removed.
Heavy Water Storage and Drum Handling Facility	Feb. 2017	June 2017 (Partial) and May 2017 (full)	8	The partial is required to store Unit 2's heavy water. In addition, a mitigating action plan is under development.
Holt Road Interchange Improvements	Oct. 2016	Dec. 2015	10	
Electric Power Distribution	Sept. 2015	April 2015	5	The need date was changed from October 2016 to September 2015. The current forecast was revised from January 2015 to April 2015.
Operations Support Building Refurbishment		Sept. 2015	13	This project is not tied to the start of Unit 2 refurbishment. As a result, the need date has been removed. The current forecast has been changed from November 2015 to September 2015 as a result of the desire to have the building available for the fall Vacuum Building Outage.

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<b>Project</b>	<b>Need Date</b>	<b>Current Forecast</b>	<b>Float to Need Date (months)</b>	<b>Notes (changes highlighted in bold)</b>
Refurbishment Project Office	Oct. 2016	Sept. 2015	13	
Re-Tube & Feeder Replacement Island Support Annex	Oct. 2016	Sept. 2015	13	
3 <sup>rd</sup> Emergency Power Generator	Oct. 2016	Feb. 2016	8	
Containment Filtered Venting System	Oct. 2016	May 2016	5	
Fire Water and Emergency Cooling		November 2015 (partial)	1	The strategy for this project has significantly changed. The replacement of emergency service water piping will be installed during the fall VBO and fully completed during Unit 2 refurbishment. Backup fire pumps, which are included in this project's scope, will move the start of Unit 2 refurbishment to the completion of the refurbishment outage. This change will need to be accepted by the CNSC.
Powerhouse Steam Venting System	Oct. 16	Oct. 2015	12	
Shield Tank Overpressure Protection	April 2017	December 2015 for Unit 3	N/A	The remaining units are tied to specific outages. Unit 2 is to be completed during the refurbishment outage. <b>Unit 3's has been moved from June 2015 to December 2015 as a result of the change in the VBO from spring to fall.</b>
Re-Tube Waste Storage Building	April 2017	December 2016	4	
Used Fuel Dry Storage Building	Oct. 2016	December 2015	12	A decision was made not to continue this project during the coldest months, resulting in a change in forecast dates from October 2015 to December 2015.

The projects that have the highest risk of not meeting the current forecast are:

- Heavy Water Storage and Drum Handling Facility for the legacy issues and introduction of a new ESMSA contractor to continue the project.

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- Containment Filtered Venting System because of potentially contaminated soil and little float to need date.
- Fire Water and Emergency Cooling project because of the need to have the CNSC accept the change in dates and strategy.

The life-to-date costs for these projects, as of February month end, are \$589M, \$60M below plan. The estimate at completion is currently forecast at \$1,213M, as compared to the 4D release, \$1,217.8M.

The current life to date, end of life completion budget and estimates are provided in the following table:

Project	Life to Date Planned Costs (\$M)	Life to Date Actual Costs (\$M)	Budget at Completion (\$M)	Estimate at Completion (\$M)
OSB Refurbishment	39.7	31.7	53.0	53.0
RFRISA	21.9	21.2	40.7	40.7
RPO	58.7	50.5	99.9	99.9
Holt Road	18.5	6.2	35.2	28.0
Electrical Power Distribution	16.5	15.4	17.7	16.9
AHS	70.0	63.6	85.1	85.1
Heavy Water Storage & Drum Handling Facility	95.2	126.5	373.1	382.7
EPG #3	51.3	39.2	88.2	88.2
CFVS	36.4	37.4	90.6	78.2
PSVS	2.7	2.6	5.4	4.6
STOP	4.9	4.2	14.0	13.5
Fire Water and Emergency Cooling	8.4	10.3	14.6	21.3



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It is noted that the Re-tube Waste Storage Building and the Used Fuel Dry Storage Building projects are Provision funded and currently do not have cost estimates and schedules.

As frequently stated in these reports, the Campus Plan and Safety Improvement Opportunity projects have had multiple issues in the establishment of cost estimates, the development of schedules, completion of engineering and the start of field execution, particularly related to building foundations. Although these issues remain to some extent, the true challenge is to ensure that the projects are completed when required to support the execution of Unit 2's refurbishment outage.

Unit 2 Prerequisite Work

There is a large amount of work that needs to be completed at the station to support the start of the Unit 2 refurbishment outage. In addition to the visible Campus Plan and Safety Improvement Opportunity projects, other work that needs to be completed prior to the start of the unit 2 outage. These can be categorized as:

- Fuel Handling Reliability Improvement Work. There is a need to improve fuel handling equipment to support current operations and the defueling of the reactor. This work is being planned and executed by the station fuel handling organization. The total number of Work Orders in this category currently identified for completion prior to the start of Unit 2 refurbishment is 141.
- Fuel Handling Work to support Unit 2 Refurbishment Outage. In addition to the fuel handling equipment reliability improvement initiative, the station fuel handling organization is executing the work to support the Defueling project. An example is to have the Service Area Rehearsal Facility (SARF) returned to service to support the commissioning of defueling equipment in September 2015. The total number of Work Orders in this category currently identified for completion prior to the start of Unit 2 refurbishment is 41.
- Station Ready for Refurbishment Work. There is work that the station is responsible to complete that is required for the start of the unit 2 refurbishment outage. This is related to improving the health of key systems, such as containment vapour recovery systems. If this work is not accomplished prior to the outage it will need to be completed at the start of the outage. The total number of Work Orders in this category currently identified for completion prior to the start of Unit 2 refurbishment is 47.
- Refurbishment Organization Work. There is some work for which the refurbishment organization is responsible. This work must be coordinated

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with the station schedule and use station processes. The total number of Work Orders in this category currently identified for completion prior to the start of Unit 2 refurbishment is 242.

In addition, the Refurbishment Core Project has several projects that must be completed prior to the start of the Unit 2 refurbishment outage. Field execution of these projects is scheduled through 2015 and 2016. Most of these are associated with Islanding, Shutdown/Layup and Balance of Plant and are summarized in the following table.

Core Project	Project	Status
Unit Islanding	Negative Pressure Containment Modifications	Field execution through 2015. This includes 4 engineering packages.
	Area Islanding Barriers	Planned for execution in Q3, 2016. This represents 4 engineering packages.
	EFADS, PAMS and CLRTS modifications	Starts in VBO and continues through 2016
Refurbishment Support Facilities	Non-contaminated maintenance workshops and offices	This contains 7 engineering packages. Scheduled for Q1 and Q2, 2016.
	Wireless Network Infrastructure	This contains 1 engineering package. Scheduled for Q4, 2015.
	Turbine Cargo Elevator	This contains 2 engineering packages. Scheduled for Q1 and Q2, 2016.
	Work Control Area and Permit Preparation	This contains 2 engineering packages. Scheduled for Q4, 2015 and Q1, 2016.
	Radiation Protection Offices and Teledosimetry	This contains 2 engineering packages. Scheduled for Q1 into Q3, 2016.
	Contaminated Shops, decontamination and contaminated scaffold storage area	This contains 1 engineering package, although likely separate areas. Scheduled for Q2 and Q3, 2016.
Shutdown/Layup/Services	Breathing Air System	This contains 3 engineering packages. Scheduled for Q1

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Core Project	Project	Status
		and Q2, 2016.
	Service Air System	This contains 2 engineering packages. Scheduled for Q1 and Q2, 2016.
	Washrooms – install and tie-in	Scheduled for Q3, 2016

As can be seen, 2015 and 2016 will have the four identified groups of station work, the identified core projects and the Campus Plan & SIO projects that will require integration, coordination and support from the station. This will have to be done in conjunction with the fall Vacuum Building Outage, a spring Unit 4 outage and the on-line work required for the continued safe operation of the plant. This will be a vast challenge for all three organizations. This challenge has now been recognized by the organization at its March 23<sup>rd</sup> Refurbishment Integration meeting. A team from the three organizations will overlap the Projects & Modification (P&M) projects requiring operations and maintenance support, required work within the station to support the start of refurbishment, core projects and station work to determine the resource demands, schedule pinch points and establish priorities. The review will conclude that critical resources (such as control maintenance personnel and Unit 0 operators) will be challenged to support all the required work during this period. In addition, the review will identify that the organization will be limited in its ability to plan and schedule the large amount of work that is required for P&M projects, refurbishment preparations and maintaining station systems to the desired high level of performance and reliability expected for Darlington Nuclear. OPG senior management will need to make difficult priority decisions between now and the start of the refurbishment outage. The consolidation of all Nuclear Operations and the Darlington Refurbishment under the President, OPG Nuclear and Chief Nuclear Officer should support more timely and effective decisions.

A specific focus of the Refurbishment organization (particularly the R&FR project) is the planning, engineering and construction of the Re-Tube Waste Processing Building (RWPB). Although not required for Unit 2 breaker open, it is required prior to the start of removal of feeders and fuel channels, it is being planned and executed by the RFR Joint Venture, and thus is the first example of field execution by the Refurbishment Organization. This project has had some of the same issues seen in the Campus Plan and SIO projects and that contributed to their cost increases and schedule delays. In response, refurbishment senior management has increased focus and oversight of this project starting in Q1. Issues facing the RWPB include:

- The engineering started before the completion of a nuclear safety assessment to determine if the design had to be nuclear safety related code or the national

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building code. Certain conservative assumptions were made in the current iteration of the RWPB design in order to permit the start of procurement and construction. These assumptions are now being addressed to get the appropriate level of safety related requirements applied to the design of the RWPB. The CVFS had the same issue, resulting in engineering schedule and cost increases.

- There has been considerable work on the schedule to improve its completion and the cost estimate to support this schedule is expected by the end of March. It is recognized that the cost estimate and schedule are planned to be accepted prior to significant construction being started. This is improvement compared with the CP and SIO projects.
- The start of the installation of caissons was initially planned for December 2014 and subsequently rescheduled to start in February 2015. The start of the caisson installation has been delayed until April as a result of quality issues with the rebar and concrete. The project is using this delay to perform a test caisson (no pedigree) to identify any technical/process issues as well as help to validate a production rate for estimate purposes. Issues with caisson installation were identified in the D<sub>2</sub>O Storage Building and Drum Handling project. It is recognized that the caissons for the D<sub>2</sub>O Storage Building and Drum Handling project serve a different purpose and represent a different complexity than the RWPB caissons.
- The project is being managed by the RFR organization. However, since the Refurbishment Organization does not have the construction organization to manage field execution, the P&M Contract Management Office is performing this role.
- Progress of the project is currently not monitored by management on a daily through a plan of the day (POD) or equivalent meeting. It was previously discussed weekly at the P&M POD meeting, but this had limited value since there was no refurbishment project leadership participation in the meeting. This may change with the start of installation of the caissons in April. Ineffective daily POD meeting was a weakness in the CP and SIO projects. However, this weakness has been significantly improved by the P&M organization during a March improvement initiative.
- The current design of the RWPB has the electrical source for the RWPB being one of two possible station transformers. The management of the electrical loads will have to be carefully coordinated with the station to maintain their configuration control.

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In response to these issues, refurbishment management has taken several actions to increase focus and drive progress; including:

- A weekly meeting with the VP Execution, RFR Project Director and the vendor to review issues and the status of actions for their resolution.
- A separate scorecard (not included in the RFR scorecard) to increase visibility and focus on the project.
- The planned inclusion (sometime in April) of the RWPB status in the CNO call on a weekly basis.

**Corrective Action Program and Use of Operating Experience – WHITE**

The refurbishment Corrective Action Program (CAP) and Operating Experience program (OPEX) represent nuclear industry standards and well implemented. Particular strengths are the quarterly trend reports and the Corrective Action Review Board. Both of these are consistent with OPG and industry standards. The additional challenge for the refurbishment organization is the integration of all sources of quality and human performance information into a broader trending product. For operating nuclear plants, the main source of quality and human performance information is the Station Condition Reports (SCRs). However, for the project this is only a small component of the available information on quality and human performance. Additional sources are the audits and surveillances performed by Supply Chain, receipt inspections of parts and materials, project oversight logs, and the corrective action program results for each vendor. To identify a potential adverse trend before it becomes a significant issue will require improved capability to trend across projects, vendors and programs.

**Oversight – WHITE**

OPG is increasing its focus on oversight of the project. During 2014 the focus of oversight has been the independent oversight team (Modus/Burns & McDonnell) that reports to the Nuclear Oversight Committee of the OPG Board of Directors, internal audits by various oversight organizations and the monitoring/oversight associated with the management of the core projects. In addition, each core refurbishment project has a senior management oversight committee and an executive CEO steering committee. During 2015, OPG senior management is having a third party review of the Release Quality Estimate and establish an executive performance assurance group reporting to the CEO. The role of this oversight group is still under development.

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**4. Accomplishments and Progress**

The following accomplishments were achieved during the first quarter of 2015:

- The CNSC staff has accepted the Integrated Implementation Plan, with Commission approval planned to occur during the Darlington license hearing in the fall of 2015.
- The Balance of Plant and Shutdown/Layup/Services design contracts have been awarded.
- The design of the Turbine/Generator equipment has been completed by Alstom to permit the JV to perform the engineering for installation.
- Manufacturing of the initial tool set for the Re-tube & Feeder Replacement (RFR) project is complete. Tool Performance Guarantee testing is continuing with a completion target of April.
- Collaboration with Bruce Power is progressing well with a number of topics that will be mutually beneficial. Both organizations have demonstrated good willingness to work with each other towards mutual success.
- OPG is progressing on the selection of a partner to provide construction management support and additional oversight services. Bids from four companies are under evaluation.
- There is a strong focus on the development of the Release Quality Estimate (RQE). An organization is in place, a roadmap for successful completion has been generated with interim milestones, estimating processes are in place, performance scorecard has been established and reinforcement of the need for support is made at each meeting. KPMG has been hired to provide the independent assessment of the RQE process and results.
- The Joint Venture's development of Class 2 (the largest component of the RFR) is in progress. Although delayed from its original target date, this was done with the realization of the significance of the task and the risks associated with a poor product. There remain several issues between OPG and the JV, whose resolution is essential for an acceptable target price.
- Each project and functional department conducted an exercise to identify the assumptions that were made for the scope, planning and execution of their work. This is an important input into the RQE. The exercise identified several areas that need further attention. Actions were documented with resolution tied to the RQE schedule.

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- The on-boarding center has significantly improved the time it takes for individuals to complete administrative, security, training and radiation protection tasks in order to obtain site access.

## **5. Refurbishment Program Challenges**

Throughout the life of refurbishment program specific challenges have been, and will be, identified that in the belief of the Independent Advisor to the Minister of Energy should have actions by OPG Refurbishment Management to address them, before they become significant issues. The currently identified Refurbishment Program challenges are related to the development of the Release Quality Estimate (RQE), the management of the engineering workload, and implementing concrete actions to address lessons learned from the Campus Plan and SIO projects.

### Release Quality Estimate

Although there is currently no indication that the RQE will not be completed by its October 2015 milestone, its importance, challenging schedule and potential obstacles result in increased focus both within OPG and the MOE Independent Oversight Advisor. The following are in place to support the completion of the RQE to the desired standard:

- An RQE team is in place to drive the various components of the RQE.
- An RQE plan and schedule have been developed and Playbooks that provide the deliverables and target dates for each specific project and function.
- A scorecard has been developed to report progress in meeting RQE deliverables as well as risks to achieving the milestone.
- KPMG has been hired to provide OPG senior management with independent oversight of the RQE process.
- Each project and functional department has identified its assumptions regarding its scope and support it is expecting from others.
- There are various communication tools to reinforce the requirements to support RQE, timetable, status and roles.

Although progress is being made, there are a number of issues that OPG needs to successfully address for a successful RQE. These include:

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- The RFR Class 2 estimate represents the single largest component to the execution costs, and thus the highest risk to an acceptable RQE. The JV is currently behind schedule in its development of the estimate, resulting in an extension from April 10<sup>th</sup> to April 24<sup>th</sup> (and potentially May 8<sup>th</sup>). A third party (BRG) has been hired to provide independent review of the validity of the process used to obtain the Class 2 estimate. However, to date there has not been sufficient product for this team to review. OPG has an expert panel in place to review the inputs into the Class 2 estimate for reasonableness. There are a number of difficult issues that require to be successfully resolved prior to RQE; including:
  - Dose Estimate. The dose estimate for the RFR project is a direct input into the number of staff required to be trained for the project and thus cost. There is significant difference between the Joint Venture's (JV) initial dose estimate (> 2500 rem) and a target based on industry operating experience (1500 rem). The JV's current estimate of 1700 rem shows improvement, but further effort is required.
  - Although Tooling Performance Guarantee testing is showing excellent results, this has not resulted in savings in overall series durations. This is a result of the JV introducing risk and uncertainties in the overall series duration.
  - The generation of Construction Work Packages (CWPs) will not likely be provided to OPG in a timely manner, resulting in the need for OPG to prioritize the CWPs for review in support of RQE.
  - The holder of the contingency for possible project work delays resulting from Radiation Protection performance will have a significant impact on the final target price for the RFR project. The JV proposes to have it within its contingency. This would likely be the single highest contingency value (likely \$100sM) and thus there is a strong desire for its elimination from the JV or at least reduction. The one possible option is to have the JV responsible for its own radiation protection. This self reliance would eliminate the need for the contingency. However, this decision would be inconsistent with operating experience and basic principle that radiation protection needs to be independent of the production contractor.
- The second largest contribution to the project execution cost is from the Turbine/Generator (TG). The risk associated with the installation of the digital controllers is considered sufficiently high to have OPG senior management mitigate it for Unit 2 by delaying installation to a future outage. It is unclear how the JV will manage this risk for subsequent units.



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- The basis of the refurbishment outages needs to be established. The basis includes such items as the duration of the individual outages, the operating state at which time Darlington Operations takes over the unit, the response to and funding for non-project specific discovery work, the time between completion of Unit 2 and start of Unit 3 outages, and the condition of the plant for return to Darlington operations.
- The duration of the outage and coordination of returning Unit 2 to Darlington operations with the shutdown of Unit 3 are critical decisions for the scheduling of the subsequent units. In particular, upon completion of these decisions, OPG will need to determine and communicate the impact (if any) on the current life for Unit 4, including the possibility and duration of idle time prior to its refurbishment.
- There are several assumptions within the functional departments that need to be validated. In addition, there are several decisions regarding field execution and support that need to be made to assess their impact on functional department costs.

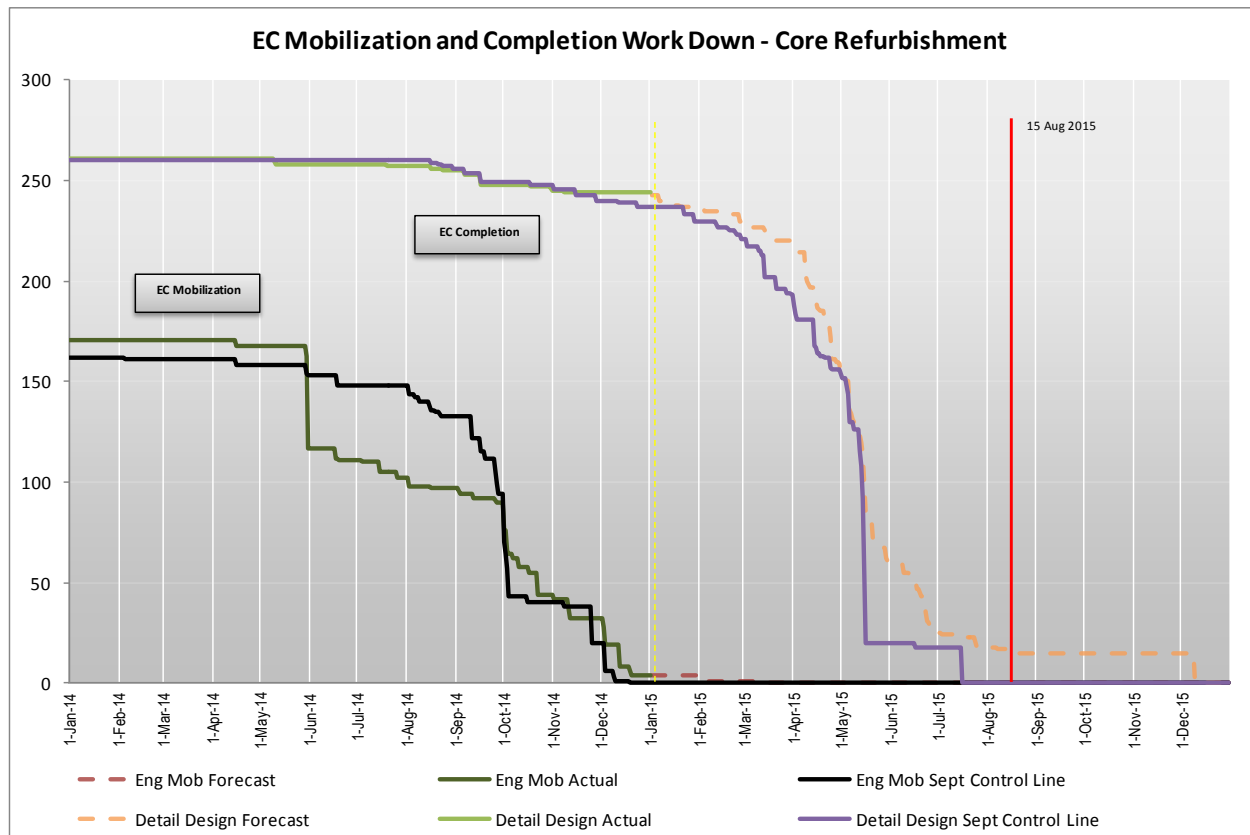
In conclusion, the development of the RQE is in progress and adequately managed. However, there are obstacles that need to be successfully resolved to obtain an acceptable RQE.

**Management of Engineering Workload**

The large engineering workload associated with the core refurbishment projects represents a challenge for completing design engineering with high quality by the May target date. There are two components to this challenge; completing the design engineering packages per a manageable schedule and assurance that the completed packages are of the necessary quality to support error free field execution and event free operation. The schedule challenge has been acknowledged by OPG management and status is routinely provided to the Board through its Nuclear Oversight Committee (NOC). The curve that was provided to the NOC at its January 20th meeting is shown below.

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Performance to date is summarized in the below table:

Time Period	Number of ECs planned to Be completed per baseline	Number of ECs completed
Total to the end of December 2014	24	15
Total to the end of January 2015	31	19
Total to the end of February 2015	38	25

The 'waterfall' in the above curve represents the risk to completion of engineering. The most recently established forecast shows a high number of engineering packages to be completed prior to the milestone date in August; specifically:

- March – approximately 30

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- April – approximately 50
- May – approximately 80
- June – approximately 30
- July – approximately 45

Refurbishment management has reviewed the challenge and reforecast the completion of engineering to be complete by the actual milestone date of August 15, 2015. Although this will be challenging, planned completion is sufficiently ahead of field execution that there is little risk of impact on field execution. In addition, there will be sufficient engineering completed to provide the necessary information the development of the Release Quality Estimate.

The second element of this challenge is the assurance of quality products. By its nature, any perceived time pressure to complete a large engineering workload in a short period of time introduces a challenge to maintain high levels of quality. This feature combined with the latent nature of engineering errors results in the need for effective implementation of a rigorous and high quality process for the acceptance of engineering design deliverables. The latent nature of engineering errors in approved designs refers to the fact that the consequences of these errors are not realized immediately. They are seen in construction, commissioning and too frequently during plant operation. As a result, the MOE Independent Advisor has identified the potential risk associated with engineering quality as an element of management of engineering workload through 2014. A quality indicator has been developed for the use in this quarterly report to provide trends in quality, starting in Q4, 2014. The following table provides the results to date.

Engineering Quality Indicator =  $100 - 15 \times (\text{L1 events (rejection by external approving authority + rework after field installation)}) - 10 \times (\text{L2 events (rejection by internal approving authority + rework during field installation + other event free day reset)}) - 5 \times (\text{L3 events (other rework (greater than \$10K)})} + 1 \times (\text{GC (documented good catches prior to submission for OPG review to maximum of 10)})$ . The following values are used for the colour rating:

Green: >80

White: 65 – 79

Yellow: 50 – 64

Red: <50

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Month	Index	Rating	Basis
Q4/14	57	Yellow	
January 2015	65	White	1 L1 event and 1 L2 event and 2 L3 events
February 2015	70	White	2 L2 events and 2 L1 events
March 2015	35	Red	1 L1 event, 2 L2 events and 6 L3 events
Q1/15	57	Yellow	

The Q1 indicator of 57 continues to represent a potential concern for quality.

It is recognized that OPG has an Engineering Change Control (ECC) process that is consistent with industry standards. It is also recognized that the process for owner acceptance implemented by OPG has some good features – the use of a Requirement Traceability Matrix (RTM), use of Comment and Disposition record table, the practice of collaborative engineering and the a Design Completion Assurance Verification and Review meeting (DACVR).

Because of the latent nature of potential errors, it is important that the OPG process to accept design agency products be rigorous and sufficiently intrusive to identify potential errors and effectively implemented. This is particularly important for high risk and infrequently conducted designs. Actually, INPO generated an important operating experience document related to such engineering (IER L1 14-20, Integrated Risk – Healthy Technical Conscience), particularly recommendation 3, which deals with vendors conducting engineering work for the owner. Several designs fall into this category; including, Emergency Power Generator 3 (EPG3), Containment Filtered Ventilation System (CFVS), access ports for the Steam Generators, the digital controllers for the Turbine/Generator and fire pumps as additional supply to the Emergency Service Water system. Such a rigorous process for high risk and infrequently performed or first of a kind designs could include verification that the design is consistent with INPO/WANO important operating experience (SOERs and IERs), independent validation of key assumptions, and independent verification of key elements - as determined by the complexity of the design, the importance of the system to safety and the potential consequence of engineering error. Because of the criticality of a strong owner acceptance process, it is recommended that refurbishment management request a Technical Support Mission from WANO/INPO to review the health and effectiveness of its owner acceptance process, capability and implementation.

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It is believed that OPG refurbishment Vice President, Engineering has concern with the number and nature of errors by design agencies and has initiated actions to support improvement; including:

- Planning a stand down to be attended by all engineering personnel (internal and design agency) that discusses performance weaknesses, causes and requirements that are in place to reduce the potential for consequential errors.
- Review of the Quality Dashboard at his direct report meeting and the project engineering status meeting.
- Request for a WANO Technical Support Mission to review design quality.

**Incorporating Lessons Learned from the Campus Plan and Safety Improvement Projects**

During more than eighteen months of observations, a number of lessons learned from the Campus Plan and Safety Improvement Opportunity (SIO) projects have been identified by the Independent Oversight Advisor. These need to be effectively addressed by the refurbishment organization to prevent recurrence. It is the intention of this paper to identify these lessons learned for a discussion on the extent to which OPG senior management is confident in preventing reoccurrence during the refurbishment project. This is neither a current status of performance within the Campus Plan and SIO projects nor an analysis of the refurbishment project in each of these areas.

The following Lessons Learned have a low likelihood of recurrence with the current processes and management focus:

a. Poor cost estimates

OPG recognizes that several of these projects were started and continued without the appropriate level of cost estimate. As a result of this issue, there is increased rigour in the cost estimates for the core projects. This increased rigour includes:

- i. Collaborative front end planning for a better understanding of the scope of work, production of an independent estimate, and reconciliation prior to contract award. To support this effort for Balance of Plant, ES Fox has established a 'war room' in its facility to facilitate the collaboration.
- ii. RFR and TG have estimating templates for which agreement has been reached with the JV and OPG is monitoring progress.
- iii. A central estimating tool is being implemented to document and monitor all estimate submissions.

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These actions should maintain any risk from inaccurate cost estimates as low.

b. Completion of engineering prior to the start of field execution

Many of these projects started and continued field construction without the completion of detailed for engineering. For several projects, engineering was done in parallel with field execution and in some cases field work was delayed due to the need for the completion of design engineering. This was previously identified as one of the major lessons learned from previous refurbishment and large nuclear projects – engineering must be completed prior to the start of field execution. As a result, OPG established a milestone for the completion of engineering of August 2015 (with an early target of May 2015), and resource loaded schedules are in place for more than 80% of the core projects. Even with the current challenges in managing the engineering workload, there is sufficient float to complete engineering for the projects being executed after Unit 2 breaker open.

The current challenge is for core refurbishment projects that are being executed prior to Unit 2 breaker open. The RWPB has started construction without completion of engineering or nuclear safety analysis. It is recognized that engineering has been done for the portions of procurement and construction that have been started, but this is not the standard of engineering complete prior to start of construction that refurbishment management is striving. In addition, there are several shutdown/layup/services and support projects to be executed in 2016 and 2016, prior to breaker open. A number of these have engineering in progress, but at least six contracts have just been awarded, with a target of August 2015 for the completion of engineering.

The following Lessons Learned have a medium likelihood of recurrence without on-going management focus and successful completion of planned actions:

c. Poor engineering and field execution schedules

Through the duration of the Campus Plan and Safety Improvement Opportunity projects, the organization has been plagued with inaccurate and unreliable schedules for engineering and field execution. Currently, the refurbishment organization is supporting the ESMSA vendors and Projects & Modifications organization in the development of detailed schedules. There is a now requirement for detailed schedules as part of the gate review process. The core

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refurbishment projects now have schedules for the completion of design engineering. Level 3 execution schedules are to be included in the estimates for the RQE. The current challenge is that there is no detailed engineering or execution schedule for RWPB beyond the substructure. Construction has recently started.

d. Availability of parts when required

There have been some examples of difficulty in obtaining the parts to support field execution. This has resulted in some delays and in some cases the acquisition of parts from the OPG warehouse. Refurbishment management recognizes the risk associated with this issue and has initiatives to support the timely procurement of parts; including:

- i. Each Project Manager is currently developing a 'Playbook' that will outline preparation milestones for Unit 2 refurbishment, including procurement of materials.
- ii. Each vendor will complete initial Assessing (including the identification of parts and materials) as part of its RQE estimate.
- iii. Engineering is establishing a process to assist vendors in obtaining parts of the correct quality level, rather than the current practice of over specification of quality level.

The current challenge will be for the procurement of parts for execution of projects that will be scheduled for completion prior to Unit 2 breaker open, although they have started to be identified and scheduled. For example, to facilitate the start of construction the RFR JV made the decision to design the RWPB base to nuclear safety standards. The initial rebar and concrete delivered for the RWPB caissons were not to this quality, resulting in about six weeks of delay in construction of the caissons.

e. Quality and timeliness of Comprehensive Work Packages (CWPs)

Once engineering is complete, the information is converted to a Comprehensive Work Package (CWP) that is used for field execution. OPG has a detailed process and high standards for the generation, review and approval of these CWPs. CWPs require the review of several disciplines; including operations and engineering. The vendors for the Campus Plan and SIO projects initially had problems meeting the station expectations to obtain timely approval of some

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execution CWPs. As a result, it was not uncommon to have the field execution delayed while waiting for the completion, review and approval of the CWP. In response to this problem, refurbishment operations and maintenance personnel have provided support in the generation and approval of CWPs. The core refurbishment projects will require vendors to generate CWPs that will be reviewed and approved by OPG refurbishment and likely in some cases station organizations. There is a refurbishment guideline for the generation of these CWPs; however, unless the involved personnel have experience with the OPG procedure, it is likely that initially, there will be similar issues with the quality of CWPs. Specification of the required standards for CWPs by the Refurbishment Execution Construction Director will support the EPC vendors in generating acceptable CWPs.

f. Integration with the station work management process

Once the unit is isolated from the other units there will not likely be much of a need to interface with the station work management process. However, between the need to perform prerequisites in support of the start of the outage, the work to be coordinated prior to isolating the unit and the return of the unit to service at the end of refurbishment there will be a significant amount of integration with the station and its processes. The P&M organization initially had trouble integrating its work through the station's on-line and outage processes. This has resulted in an overreliance on the use of scope injection, which frequently is rejected. As a result of these problems, refurbishment work management personnel have supported P&M organization in interfacing with the station process. Transition plans are being developed to transfer the refurbishment unit to the Refurbishment Organization at the start of the refurbishment outage and back to the operating organization upon completion of the outage. A commissioning strategy is under development. In addition, Refurbishment management has initiated the 'Day in the Life' exercise to define interfaces and transitions during the outage. These actions focus on the refurbishment outage itself, and do not address the issue identified from the current P&M projects that is related to prior to Breaker open. There is an action associated with the plant/refurbishment integration meeting that is designed to prioritize needs for station support and support its schedule.

g. Not effectively using station processes

There are a number of station processes which are required to be used by the ESMSA contractors, but were not initially effectively implemented. These include



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work management processes, work protection, work authorization, event free challenge process, etc. Refurbishment operations and maintenance is assisting in facilitating the ESMSA contractors through some of these processes. For the core refurbishment contracts, it is assumed that the contractors and subcontractors will have processes equivalent to the OPG processes. In addition, the 'Day in the Life' initiative is given credit to address this issue.

These actions may not be sufficiently rigorous to address this issue. Examples in the core project include:

- Lifting and rigging practices for both the Joint Venture (JV) and ES Fox have not always been consistent with OPG processes and WANO SOER 2008-1 recommendations.
- The initial Turbine Generator FME plan was found deficient in several areas.
- The JV's first Event Free Challenge meeting for the RWPB trial caisson was not to OPG standards or consistent with the requirement to identify challenges to the safe, effective and timely execution of a job.
- The process by which OPG will ensure equivalency of a vendor's process to OPG's process is not clearly documented, nor has been visibly demonstrated. It is intended to be included in the Execution Strategy.

The following Lessons Learned with high likelihood of recurrence without increased management focus and associated initiatives:

h. Coordination among contractors for common issues and processes

Several Campus Plan and SIO projects have had similar issues and problems, such as daylighting, dewatering, removal of contaminated soil, management of associated totes and RP support. In general, rather than identify a lead organization or company in the management of such common processes, each project was left to its own to resolve the issues. This resulted in some delays, conflicts among contractors and likely some increase in costs.

For the core refurbishment projects, there will be common processes that will be used by multiple vendors; such as scaffolding, lifting and rigging, confined spaces, management of consumables, and FME, to name a few. A lack of coordination among contractors in such common processes increases the potential of delays and issues. The Construction Execution Strategy organization

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is currently evaluating the benefits (cost and work impact) from identifying a single vendor for some supply of common services and materials.

i. Effectiveness of PCC and POD meetings

The P&M's PCC and POD was not effective at meeting the objective of driving the Campus Plan and SIO projects to maintain schedule, to coordinate among projects, to prioritize issues and resources and to identify and resolve issues before they impact field execution. The meeting did significantly improve during March 2015.

The 'Day in the Life' initiative is intended to cover all daily status meetings and POD meetings and which parts of the refurbishment outage they will cover. It is the intention to have a fully staffed PCC during defueling and bulkhead installation. It is also the intention to move the PCC to a day operation once there is confidence that it is not required for 24 hours per day.

Although the 'Day in the Life' initiative does include the PCC and daily status meetings, progress has not been sufficient to assess its future effectiveness. However, there is no daily status meeting for the current refurbishment work being executed – the RWPB. Also, since the P&M improvement initiative that started in early March, the RWPB has not been included in the P&M meeting. Also, refurbishment management's intention for status meetings during the increase in prerequisite project execution is unclear. Establishing a daily execution status meeting and an equivalent of a PCC would be an excellent opportunity to demonstrate the required execution behaviours prior to breaker open, as well as support the safe, effective and timely execution of the prerequisite projects.

j. Requirements to restart work when stop work order is initiated

There have been events resulting in the stoppage of work. These have normally been associated with safety or environmental incidents. Normally, once the stop work has been issued, the P&M organization has struggled to identify what specific actions are required to be performed prior to restarting the work. There is no guidance provided to management on determining the criteria to restart work. This has resulted in a reduction in the timeliness and sometimes effectiveness of the actions to restart work. Refurbishment intends to address this issue through its 'Day in the Life' initiative.

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k. Management of subcontractors

The ESMSA contractors have had issues with the performance of subcontractors in the engineering, procurement and field execution associated with the Campus Plan and SIO projects. Issues have included the delivery of engineering products in a timely manner, some engineering quality problems, timely delivery of parts, some quality issues related to parts manufacture, field execution rework and safety performance. The lead contractor typically responds to individual issues.

The core refurbishment projects have had some similar issues, although with lower consequences. The Joint Venture (JV) has had some schedule and quality issues in tooling program. OPG project monitoring identified quality issues with one inspection technique associated with the Steam Generator project. ES Fox identified performance issues with the design agency for two services projects and replaced them with another company.

Refurbishment management's strategy to address this issue includes:

- i. Holding the prime contractors accountable for the performance of their subcontractors.
- ii. Creation of a Vendor Leadership Forum and All Vendors summit.
- iii. Field observations by the execution construction organization and results of the 'Day in the Life'.
- iv. Conducting appropriate weekly project schedule review meetings that cover the current work being performed by the vendors for core projects. Currently, covering engineering, shifting to procurement and finally CWP production as the work progresses.

l. Performance of Contractors

The overall performance of the main ESMSA contractors was not consistent with OPG expectations during 2014. The performance for each company as measured by the OPG scorecard was less than 60% with significant point losses in Human Performance and schedule adherence. In addition, an adverse performance trend in personnel safety was identified in March and is currently under investigation by OPG. As with the management of subcontractors'

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performance, OPG is relying on accountability of the contractor, creation of the Vendor Leadership Forum and the execution construction organization's field presence as the strategy to address potential weaknesses by contractors. For core refurbishment projects, emphasis is being placed on having quality schedules and estimates for the completion of all aspects of the work and having the detailed schedules in place prior to a particular phase of the beginning.

m. Not responding to adverse trends in a timely and effective manner

These projects have had several, longstanding issues, starting with the D<sub>2</sub>O storage project, but also cost estimates, development of reliable schedules, completion of engineering, performance of subcontractors and interfacing with the station to execute field work. Many of these issues existed for several months – some years. The P&M organization has not been effective at identifying and addressing performance issues in a timely and effective manner in order to limit their impact on safety, quality, cost and schedule delays. This behaviour of not identifying and addressing performance issues is similar to the cause of the Pt LePreau calandria tube insertion production and quality event.

Refurbishment management's strategy to reduce this risk includes the following items:

- i. Establishing a meeting focus on performance against plan and the identification/resolution of issues.
- ii. The future creation of a project Change Control Board.
- iii. Creation of a Project Decision Making forum.
- iv. Formalizing the purpose and function of the 'contrarian' in the deliberations of important program and project decisions.
- v. Formalize the application and use of Event Free Challenge meetings for critical work.

These actions will support addressing this issue. However, there should be recognition and actions to improve the culture to drive issues to a more timely and effective resolution. The slow response to address the management of the large engineering backlog, the resolution of BOP and shutdown/layup/services contracts and the RWPB performance issues can be used to help refurbishment mid management understand the issue and the need for its reduction.

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The Refurbishment Execution leadership is driving a proactive approach to ensuring that lessons learned by one core project in one area are effectively communicated and addressed in the other projects via the Horizontal Integrator roles for engineering, materials/procurement, construction and estimating reporting to the VP Execution.

## **6. Status of Individual Projects**

The Darlington Refurbishment Program consists of seven individual projects and a number of infrastructure projects (also called Campus Plan) and Safety Improvement Opportunity projects:

- Re-tube and Feeder Replacement (RFR)
- Fuel Handling/Defueling (FH)
- Turbine Generator and Controls (TG)
- Steam Generator and Auxiliary Systems (SG)
- Balance of Plant (BOP)
- Islanding
- Shutdown, Layup and Services

The status of Campus Plan and Safety Improvement Opportunity projects is provided in the relevant section of the scorecard.

### **6.1 Re-tube and Feeder Replacement Project**

The Re-tube and Feeder Replacement (RFR) project represents the largest scope and cost component of the Darlington Refurbishment Project. The RFR project will define the project's critical path and thus duration. As demonstrated by the schedule delays, cost overruns and performance issues in previous CANDU refurbishment projects, the RFR project also represents the largest risk to the project being completed on schedule and on cost. The RFR project consists of the removal and replacement of 480 pressure tubes, 480 calandria tubes, 960 end fittings and 960 feeder pipes for each of the Darlington four units. This requires the development, testing, manufacturing and maintenance of specialized tooling; the generation and verification of specialized procedures; and the training of the staff that will perform the field work. The project also

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includes the construction of a realistic reactor mock-up for the purposes of tooling testing, procedure verification and staff training.

There are currently five focus areas for the RFR project:

- The development of the Class 2 estimate and OPG's review and acceptance, as part of the Release Quality Estimate (RQE). The Class 2 estimate is based on detailed performance information gained from tool performance guarantee work and limited procedural testing that is currently underway. This is covered in the Scorecard under RQE.
- The design and construction of the Re-tube Waste Process Building (RWPB). This is reviewed in the Scorecard under Unit 2 Prerequisite Work.
- The testing of tooling performance and time durations for individual series.
- Completion of design engineering for Unit 2 modifications. The completion of engineering has the same challenges described in the challenge on management of the large engineering workload. (Section 5).
- Order and management of procurement of major reactor components and other materials for Unit 2's re-tube and feeder replacement.

A key component of OPG's strategy for a successful refurbishment is the construction and use of a full—scale reactor mock-up to ensure excellent tooling performance, verification of procedures, validation and refining of sequence durations and the training of execution staff. The training provided on the reactor mock-up reduces the likelihood of significant human performance events and supports high performance standards in conventional and radiological safety. Some concrete examples of the benefit of the mock-up include:

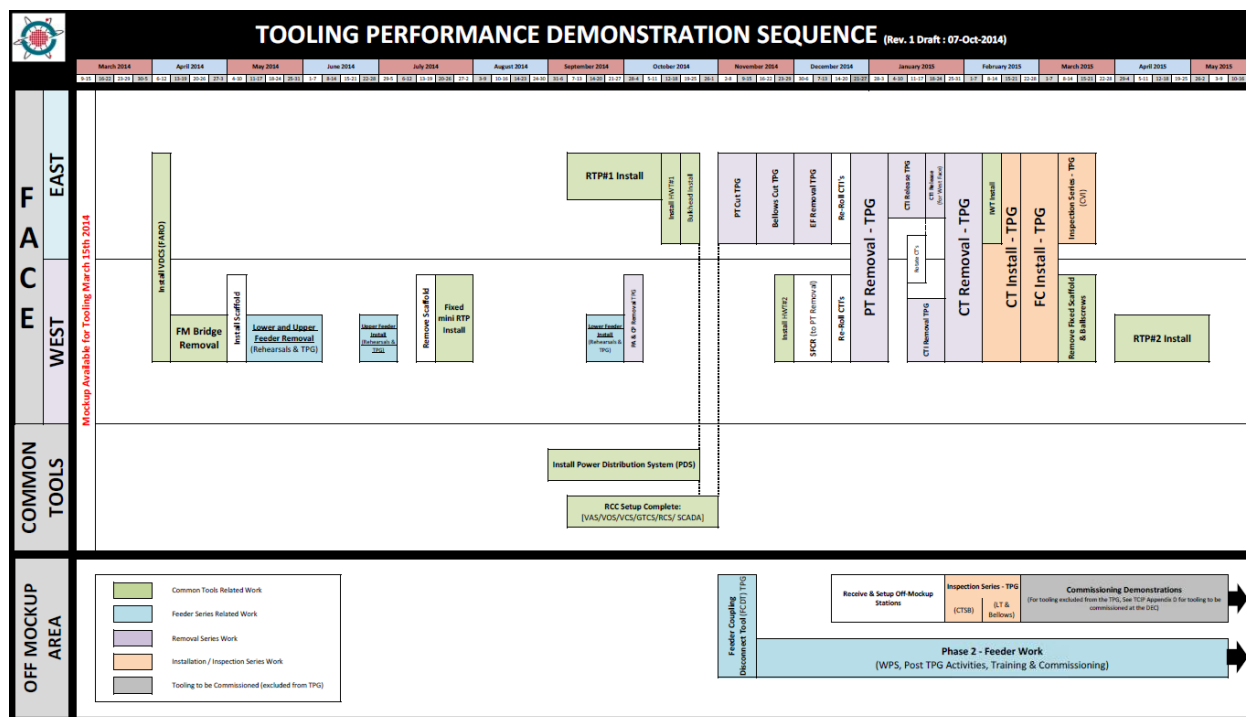
- A dimensional discrepancy in the Re-Tube Platform (RTP) was identified and corrected.
- Validation of non-interference was validated, which removed one Temporary Modification (TMOD) from the vault. The removal of this TMOD results in a critical path savings of a few days.
- Panel locations and cable lengths have been verified.
- Tool Performance Guarantee (TPG) tests have started. Pressure tube (PT) cuts have been performed using the remote controls and the PT cutter. The cut was consistently performed within 20 minutes, which is about a factor of 3 better than the TPG.

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- Tool integration testing has started and will be used in the development of the Class 2 estimate.

The tooling qualification testing continues and is currently on schedule. The strategy is summarized in the following diagram.



The use of the tooling represents about 30% of RFR's critical path time. The remainder is the movement, set-up and dismantle of the tools and work platforms, or individual sequences. These will not be fully validated prior to the submission of the Class 2 estimate, but should be fully explored and optimized in the 18 months leading to the start of the RFR execution.

Procurement of the OSM (Owner Supplied Material) is the responsibility of the Joint Venture. The key components include feeder piping, end fittings, pressure tubes and calandria tubes. Manufacturers have been identified for each component and pre-production qualification manufacturing for each component by each manufacturer is in progress. Although there are some challenges in this demonstration, they do not represent a significant risk to the project. In addition, the Inspection and testing Procedures for their manufacturing are in progress.

## 6.2 Fuel Handling/Defueling Project

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This project consists of two main subprojects – the defueling of the reactor to start the outage and the refurbishment of the fuel handling equipment and associated systems.

The defueling of the reactor represents the first critical path activity for the project. It is currently estimated that the duration for defueling the reactor will be 113 days. This duration is based on a project report that makes a number of assumptions for success. Key assumptions include:

- The defueling will be conducted by station fuel handling operators around the clock, 7 days a week. The organization is currently obtaining sufficient qualified individuals to perform this work.
- The reliability of fuel handling equipment will be improved to support defueling with limited breakdown maintenance required.
- Testing and commissioning of tooling will be performed on available station equipment. This will require the return to service of the SARF (Service Area Rehearsal Facility), which the project has identified as currently at risk with a recovery plan.
- Sufficient maintenance resources to implement the current Preventive Maintenance Program and schedule for major overhauls, as well as support the defueling window. This has been identified as an at risk component of the plan.

The project has a Fuel Handling Defueling Readiness Plan that integrates the fuel handling equipment reliability improvement work with the work required to directly support the defueling of the reactor (such as SARF return to service and commissioning of tools on SARF).

The completion of the work to improve fuel handling equipment reliability represents a risk to the defueling project meeting its objective of reactor defueling duration of 113 days. To address this risk, a station/refurbishment Fuel Handling Equipment Reliability Steering Committee was established in mid 2013, with a project plan developed in Q1 2014. The project did not make the desired progress during 2014 resulting in the following actions:

- Move from an equipment reliability improvement plan to a Defueling Readiness Plan whose status is reviewed at the regular Defueling Project Steering Committee and Executive Steering Committee meetings.
- Redefine the Fuel Handling Equipment Reliability Index to provide a more reliable indicator of progress towards readiness. The ERI target for the start of defueling is 80. The following table provides the current values.



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	<b>Jan – 15</b>	<b>Feb – 15</b>			
<b>ERI</b>	72	74			

- The station has flagged work orders that are required to be completed to improve the Fuel Handling Equipment Reliability. The ability of the station to complete this work is a direct measure of the ability to manage the associated risk on the duration of the critical path activity for defueling the reactor.

The second risk associated with this project is the ability to complete the testing and commissioning of tooling and procedures in order to defuel the reactor as planned. The first set of tests is being performed at GE Hitachi (GEH-C) in Peterborough. Although they are currently behind schedule, a recovery plan has been developed to ensure they do not impact the completion of engineering or the delivery of equipment. However, there is a need to perform commissioning of tooling (Universal Carrier and New Fuel Transfer Mechanism Modifications, and defueling equipment) at the station. These are to be done on the Pressure Test Facility (PTF) as well as the SARF. Both of these currently have their challenges.

To perform the commissioning on the PTF, scheduled for June 2015, requires:

- Completion of the testing at the GEH-C facility in Peterborough.
- Sufficient verification and validation of the OPDATA software to permit commissioning on the PTF of the tooling.
- An available fuel machine head for 4 weeks to support the commissioning.

To perform the commissioning on SARF, scheduled for September 2015, requires:

- The availability of a fuel handling trolley for the duration of commissioning.
- Sufficient verification and validation of the OPDATA software to permit commissioning on the SARF of the tooling.
- Rehabilitation and return to service of the SARF. This requires completion of a number of work orders by station staff.

There is one additional risk for the readiness to defuel the reactor – the OPG re-categorization of OPDATA from a database to a software program requires that Quality

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Assurance verification requirements be met that were not previously demonstrated. This has been identified by the project as a significant risk that has the potential to impact both cost and schedule for defueling readiness. The overall schedule has the completion of verification and validation in early 2016. The addition of a second simulator, which is under discussion, will progress this schedule. Work is currently in progress to understand the full impact of the project by mid April.

The success of this project requires the coordination of work by the vendor (GEH-C), the refurbishment project team and the station. Although support was good in 2014, integration of efforts will need to be increased for success in 2015. For example, station representation does not always attend the monthly project oversight meeting with GEH-C, and this meeting does not always review the status of the station work to support the project.

In summary, the defueling of the reactor is planned to be 113 days in duration. There are three risks to meeting this objective, which are recognized by OPG refurbishment management. Prevention of these risks requires the effective integration of the efforts of refurbishment project team, the contractor (GEH-C) and the station fuel handling organization.

### **6.3 Turbine/ Generator Project**

The scope of the Turbine/Generator includes:

- Steam Turbines and Turbine Auxiliaries: inspections, repairs, and/or replacements of generator components (including generator stator rewind) and a number of generator auxiliaries,
- Steam Turbines and Turbine Auxiliaries: inspections, repairs, and/or replacements of High Pressure (HP) and Low Pressure (LP) turbine components and a number of turbine auxiliaries;
- Moisture Separator Reheater (MSR): inspection, overhaul, and/or replacements of MSR internals and auxiliaries (e.g. strainers, valves);
- Turbine Control Upgrade: replacement of the obsolete analogue Steam Turbine Electronic Control (STEC) System, includes entire Turbine Supervisory System with modern design (digital system); and
- Generator Excitation Upgrade: replacement of the analog Generator Excitation system controls with a digital design and a set of additional Generator Excitation and Protection equipment to resolve obsolescence issues.

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A contract was awarded to Alstom for the design and delivery of the digital controllers as well as technical support during the execution of the project. The design work by Alstom is mainly on schedule, with some delays in the controllers that are not being included in unit 2's refurbishment outage.

The TG engineering integration and field installation vendor (SNC/Aecon Joint Venture (JV)) has submitted a class 3 cost estimate and a level 4 schedule for field execution. The JV has started the work for the Class 2 estimate, which has a milestone of the end of March. Because the Unit 2 refurbishment will not include the modifications designed by Alstom, the integration engineering packages have been delayed, and are scheduled to be completed by July 31, 2015. There is a significant amount of engineering to be completed in the second quarter to meet the July 31<sup>st</sup> completion date. As of the end of February the project estimated that 50.5% of the engineering was complete. Considering the operating experience with the integration of digital controllers at other plants, OPG resources will be challenged to review and approve the engineering design deliverables to meet the contractor's production curve.

This project is unique in that it includes one company (Alstom) providing the design and manufacture of equipment and technical expertise during the actual TG refurbishment and modifications, and one company (the Joint Venture) providing the interface engineering and the construction. This unique model requires increased oversight and integration by OPG and the project's senior management oversight committee, since the two companies are not fully integrated for the project.

There are 2 noteworthy risks for this project:

- Weaknesses in the replacement of analog controllers with digital controllers have resulted in several events in the industry both during commissioning and normal operation. This was the reason for OPG senior management to defer the introduction of digital controllers until the second unit's refurbishment, and back fit Unit 2 at a future outage. Although there is the opportunity to validate the design through the use of a simulator, it is not clear that these events (provided in INPO operating experience reports) have been studied during the design of the controllers and their integration with Darlington systems.
- Maintenance on the turbine, generator and stator systems is considered high Foreign Material Exclusion risk both because of the potential consequences of foreign material in the system when operating and the difficulty to retrieve foreign material, particularly in the generator and stator. OPG refurbishment will need to review these work plans for industry standards in the prevention of foreign material intrusion.

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**6.4 Steam Generators**

The Steam Generator project had its first Executive Oversight meeting on March 6, 2015. The Engineer Procure Construct (EPC) contract has been awarded to a consortium of Babcock & Wilcox Canada and Candu Energy Inc. The project consists of maintenance activities and modifications to meet the requirements of its Life Cycle Management Plan. This includes:

- Tube sheet waterlancing to address possible degradation from sludge accumulation. The DACVR meeting for Design Authority approval of the detailed design was successfully completed on March 10.
- Installation of access ports to improve secondary side inspection capabilities for future inspection outages. An enhanced COMS (constructability, operability, maintainability, safety) meeting was held on February 25, with no additional requirements specified.
- Primary side tube cleaning to improve overall thermal efficiency, increase neutron overpower margin and reduce radiation fields
- Divider plate leakage characterization to establish a baseline for cross flow between the cold and hot legs of the SGs
- Primary and secondary side ultrasonic, eddy current and visual inspections. These will be performed by the OPG Inspection, Maintenance Service organization.

With exception of installation of the access ports, the activities associated with this project are services performed during routine planned outages. There are two noteworthy risks that exist for this project:

- The tooling that is used for the waterlancing and primary side cleaning represent tooling entering systems that are required to be free of foreign material. Although designed to be fully intact, there is always the risk that a component may become loose and enter the primary side or secondary system. This would result in the need to develop and execute a recovery plan.
- The installation of 7 access ports into each steam generator represents cutting into a containment boundary. Although the contractor has successfully performed this installation at other plants, any time a containment boundary is modified is considered a risk.

**6.4 Balance of Plant Project**

The Balance of Plant (BOP) scope consists of plant modifications and maintenance work in the following areas:

- Pre-refurbishment work
- Safety and Control Systems
- Reactor component systems

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- Conventional Systems
- Common Systems

During the first quarter, the project has worked closely with contractors to establish the schedules and plans to perform the detailed engineering. It was recognized that the engineering products would be challenged to meet the engineering completion milestone as a result of the late awarding of contracts to the vendors. Currently, of the 46 identified EC products for Balance of Plant, 5 have been completed, 29 are scheduled for completion prior to the August 2015 milestone, 4 do not have a completion date and 8 are scheduled for completion in 2016. Balance of Plant (BOP) is using one ESMSA contractor for much of its work. Because of engineering performance issues with its engineering subcontractor, the ESMSA contractor has mitigated this risk through subcontracting to multiple engineering companies. In addition, BOP management is reducing the potential and consequences of future performance issues through weekly performance reviews of the project bundles. This has provided oversight that has contributed to the ESMSA contractor taking timely action to address identified issues. It is noteworthy that the ESMSA contractor has identified and initiated corrective actions when engineering performance is not meeting expectations. OPG project management is kept informed of issues and proposed actions.

Although not currently a risk, operating experience has indicated that Balance of Plant work can become the critical path to restarting the unit if not effectively scheduled and managed. One action taken by refurbishment management to reduce this potential is to not have work scheduled after the critical path is 60% completed. Exceptions would be limited to work that can only be done in the conditions that are provided after 60% completion. Additionally, Refurbishment Execution will perform an additional detailed review of the BOP work to verify that there are robust plans in place to complete the work without effecting critical path.

## **6.5 Station Readiness Projects**

There are a number of core refurbishment projects that are critical to support the refurbishment of the unit, but do not provide refurbishment of equipment. These are:

- Islanding projects. These projects are required to establish the physical and administrative separation of the refurbished unit from the operating plant, as well as separate a number of common areas for the duration of the refurbishment outage.
- Shutdown/Layup projects. These projects are in place to shutdown and layup individual systems at different stages and for different durations through the unit's refurbishment outage. This is required to protect the systems against corrosion and other damage mechanisms when not in normal operation.

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- Services projects. These projects provide the needed services to support the unit's refurbishment outage. Such services include electrical, breathing air, service air, instrument air, and water.

In general, the Islanding projects are making use of the other contracts that align with its work in the same or adjacent area. For example, the EPC contract for the installation and removal of the bulkheads has been awarded to the R&FR Joint Venture (JV). This is a sound decision since the JV has the most to gain from the timely installation of the bulkheads, there is elimination of coordination issues in the vault, and the required capabilities for the two projects are similar.

The strategy for the Shutdown/Layup and Services projects is the same as for the BOP projects (use of the ESMSA contractors). These projects are also using the same ESMSA contractor as selected for several of the Balance of Plant projects. As a result, the engineering strategy and weekly meetings described for the Balance of Plant also exist for these projects. As with the Balance of Plant, this focus provides the ESMSA the opportunity to take timely corrective action when engineering performance does not meet expectations. This has been done for both Breathing Air and Service Air projects.

## **7. Oversight of the Darlington Refurbishment Program**

Both OPG and the Ministry of Energy (MOE) understand the need for a successful refurbishment for the Province, the company and the industry. In line with that importance, the Minister of Energy established the role of independent advisor and OPG established the role of an external independent oversight team reporting to the OPG Board. This team consists of individuals from the companies Burns & McDonnell and Modus.

The OPG external independent oversight team issued its Q1, 2015 at the March Nuclear Oversight Committee meeting. The focus of the report was the refurbishment team's preparation of the Release Quality Estimate. The following observations were identified in the report:

- The independent oversight team believes that the RQE roadmap provides sufficient milestones to generate the RQE by its October 2015 milestone, a process that will provide quality estimations, solid documentation that will permit a good basis for vetting and an effective Gate 3 process as primary RQE inputs.
- The progress of engineering is sufficient for input into the RQE and does not represent a risk to breaker open milestone.
- The Joint Venture's (JV) progression to its Class 2 estimate and the ultimate agreement to target price for execution of the work represents the largest portion,

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and thus largest risk to RQE. Currently the risk includes closing the \$700M gap between the JV's Class 3 estimate and the amount OPG carried in its 4d cost estimate. As a result of the JV being behind schedule in the development of its Class 2 estimate, a 2-week extension to April 24 has been approved with a second extension to May 8 very likely and the OPG RFR team will receive a very large amount of material from the JV close to the submission date.

- The initial JV proposal for the RWPB was rejected by OPG due to its lack of detail and inadequate schedule. The RFR team initiated challenge meetings with the JV to produce a more detailed cost estimate and schedule. To reverse the trends of the Campus Plan and SIO projects will require an excellent estimate and strong accountability to the cost and schedule.
- The ability for corporate IT to support the needs for such a mega project and the risk associated with the current hiring and talent retention processes were highlighted as risks.
- The independent team will conduct a detailed review of the integration between station and refurbishment.

These observations are similar to those made by the Independent Oversight Advisor (IOA). Two challenges identified by the IOA have not been mentioned by the OPG independent oversight team. The risk associated with quality of design engineering deliverables by design agencies has been a common theme within these reports. The refurbishment VP of Engineering has recently (March) expressed the same concern. The second challenge related to addressing lessons learned from the Campus Plan and SIO projects is recognized by the VP Execution.

**Alignment with the Principles of the Long Term Energy Plan**

The MOE's 2013 Long Term Energy Plan identified seven principles by which it expects OPG and Bruce Power to follow in the development and execution of their respective units. OPG performance to these principles is good, as can be seen through the review of this section.

Principle 1: Minimize commercial risk on the part of ratepayers and government.

The majority of DNR contracts are fixed/firm price with the remaining tied to cost and schedule performance. Commercial individuals have been embedded on each project team to manage commercial risk. Project scope has been defined to the component level, and detailed engineering will be completed prior to the start of construction. OPG has invested in a reactor mock-up and training facility, to perform full testing of the tools, processes and procedures, as well as train staff prior to performing work on the actual

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reactors. The contract with SNC/Aecon includes provisions for OPG to take over the tooling and the mock-up at the conclusion of the Definition Phase if the parties are unable to negotiate the target price contract for the Execution Phase.

Incentives in the RFR contract were established on the basis of four unit performance, allowing the RFR contractor to make-up cost overruns and schedule delays to the first unit on subsequent units. However, the LTEP prioritizes the importance of a successful Unit 2 refurbishment. This will need to be included in the target price for the RFR and TG projects.

Principle 2: Mitigate reliability risks by developing contingency plans that include alternate supply options if contract and other objectives are at risk of non-fulfillment.

One contingency action contributing to this principle is the decision to start the second unit after unit 2, rather than overlapping the units. In addition, the effort to improve the reliability of fuel handling equipment reduces the chance that fueling of the operating units will be reduced during the defueling of the refurbishment unit.

Principle 3: Entrench appropriate and realistic off-ramps and scoping.

Each contract has an off-ramp for termination. Reimbursement to contractors is limited to reasonably incurred costs. Each unit requires individual approval that provides well-defined off-ramps. The yearly release strategy and gating process for funding individual project initiatives has wide visibility and adherence within the DR Team. be done in drained/defueled state.

Principle 5: Require OPG to hold its contractors accountable to the nuclear refurbishment schedule and price.

Schedule accountability is built into each contract. The contractor is required to provide a detailed schedule for execution as an input into the Release Quality Estimate. Cost accountability is built into contracts to establish target cost and incentives/disincentives. Monthly project oversight meetings with OPG senior management and contractor senior management have improved oversight and contractor accountability. Quarterly CEO meetings reinforce this principle. OPG has chosen to perform the work in the Execution Phase on a target price basis which increases the contractors' transparency. This will enhance OPG's ability to resolve issues as they arise. This may result in OPG performing specific work rather than use a contractor. For example, agreement could not be reached with a supplier of radiation protection services, resulting in OPG deciding to perform the services itself.



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Principle 6: Make site, project management, regulatory requirements and supply chain considerations, and cost and risk containment the primary factors in developing the implementation plan.

Regulatory requirements were a primary input to the defined scope of the refurbishment outage and life extension projects. There is an agreement between the station and refurbishment on the condition that the unit will be turned over to the project and then returned to the station. The program is being managed in accordance with PM Institute standards and INPO project principles. The Release Quality Estimate process is using Association for Advanced Cost Engineering (AACE) best practices and is being monitored by KPMG. Risk management is recognized as a key element of success and the program is being well implemented.

One opportunity for improvement is the ability to identify and address adverse trends in performance in a timely and effective manner.

Principle 7: Take smaller initial steps to ensure there is opportunity to incorporate lessons learned from refurbishment including collaboration by operators.

To fully incorporate lessons learned from the first unit's (Unit 2) refurbishment, the second unit's (Unit 1) start has been delayed until the completion of the first unit. If appropriate, other units may be able to be delayed to continue this risk reduction. However, this will likely result in an overall increase in cost. To reduce risk for the first unit, the decision was made to install its digital controller in a future outage. To prevent the risk associated with single source suppliers of key reactor components, OPG has qualified second vendors for key components. This will help Bruce Power with an associated materials risk.

OPG and Bruce Power refurbishment management have met on three occasions to develop areas in which they can be mutually supportive. In addition, the engineering organizations have met to discuss opportunities to improve the efficiency and effectiveness of design engineering. The following are areas in which collaboration is being sought by senior management:

- a framework for collaboration
- Reviewing the significant work scope in each program
- Reviewing key performance and workplace challenges
- Reviewing planned trades work schedules
- Reviewing resource leveling strategies and likely high resource demand periods
- Reactor Defueling planning and tools

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- Plans and Lessons Establishing learned on systems layups and drying of systems that are drained
- Modifying field work controls on defueled units
- Lessons learned on transitioning into and out of Refurbishment
- Plans for completing Balance of Plant work without impacting critical path
- Performance of RFR tools and value of full mock-up of the reactor
- Close out issues and unit return to service challenges

An additional opportunity from this collaboration would be to analyze series which have different durations between the two refurbishment Level 1 plans. For example, Bruce Power has estimated defueling the reactor in about a third of the duration that is estimated for the Darlington units. Since neither plant has direct operating experience, it would be useful to understand the assumptions each estimate has made to determine if any should be challenged. Another example is that Bruce Power estimates more than four times the duration for bulkhead installation than OPG. Since Bruce Power did install bulkheads for the refurbishment of Units 1 and 2, there is some operating experience that may be of value to verify the estimate for the Darlington units.

## **8. State of Readiness**

The Nuclear Refurbishment program is fully into its Definition Phase to support the successful execution of Unit 2, starting in October 2016. There are several areas that provide confidence that the organization is on track for breaker open; including:

- Regulatory approvals have been received for the Environmental Assessment, Integrated Safety Review, and the Global Assessment Report. There has been agreement with the CNSC on the Integrated Improvement Plan, with written acceptance tied to the Darlington operating license renewal process, scheduled in 2015.
- Scope for life extension and the work required to be performed during the refurbishment outage are defined and approved. The life extension work that is not included in the refurbishment outage will be performed by Projects & Modifications and the station.
- Although there is a challenge to meet the August milestone, engineering will be completed in sufficient time before breaker open to support downstream activities, such as order materials and generation of field execution instructions.
- The Release Quality Estimate is currently under development to meet its October 2015 milestone. The RQE will include the cost estimate for the four units, the

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Level 1 plan for the four units and Level 3 detailed schedule for Unit 2, the refurbishment outage scope for each unit and the execution strategy.

- A number of products to support the RQE will define several key areas for success, such as scope and responsibilities of functional departments, assumptions on the support needed for each project and responsibilities for the transition of the unit between Darlington Operations organization and refurbishment organization.
- The project management and support organization is in place for the Definition Phase and the transition into the execution phase.
- The assembly of the execution organization has started. There is the commitment to hire a construction management company to support the execution phase.
- Contracts are in place for all projects to complete the engineering and develop the estimate (cost and schedule) required for the RQE.
- The Class 2 estimate for the Re-Tube and Feeder Replacement project is under development. There are several issues that still need to be resolved to OPG's satisfaction, resulting in an appropriate level of oversight by senior refurbishment management and OPG's CEO.
- The RFR full scale reactor mock-up is proving to be a valuable asset in the verification of tool designs and validation of Tooling Performance Guarantee (TPG) durations. Its value will increase during the refining of the procedures for the reactor face series, and the training of re-tube face and feeder replacement personnel.
- With the unsuccessful negotiation for a contract for radiation protection services, OPG has decided to self perform this function.
- Pre-production qualification runs for the major reactor components are well in progress. The few existing issues are being managed by the Joint Venture with the active involvement of OPG supply chain and RFR project team. OPG implemented the strategy to have two vendors qualified for each major component. This will provide OPG the ability to mitigate significant quality issues with one vendor, as well as provide Bruce Power with the same flexibility in procurement of these critical components.

Although OPG is making good progress towards breaker open readiness, there are a number of issues that once resolved will increase the comfort level for the execution of the project. These include:

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- Probably the most significant need is for the refurbishment organization to demonstrate effective execution of field work in 2015 and 2016. The current focus on execution is to put the infrastructure (processes, facilities and organization) in place for breaker open. This creates an opportunity to ensure contracts are effectively managed and contractors perform to the expected standards. In addition to addressing performance issues as they arise, management needs to incorporate lessons learned from the Campus Plan and SIO projects during this early execution phase. This demonstration should be encouraged prior to breaker open.
- Tied to execution is the fact a good fraction of the work is first time execution for the vendor, very infrequently performed or first of a kind. A few examples include that this is the first time for the Joint Venture to execute a re-tube and feeder replacement, first time in a decade for B&W to clean the Darlington steam generators, first of a kind process for the handling and reduction of re-tube radioactive waste and some first of a kind turbine inspection at Darlington. Since refurbishments by their nature are infrequently performed, this is not a surprise. In addition, OPG has taken a number of actions to mitigate the risk – the most visible being the full-scale reactor mock-up. However, execution is significantly different than planning and the need for OPG to have effective oversight and the ability to identify and respond to degrading execution performance is once again emphasized.
- Radiation protection issues have been resulted in work stoppage and delays in previous refurbishments, projects and outages. By self-performing radiation protection services, OPG has accepted the responsibility to prevent unplanned events, but also effectively respond to them in a timely manner (although, one could argue they have this responsibility in any model). OPG has a solid radiation protection program. It will have a self-contained RP organization for field execution. In addition it will need to prepare a response to a variety of unplanned radiological events in order that an unplanned event does not result in a significant delay.
- Although there is confidence that the RQE will be completed on time, there is a risk that the JV's target price plus requested contingency will exceed the class 4d estimate by a sufficient amount to have a target price not achieved. OPG and the JV are working diligently to resolve a number of remaining nontrivial issues. A failure to achieve an acceptable target price will require OPG to implement its contingency plan in a relatively short period of time.
- The performance of the fuel handling equipment during the defueling of the reactor will set the stage for the first phase of the refurbishment outage. The station has an initiative to improve fuel handling equipment reliability. The

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success of this initiative is imperative for the success of the defueling of the reactor.

Although OPG has the infrastructure and framework for execution of the outage, there the ability to demonstrate successful execution of projects and initiatives during the 18 months prior to breaker open will provide increased confidence in the ability to effectively execute the outage.

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# **Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program**

**For the Quarter ending June 30, 2015**



Mike White  
CALM Management Consulting, Inc.  
July 9, 2015

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## **1. Minister Summary**

This report provides the detailed quarterly review of trends, accomplishments and challenges related to the Darlington Nuclear refurbishment project. The project is reaching a critical phase, with completion of Definition Phase by yearend of 2015 and the start of execution of some core refurbishment projects. Between now and breaker open the refurbishment organization will be executing projects associated with the Re-tube Waste Processing building, refurbishment support facilities, services and shutdown/layup projects.

Refurbishment management is progressing well towards being in a state of readiness for breaker open. This progress includes:

- Life to date total cost of the project as of the end of May 2015 is \$1,889M, which is \$214M below the plan of \$2,103M.
- The Release Quality Estimate is currently under development to meet its October 2015 milestone. The RQE will include the cost estimate for the four units, the Level 1 plan for the four units and Level 3 schedule for Unit 2, the refurbishment outage scope for each unit and the execution strategy.
- Regulatory approvals have been received for the Environmental Assessment, Integrated Safety Review, and the Global Assessment Report. There has been agreement with the CNSC on the Integrated Improvement Plan, with written acceptance tied to the Darlington operating license renewal process, scheduled in 2015.
- Scope for life extension and the work required to be performed during the refurbishment outage are defined and approved. The work not performed as part of the refurbishment outage will be executed by the station and Projects & Modifications. There is a scope control process in place to review and approve additional work that will be performed during the Refurbishment outage; irrespective if it is to be executed by Refurbishment, Projects & Modifications or the station.
- Although there is a challenge to meet the August milestone, engineering will be complete in sufficient time before breaker open to support downstream activities, such as the order of materials and generation of field execution instructions.
- Scope and responsibilities of functional departments are documented in Functional Management Plans, assumptions on the support needed for each project have been identified and documented, and responsibilities for the transition of the unit between Darlington Operations organization and



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refurbishment organization have been accepted by both.

- The assembly of the execution organization has started. This includes the use of Kiewit as the construction partner to assist in active management and oversight of field activities. In addition, an Executive Performance Assurance Group will be established to provide additional oversight to the OPG executive.
- The Class 2 estimate (revision 0) for the Re-Tube and Feeder Replacement project was submitted by the Joint Venture (JV) in May. There are several issues that still need to be resolved to close the gap between the estimate and OPG's expectations. The Class 2 estimate (revision 1) is expected to be submitted by the JV by August 31.
- The RFR full scale reactor mock-up is valuable in the verification of tool designs and validation of Tooling Performance Guarantee (TPG) durations. Its value will increase in the refining of the procedures for the reactor face series, and the training of re-tube face and feeder replacement personnel.
- Pre-production qualification runs for the major reactor components are well in progress.
- The on-boarding center, fully operational in the first quarter, has significantly improved the time it takes for individuals to complete administrative, security, training and radiation protection tasks in order to obtain site access.

Although OPG is making good progress towards breaker open readiness, there are a number of issues that once resolved will increase the comfort level for the execution of the project. These include:

- Probably the most significant need is for the refurbishment organization to demonstrate effective execution of field work in 2015 and 2016. During the second quarter Refurbishment Execution senior management established a Ready to Execute Plan. This plan includes the use of Refurbishment managed prerequisite projects to test the processes, infrastructure, organization and oversight that will be used in full refurbishment outage. This is an excellent opportunity to identify needed improvements prior to the start of full execution at breaker open. The plan has 5 months to analyze performance and incorporate improvements prior to the October start of the full outage.
- Tied to execution is the fact some of the work is first time execution for the vendor, very infrequently performed or first of a kind. For example, this is the first time for the Joint Venture to execute a re-tube and feeder replacement, first time in a decade for B&W to clean the Darlington steam generators, first of a kind process for the handling and reduction of re-tube radioactive waste and some

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first of a kind turbine inspection at Darlington. Since refurbishments by their nature are infrequently performed, this is not a surprise. OPG has taken a number of actions to mitigate the associated risk – the most visible being the full-scale reactor mock-up. However, execution is significantly different than planning and the need for OPG to have effective oversight and the ability to identify and respond to degrading execution performance is emphasized.

- There is confidence that the RQE will be completed on time. However, there is a risk that the JV's target price plus requested contingency will exceed the class 4d estimate by a sufficient amount to have a target price not achieved. OPG and the JV are working diligently to resolve a number of remaining issues. A failure to achieve an acceptable target price will require OPG to implement an alternative plan in a relatively short period of time.
- The performance of the fuel handling equipment during the defueling of the reactor will set the stage for the first phase of the refurbishment outage. The station has an initiative to improve fuel handling equipment reliability. This initiative is challenging, and is being monitored by a station oversight committee and the Defueling Project's senior management oversight committee.

OPG has the infrastructure and framework for execution of the outage. With the recently developed Ready to Execute Plan, the organization will monitor completion of prerequisite projects (including Campus Plan and SIO projects) and processes needed for the start of the Unit 2 outage, and test the processes, infrastructure, organization and oversight prior to the breaker open in order to implement desired improvements.

The challenges that were identified in the first quarter continue to exist, with a fourth challenge related to a contractor personnel safety. These challenges represent performance trends that should be addressed to reduce the possibility of becoming significant issues.

**Safety performance**

The adverse trend in contractor and subcontractor safety performance in the Campus Plan and SIO projects continues, with some examples in the Re-tube and Feeder Replacement (RFR) field activities. The adverse trend includes moving vehicles hitting site objects, improper practices related to working at heights, and lifting and rigging. These poor safety practices cut across the ESMSA contractors, the RFR contractor and a subcontractor directly managed by OPG and has resulted in some increased oversight and discussions by OPG and contractor management. The organization will need to implement a number of mitigating interim actions while a long term corrective action plan is developed and implemented. Actions that have been effective at other facilities should be considered for this initiative.

### Release Quality Estimate

The development of the Release Quality Estimate (RQE) was the major focus of the refurbishment organization during the second quarter. OPG has several challenges to overcome in a short period of time to meet the RQE timeline. However, it is on course to provide a defensible upper bounding RQE. The challenges that need to be successfully addressed include:

- **RFR Class 2 Estimate.** The Joint Venture (JV) submitted a Class 2 estimate (revision 0) in early May. There are three major components to the estimate that are essential for RQE – schedule, cost and risk. Although OPG had reviewed many of the individual elements of the estimate prior to the submission, OPG and the JV had not reached agreement on most individual elements and this was the first opportunity for OPG to review the integrated and consolidated estimate (including cost, critical path schedule and risk). All three components of the Revision 0 submission were outside of OPG's planning basis, resulting in the need for detailed reviews and meetings between the JV and OPG. These will continue until their resolution and submission of revised Class 2 estimate (revision 1) by August 31, 2015.
- **Project Estimates.** By the end of this quarter, the vendors of the projects have submitted over 95% of the cost estimates and schedules and those submitted have been reviewed by the responsible OPG project managers. This represented a total of 341 cost estimates and 80 schedules. This information is in the process of being reviewed by the RQE team for acceptance.
- **Functional Estimates.** Along with the RFR project, the OPG functions represent the largest cost component of the refurbishment program. With the exception of the maintenance function, this cost is strictly support and does not touch the plant. As a result it is easy to have increases that individually do not seem significant but the aggregate can result in a more significant contribution to the overall cost of the program. Refurbishment senior management established a Functional RQE Review Team to critically analyze the individual functional submissions for savings. As a result, an opportunity to save nearly \$300M was identified which will bring the functional RQE value in line with the 4D estimate.
- **Contingency Funds.** Now that the project and functional estimates have been submitted, it is possible to focus on risks and their monetization. A series of workshops have been scheduled during July to examine the risks associated with the projects, the functions and the program. From these workshops, RQE contingency will be developed in terms of cost uncertainty, schedule uncertainty and discrete risks in projects and functions. Unrealized risks associated with the

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Campus Plan and SIO projects will be included in the RQE contingency determination.

- KPMG is performing an independent review of RQE. It contains two components – a review of the RQE processes and a review of their implementation through a deep dive in the RFR, Balance of Plant and Operations and Maintenance function estimates. The review of the RQE process has been completed with the report expected by the end of July. The conclusion of the review is that the RQE processes are consistent with industry practices and the effort is appropriate for a megaproject. A number of improvement opportunities are identified, but none impact the validity of the RQE.

Management of Engineering Workload

The challenge related to large engineering workload associated with the core refurbishment projects and the ability to complete design engineering with high quality by the May target date. This stretch target date was not made. However, the impact on RQE is not significant. The organization will again be challenged to meet its milestone of completing design engineering packages by August 15, 2015 (with some approved exceptions related to computer software and the Re-tube Waste Processing Building (RWPB)).

The concern is the potential impact on the quality of the design engineering products from the possible perceived time pressure combined with the robustness of OPG's owner acceptance process to identify quality issues in design products. The Vice President of Refurbishment Engineering has recently expressed concern regarding the current level of design engineering errors. He held a stand down for the engineering design agencies during the second quarter. Since engineering errors are latent in nature (not likely detected until installation, commissioning or operation), it is important that there is strong confidence in the owner acceptance process and its effective implementation. The rigor of this process and its implementation has not been reviewed to provide a high level of confidence.

Incorporating Lessons Learned from Campus Plan and Safety Improvement Opportunity Projects

This challenge is for refurbishment management to implement robust actions to address the many lessons learned from the problems and issues seen in the planning and execution of the Campus Plan and Safety Improvement Opportunity projects. Actions have been implemented for the planning (definition) phase of the project. Actions for the execution phase are being developed with a test period planned for the first five months of 2016. This test period will use, to the extent possible, the processes, infrastructure, organization and oversight that will be used through the refurbishment of Unit 2. This is

an excellent opportunity to identify improvement opportunities and implement them for breaker open.

## 2. Purpose of Report

This quarterly report provides a more detailed review and expansion of the monthly reports to the Ministry of Energy of OPG management's progress to plan and execute a successful refurbishment outage of the Darlington nuclear units. Success is defined as the preparation and execution of 100% of the correctly identified project scope safely, on schedule, within budget and with quality. It is the belief of the MOE's Independent Oversight Advisor that the Refurbishment Program Challenges that are identified in Section 5 deserve consideration by OPG Refurbishment management. It is the intention to identify such challenges when they represent an early trend rather than wait until they become a significant issue.

## 3. Darlington Nuclear Refurbishment Scorecard

### 3.1 Darlington Nuclear Refurbishment Scorecard – June 2015

	Current Month	Previous Month	Trend	Notes
<b>Unit 2 Readiness for Breaker Open</b>				
Safety Performance and Preparations for Unit 2	x	x	↘	This has been identified as a new challenge
Regulatory Approvals	✓	✓	→	
Risk Management	✓	✓	→	
Release Quality Estimate	x	x	→	
Cost Management	✓	✓	→	
Unit 2 Refurbishment Core Projects Readiness	✓	✓	→	
Unit 2 Execution Readiness	✓	✓	→	

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	<b>Current Month</b>	<b>Previous Month</b>	<b>Trend</b>	<b>Notes</b>
Unit 2 Return to Service Readiness	✓	✓	→	
Unit 2 Execution Schedule Development	✓	✓	→	
Unit 2 Scope Control	✓	✓	→	
Resource Management	x	x	→	
<b>Field Execution</b>				
Performance of Campus Plan & Safety Improvement Opportunity Projects	x	x	→	
Unit 2 Prerequisite Work	x	x	→	
<b>Learning and Oversight</b>				
Operating Experience & Corrective Action	✓	✓	→	
Oversight	✓		→	

**Basis for Scorecard Ratings**

Safety Performance and Preparations for Unit 2– YELLOW

The adverse trend in worker safety performance in the Campus Plan and Safety Improvement Opportunities (SIO) projects has continued through the second quarter of 2015. This trend includes incidents involving lifting and rigging, work at heights and vehicle movement. In addition, during Q2 the Joint Venture has had safety incidents while working at the mock-up and the Re-tube Waste Processing Building. Since there has not been a corrective action plan developed to address this continuing adverse trend, it has been identified as a challenge.

The first refurbishment ALARA committee meeting was held in the second quarter. The establishment of an ALARA committee during the planning phase is an excellent practice. However, it has set the end of Q1, 2016 as the target for a Unit 2 ALARA plan. This late date will provide little opportunity to have the ALARA plan influence the projects both in terms of dose reduction techniques during the execution of Unit 2's refurbishment, as well as minimize source term and radiological hazards during post refurbishment operation.

Regulatory Approvals – WHITE

The CNSC provided a letter to OPG stating that the revised Integrated Implementation Plan (IIP) meets the intent of CNSC regulatory document RD-360. The CNSC staff accepts OPG's IIP Revision 001 with implementation of specific changes that were documented in the letter. The changes are required to be made in the document's revision for submission to the CNSC in support of the 2015 licensing renewal for the Darlington nuclear plant. The IIP represents OPG's commitment to the CNSC in response to findings of the Environmental Assessment and Integrated Safety Review.

Risk Management – WHITE

There were two Risk Oversight Committee meetings during the second quarter of 2015. The April meeting reviewed the status of the identified Nuclear Refurbishment Key Risk Areas, which are the result of an aggregate analysis of the risk registry. The June meeting reviewed the Contingency Development Plan for RQE. The Key Risk Areas and status are:

- Availability/Retention of Key Staff (remained as a Yellow risk)
- Cost and Estimating Management (remained as a Yellow risk)
- Completion of Unit 2 Prerequisites (remained as a Yellow risk)
- Regulatory Approvals (improved from a Yellow risk to a Green risk)
- Fuel Handling Reliability (remained as a Yellow risk)
- Vendor Performance (remained as a Yellow risk)
- Integrated Schedule Development (remained as a Yellow risk)
- Materials not Procured Prior to Lead Time Expiry (remained as a Yellow risk)
- Completion of Engineering (remained as a Yellow risk)
- Integration with External Organizations (remained as a Yellow risk)
- Support Staff Resourcing (this is a new key risk area regarding the availability and retaining specialty support resources to support the refurbishment project.)

There has been some improvement in the development and implementation of mitigating actions to reduce the individual risks associated with these key areas.

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During the second quarter the contingency development process and plan for RQE were developed, with initial implementation. The actual determination and allocation of contingencies for individual projects, the functions, and the program, and management reserve will be completed for inclusion in the RQE.

As the organization refines its analysis of risks, there will be some medium and perhaps high risks, which will either be accepted or not fully mitigated. It would be prudent to select a subset of these risks and develop a contingency plan in the event that the risk materializes.

Release Quality Estimate (RQE) - YELLOW

Progress towards RQE has been a major refurbishment focus during the first half of 2015, and will continue until its submission in October, 2015. The RQE has four major deliverables:

- The cost estimate for the refurbishment of four units, including contingency. This requires a detailed understanding of the basis and assumptions for the outages and the associated risks.
- A schedule for the four units – detailed for level 2 and high level for the remaining units. This also requires an understanding of the basis and assumptions for the outages and the associated risks.
- Confirmation of the scope of the project and specifically Unit 2. This not only includes the scope of the refurbishment outage but also the commitments to the CNSC tied to the unit's return to service but assigned to the station.
- The Execution Strategy for Unit 2. This includes many items that have not been effectively implemented during execution of the Campus Plan (CP) and Safety Improvement Opportunity (SIO) projects. These are described in the challenge for incorporating lessons learned from the CP and SIO projects.

OPG is working through a number of issues to meet its milestone of October 15, 2015. The status of the RQE is provided in the RQE challenge. The sheer magnitude of the RQE effort, its overall importance to the approval for the start of the Unit 2 refurbishment and the relatively short schedule has resulted in this being identified as a challenge. The Yellow rating is reflective of the need for continued monitoring.

Cost Management - WHITE



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For the purpose of this scorecard, cost management has been separated from the risks associated with the basis and assumptions for the refurbishment project, which are captured under the RQE element. Life to date total cost of the project as of the end of May 2015 is \$1,889M, which is \$214M below the plan of \$2,103M.

The release 4d estimate was approved by the OPG Board of Directors at its November meeting. The release was for \$1,124M to complete the 2015 planning activities for a cumulative release of \$2,732M. The bounding cost estimate for the project remains within \$10B (2013B). The breakdown of this estimate, its evolution since 2009 and resulting impact on LUEC is shown in the following table.

<b>2014\$</b>	<b>2009</b>	<b>2013 (release 4c)</b>	<b>2014 (release 4D)</b>
Project Estimate	n/a	\$7,223M	\$7,635M
Contingency	n/a	\$2,133M	\$2,135M
Management Reserve	n/a	\$844M	\$430M
TOTAL	\$10,970M	\$10,200M	\$10,200M
Levelized Unit Energy Cost (LUEC)	8.9¢	7.7¢	7.8¢

**Unit 2 Refurbishment Core Projects Readiness - WHITE**

The readiness of the core projects is a measure of the completion of engineering, the ordering of parts and materials, the generation of Comprehensive Work Packages (CWPs) to execute the work in the field, and the development of Class 3 estimates (Class 2 for the RFR and TG projects). Design engineering did not meet the early completion milestone of May 15<sup>th</sup> and is challenged to meet the milestone of August 15<sup>th</sup>. However, engineering is progressing at a rate that it will not be a risk to breaker open, even if the milestone is not met. The RQE focus has schedules and work down curves for estimated and schedules. As of June 30<sup>th</sup>, most projects have submitted their RQE deliverables. Strategy for the procurement of parts and materials is in progress. The generation of CWPs requires the same focus as the completion of design engineering deliverables. The effectiveness of the processes to procure materials and have CWPs available when required will be assessed during the test period that uses the prerequisite projects scheduled in 2015 and 2016 prior to breaker open.

Unit 2 Execution Readiness - WHITE

In recognition of the challenge of the refurbishment project and to increase the overall project execution capability, OPG has issued a contract to Kiewit Corporation to provide project execution management support and oversight services. The Construction Execution Strategy document has been issued.

The execution strategy is currently under development as one of the four elements of RQE. Refurbishment execution will use prerequisite support projects to pilot processes, organization and infrastructure to assess their effectiveness in managing execution and addressing the identified lessons learned from the Campus Plan and SIO projects.

Unit 2 Return to Service Readiness - WHITE

OPG refurbishment management recognizes the need to start the strategy to perform commissioning of systems and return the unit back to service upon the completion of each unit's refurbishment. This is seen in a Return to Service section reporting to the Refurbishment Director of Operations and Maintenance, as well as an associated functional management plan. Since the return to service requires detailed input from and coordination between operations and engineering, there should be documented roles and responsibilities of each group.

Unit 2 Schedule Development - WHITE

The current focus is the completion of the critical path duration and schedule as part of the JV Class 2 (revision 1) estimate. This will be submitted by August 31. However, during its finalization refurbishment work management personnel are placing non critical path activities and projects in appropriate windows. The goals of this exercise are to have a detailed schedule (Level 3) that provides safe conditions for execution at all times, that has a challenging but achievable Critical Path and has a low probability that other work (such as Balance of Plant) piles up to the point it becomes Critical Path. The Unit 2 Level 3 schedule is a commitment for RQE. In addition, Level 1 schedules for the remaining units will be included in the RQE.

Unit 2 Scope Control - WHITE

The scope for the Unit 2 refurbishment outage is well defined, and is controlled by an established process and Unit Scope Control Board. This controls both the addition and

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removal of work to the outage. It is expected that some scope addition will occur as a result of discovery work associated with the core projects, as well as corrective maintenance on components that are planned to be operating during the outage. Some of this work will need to be done, and the RQE contingency funds will recognize this reality. The work performed within the core refurbishment projects is not the only source of work to be performed during the outage period. Additional work will be done as a result of:

- The Unit 2 cyclic outage will be performed during the unit's refurbishment outage. Its scope includes corrective maintenance and preventive maintenance activities that are not included in the core refurbishment projects, but necessary for the continued health of the asset. The scope of this outage is in the process of being defined and controlled through a separate scope control process. Its scope and associated estimate are required to support the submission of the RQE.
- There will be a number of projects managed by Projects and Modifications that will be conducted during the refurbishment outage period. They are not associated with the refurbishment outage and thus will not be part of RQE. However, the scope of work needs to be fully defined and controlled to prevent impact on the core refurbishment project.
- Although not funded by the refurbishment project or part of its scope, the station organization has a number of work activities for which it is responsible and has a CNSC commitment for completion prior to Unit 2 start-up. These will be managed through established station processes.

A Unit 2 Scope Review Board meeting was conducted in May, and a number of projects to address equipment reliability issues were accepted into the Unit 2 refurbishment outage. These projects will be managed and funded through the Projects & Modifications organization since they are operating projects rather than required for the refurbishment of the unit.

**Resource Management - YELLOW**

The availability/retention of key project staff is identified as one of the program's Key Risk Areas. It consists of:

- The possibility of limited skilled trade resources and supervision for project execution is one of the highest program risks. Currently the trades unions predict that there may be a total shortfall of approximately 50,000 personnel during the duration of the Darlington refurbishment. They have also identified poor progress in increasing the number of journeypersons in several trades. The current rate of

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individuals moving from the apprenticeship program to become a journey person is 18% - 20%. It is recognized by all parties that this must improve. The Darlington VP of Execution is leading an initiative that includes the unions, OPG and its main contractors to address this potential shortfall.

- The potential that project leadership and specialized resources are not in place when required. There are a number of initiatives under development to reduce the significance of this risk. Refurbishment management is constrained through the need to implement the corporate policies and procedures that have been developed for operating facilities and small projects.
- The possibility of an insufficient number of Authorized Staff for both station and refurbishment needs. This is being addressed through a combination of increased number of candidates for the associated positions as well as challenging the extent of the need for such staff once the unit is defueled and isolated through the bulkhead.
- The potential of an insufficient number of qualified radiation protection coordinators to support project execution.

OPG refurbishment management is developing and implementing actions to ensure its leadership team is in place for the current outage and future leaders are identified and developed for the program's sustainability. However, the recent trend of key individuals leaving OPG or the project represents a degrading trend in this area. During this quarter a number of key individuals have left the project, including the Director of Operations and Maintenance (DOM) (became the Chief Nuclear Engineer), the Manager of Maintenance (retired) and the Manager of Restart (hired by a vendor). Movement of key, experienced personnel from the project is a risk not only because of the lost talent, but also because of the loss of project specific knowledge, including the basis of decisions and operating experience. In particular, this is the fourth DOM in the past two years.

**Performance of Campus Plan & Safety Improvement Opportunity Projects - YELLOW**

It is recognized within the OPG organization that the performance of the Campus Plan and Safety Improvement Opportunity (SIO) projects continues to be a challenge to OPG. The most important observations from this quarter are:

- The Joint Venture has received the contract for the D<sub>2</sub>O Storage Building project. The JV has challenged that certain aspects of the civil design do not meet code. If it validated by OPG, this will be rework due to poor quality that was accepted by refurbishment engineering. A schedule and cost estimate

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has been presented to OPG and are currently under review. However, these will need to be revised if the civil design challenged is accepted. The decision to implement the contingency plan for the storage of Unit 2's heavy water will need to be initiated by the start of the fourth quarter.

- As stated in the challenge, the adverse trend in contractor safety continued through the second quarter. An adverse trend investigation has been completed, but the corrective actions have not been finalized. Interim actions to effectively prevent the adverse trend worsening have not been implemented.
- The majority of these projects have submitted estimates for RQE. The exceptions are EPG3, AHS and the D<sub>2</sub>O storage building.
- Visible progress is observed in the projects once the foundation has started. The initial prerequisites (day lighting for underground services, dewatering and caisson installation) were significantly more complicated and thus longer in duration than initially scheduled.
- Engineering continues as construction progresses in some projects, including the EPG3, AHS, CFVS and D<sub>2</sub>O storage building.

The current completion milestones and changes from the May report to the Ministry for these projects are identified in the following table.

Project	Need Date	Current Forecast	Float to Need Date (months)	Notes (changes highlighted in bold)
Auxiliary Heating Steam		Aug. 2015		This project is not tied to the start of Unit 2 refurbishment. <b>The vendor has a forecast to completion of November, 2015</b>
Heavy Water Storage and Drum Handling Facility	Feb. 2017	June 2016 (Partial) and May 2017 (full)	8	The partial is required to store Unit 2's heavy water. In addition, a contingency plan for Unit 2 water is under development. <b>The JV has been selected to complete the project. Final cost and schedule are under development.</b>
Holt Road Interchange Improvements	Oct. 2016	Dec. 2015	10	

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<b>Project</b>	<b>Need Date</b>	<b>Current Forecast</b>	<b>Float to Need Date (months)</b>	<b>Notes (changes highlighted in bold)</b>
Electric Power Distribution	Sept. 2015	TBD	4	The Available for Service declaration was not performed in May. There currently is not a new date.
Operations Support Building Refurbishment		Sept. 2015		This project is not tied to the start of Unit 2 refurbishment.
Refurbishment Project Office	Oct. 2016	Sept. 2015	13	
Re-Tube & Feeder Replacement Island Support Annex	Oct. 2016	Nov. 2015	11	The forecast date has slipped 2 months.
3 <sup>rd</sup> Emergency Power Generator	Oct. 2016	Mar. 2016	7	<b>The contractor's schedule has the forecast completion as August 2016.</b>
Containment Filtered Venting System	Oct. 2016	May 2016	5	<b>The contractor's schedule has the forecast completion as July 2016.</b>
Fire Water and Emergency Cooling		November 2015 (partial)	1	The strategy for this project has significantly changed. The replacement of emergency service water piping will be installed during the fall VBO and fully completed during Unit 2 refurbishment. Backup fire pumps, which are included in this project's scope, will move the start of Unit 2 refurbishment to the completion of the refurbishment outage.
Powerhouse Steam Venting System	Oct. 16	Oct. 2015	12	
Shield Tank Overpressure Protection	April 2017	December 2015 for Unit 3	N/A	The remaining units are tied to specific outages. Unit 2 is to be completed during the refurbishment outage. Unit 3's has been moved from June 2015 to December 2015 as a result of the change in the VBO from spring to fall.
Re-tube Waste Processing Building	July 2017	Dec. 2016	7	
Re-Tube Waste Storage Building	April 2017	December 2016	4	The actual need date is tied to the RWPB, which is July 2017. <b>The contractor's schedule has the forecast completion as February 2017.</b>

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<b>Project</b>	<b>Need Date</b>	<b>Current Forecast</b>	<b>Float to Need Date (months)</b>	<b>Notes (changes highlighted in bold)</b>
Used Fuel Dry Storage Building	Oct. 2016	December 2015	12	A decision was made not to continue this project during the coldest months, resulting in a change in forecast dates from October 2015 to December 2015.

The life-to-date costs for these projects, as of May month end, are \$524M, \$42M below plan. It is noted that there was a re-classification of a number of projects from the Refurbishment program to operating program. This represented about \$133M of cost reduction for Refurbishment.

As frequently stated in these reports, the Campus Plan and Safety Improvement Opportunity projects have had multiple issues in the establishment of cost estimates, the development of schedules, completion of engineering and the start of field execution, particularly related to building foundations.

Unit 2 Prerequisite Work

There is a large amount of work that needs to be completed at the station to support the start of the Unit 2 refurbishment outage. In addition to the visible Campus Plan and Safety Improvement Opportunity projects, other work that needs to be completed prior to the start of the unit 2 outage. These can be categorized as:

- **Fuel Handling Reliability Improvement Work.** There is a need to improve fuel handling equipment to support current operations and the defueling of the reactor. This work is being planned and executed by the station fuel handling organization. The total number of Work Orders in this category currently identified for completion prior to the start of Unit 2 refurbishment is 141.
- **Fuel Handling Work to support Unit 2 Refurbishment Outage.** In addition to the fuel handling equipment reliability improvement initiative, the station fuel handling organization is executing the work to support the Defueling project. An example is to have the Service Area Rehearsal Facility (SARF) returned to service to support the commissioning of defueling equipment in September 2015. The total number of Work Orders in this category currently identified for completion prior to the start of Unit 2 refurbishment is 41.
- **Station Ready for Refurbishment Work.** There is work that the station is responsible to complete that is required for the start of the unit 2

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refurbishment outage. This is related to improving the health of key systems, such as containment vapour recovery systems. If this work is not accomplished prior to the outage it will need to be completed at the start of the outage. The total number of Work Orders in this category currently identified for completion prior to the start of Unit 2 refurbishment is 47.

- Refurbishment Organization Work. There is some work for which the refurbishment organization is responsible. This work must be coordinated with the station schedule and use station processes. The total number of Work Orders in this category currently identified for completion prior to the start of Unit 2 refurbishment is 242.

In addition, the Refurbishment Core Project has several projects that must be completed prior to the start of the Unit 2 refurbishment outage. Field execution of these projects is scheduled through 2015 and 2016. Most of these are associated with Islanding, Shutdown/Layup and Balance of Plant and are summarized in the following table.

Core Project	Project	Status
Unit Islanding	Negative Pressure Containment Modifications	Field execution through 2015 and 2016. This includes 4 engineering packages.
	Area Islanding Barriers	Planned for execution in Q3, 2016. This represents 4 engineering packages.
	EFADS, PAMS and CLRTS modifications	Starts in VBO and continues through 2016
Refurbishment Support Facilities	Non-contaminated maintenance workshops and offices	This contains 7 engineering packages. Scheduled for Q1 and Q2, 2016.
	Wireless Network Infrastructure	This contains 1 engineering package. Scheduled for Q4, 2015.
	Turbine Cargo Elevator	This contains 2 engineering packages. Scheduled for Q1 and Q2, 2016.
	Work Control Area and Permit Preparation	This contains 2 engineering packages. Scheduled for Q4, 2015 and Q1, 2016.
	Radiation Protection Offices and	This contains 2 engineering packages. Scheduled for Q1



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Core Project	Project	Status
	Teledosimetry	into Q3, 2016.
	Contaminated Shops, decontamination and contaminated scaffold storage area	This contains 1 engineering package, although likely separate areas. Scheduled for Q2 and Q3, 2016.
Shutdown/Layup/Services	Breathing Air System	This contains 3 engineering packages. Scheduled for Q1 and Q2, 2016.
	Service Air System	This contains 2 engineering packages. Scheduled for Q1 and Q2, 2016.
	Washrooms – install and tie-in	Scheduled for Q3, 2016

As can be seen, 2015 and 2016 will have the four identified groups of station work, the identified core projects and the Campus Plan & SIO projects that will require integration, coordination and support from the station. This will have to be done in conjunction with the fall Vacuum Building Outage, a spring Unit 4 outage and the on-line work required for the continued safe operation of the plant. This will be a vast challenge for all three organizations.

A specific focus of the Refurbishment organization (particularly the R&FR project) is the planning, engineering and construction of the Re-Tube Waste Processing Building (RWPB). Although not required for Unit 2 breaker open, it is required prior to the start of removal of feeders and fuel channels, it is being planned and executed by the RFR Joint Venture, and thus is the first example of field execution by the Refurbishment Organization. This project has had some of the same issues seen in the Campus Plan and SIO projects and that contributed to their cost increases and schedule delays. In response, refurbishment senior management has increased focus and oversight of this project starting in Q1. This oversight includes a weekly meeting with the Vice President, Execution and a weekly scorecard discussed on the Chief Nuclear Officer phone call. However, the project neither participates in the daily project Plan of Day meeting nor has the equivalent daily meeting or phone call with senior management. The project relies on the capability of the OPG project manager. This may be adequate for this project, but is not the approach for sustainability.

Refurbishment senior management is using the prerequisite projects as an opportunity to test the processes, infrastructure and organization prior to the full execution in October 2016. It is unclear if the RWPB project will be included in this pilot in order that the JV is exposed to the processes prior to breaker open.

Corrective Action Program and Use of Operating Experience – WHITE

The refurbishment Corrective Action Program (CAP) and Operating Experience program (OPEX) represent nuclear industry standards and well implemented. Particular strengths are the quarterly trend reports and the Corrective Action Review Board. Both of these are consistent with OPG and industry standards. The challenge for the refurbishment organization is the integration of all sources of quality and human performance information into a broader trending product. For operating nuclear plants, the main source of quality and human performance information is the Station Condition Reports (SCRs). However, for the project this is only a small component of the available information on quality and human performance. Additional sources are the audits and surveillances performed by Supply Chain, receipt inspections of parts and materials, project oversight logs, and the corrective action program results for each vendor. To identify a potential adverse trend before it becomes a significant issue will require improved capability to trend across projects, vendors and programs.

Oversight – WHITE

During the Definition Phase, refurbishment oversight focused on the projects (engineering, estimating and commercial compliance) and the independent oversight team (Modus/Burns & McDonnell) that reports to the Nuclear Oversight Committee of the OPG Board of Directors. In addition, there have been a number of internal audits by various oversight organizations. As refurbishment transitions to planning and field execution of the prerequisite projects, there will need to be an increasing focus on both field execution and the horizontal oversight required to identify potential cross-cutting issues. The initiation of the Performance Assurance Group is a good first step in this essential on-going review.

#### **4. Accomplishments and Progress**

The following accomplishments were achieved during the first second quarter of 2015:

- Life to date total cost of the project as of the end of May 2015 is \$1,889M, which is \$214M below the plan of \$2,103M.
- Tool Performance Guarantee testing for the Re-tube and Feeder Replacement (RFR) project was successfully completed.

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- The Joint Venture (JV) submitted its Class 2 (revision 0) estimate for the RFR project in May. The JV and OPG are going through a series of reconciliation meetings to close gaps between the JV's estimate and OPG's expectations. These gaps include the duration of critical path and thus the outage, the amount of project management support and thus cost, and the allocation of risks and thus JV contingency funding. The Class 2 (revision 1) estimate is expected by August 31<sup>st</sup>.
- The execution estimate and schedule for Unit 2 for the Steam Generator project has been submitted, with OPG review and acceptance.
- Considerable work was performed in the development of the Release Quality Estimate during the second quarter. This included the generation of cost estimates for more than 300 individual projects and 80 detailed schedules. The functional estimates were completed, with a peer team providing structured challenges in the areas of duplication of support, cost reductions for subsequent units and sharing specific services with the station. This effort resulted in reduction of the functional estimate of more than \$300M. The next steps for the completion of RQE include completion of the Class 2 (revision 1) for the RFR project and the development of contingency funding. KPMG is currently assessing the process for developing the RQE against industry standards. Their report will be issued at the end of July. In addition, they are conducting deep dives in the estimates for RFR, Balance of Plant and operations and Maintenance function. This will be used to assess the extent to which OPG complied with its processes.
- Collaboration meetings with Bruce Power continue to explore and implement collaboration opportunities.
- PSA agreements have been established with both unions (PWU and Society) for the life of the refurbishment project.
- OPG issued its Performance Report on Darlington Refurbishment in June. In addition, it held a successful open house of the Mock-up, with more than 2,000 attendees.
- Kiewit has been selected as the construction management partner to assist in active management and oversight of field activities. They supported OPG's Lower Mattagami Project.
- Darlington Refurbishment Project underwent a corporate Fraud Risk Assessment Audit, receiving an effective rating and no reportable findings identified.

**5. Refurbishment Program Challenges**

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Throughout the life of refurbishment program specific challenges have been, and will be, identified that in the belief of the Independent Advisor to the Minister of Energy should have actions by OPG Refurbishment Management to address them, before they become significant issues. The currently identified Refurbishment Program challenges are related to safety performance, the development of the Release Quality Estimate (RQE), the management of the engineering workload, and implementing concrete actions to address lessons learned from the Campus Plan and SIO projects.

Safety performance

The adverse trend in contractor and subcontractor safety performance in the Campus Plan and SIO projects continues and examples have been observed in Re-tube and Feeder Replacement (RFR) field activities. The adverse trend includes the continuation of the previously identified issue of moving vehicles hitting site objects, improper practices related to working at heights, and lifting and rigging. These poor safety practices cut across the ESMSA contractors, the RFR contractor and a subcontractor directly managed by OPG.

An adverse trend in contractor safety was identified and investigated during April and May. Actions to address the causes of the performance trend have not been fully finalized and implemented. There has been increased discussion between OPG and contractor management. There are several possible contributors to this adverse trend. One is that the amount of work performed by the ESMSA contractors and managed by the Projects and Modifications Organization has increased significantly in the past few years without a full understanding of the potential impact on each organization's capability. In addition, the requirements for construction of new buildings on a nuclear site were not fully appreciated, including the extensive use of subcontractors. Managing the commercial aspects of the large workload reduced the amount of time senior managers were in the field observing actual work. Corrective actions taken to date have largely focused on communications, reviewing supervisors' competence and stand downs to share incident information and lessons learned. These have a relatively short retention life.

Actions that have been effective at other facilities should be considered for this initiative. Some examples that have been used at nuclear plants are:

- Reduce the threshold for high risk work in order to increase the oversight of contractor activities. Possible examples include all lifts of heavy loads, vehicle manoeuvre in confined areas, tie-ins to station equipment, EPG3 work, and work at heights by subcontractors. In addition, consideration should be given to declaring medium risk work as described in the OPG risk management procedure that is performed by a contractor should be considered high risk.

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- Have the oversight manager for selected high risk work provide observations to a public meeting – such as the daily PCC Plan of the Day meeting.
- Have the lifting and rigging recommendations from WANO SOER 2008-1 be implemented by Projects and Modifications, and Refurbishment organizations.
- Provide observation and coaching training to contractor, projects and modifications, and refurbishment personnel who conduct field observations.
- Implement a paired coaching program that pairs project managers with contractor managers as well as managers with first line supervisors. In this way, performance standards can be directly reinforced by senior OPG and contractor management to field supervisors and workers. Have field supervisors debrief observations at the PCC Plan of the Day (POD) or other meeting.
- Increase the emphasis on quality pre-job briefings. On several occasions workers are provided a start of shift briefing and sent to work without an actual pre-job briefing. The characteristics of a good initial and update briefings are not well understood by many first line supervisors. Provide some fundamental training on pre-job briefings. In addition, conduct observations on pre-job briefings.
- Conduct observation blitzes of performance areas of concern. Potential topics include lifting and rigging, work at heights, work in trenches, use of flag persons and pre-job briefings. Assign a central group (such as refurbishment's Managed Systems Oversight group) to provide analysis, trending and reporting of results.
- Have the first line supervisor, rather than a contractor representative, present the human performance rapid response package at the PCC POD meeting to increase accountability.
- Coach workers and first line supervisors on observed safety practices (positive and negative) and incidents.

**Release Quality Estimate**

The development of the Release Quality Estimate (RQE) was the major focus of the refurbishment organization during the second quarter. Although there remains considerable work, the RQE will be ready for submission to OPG's Board in early October 2015.

The current status of the REQ elements is provided below.

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- **RFR Class 2 Estimate.** The Joint Venture (JV) submitted a Class 2 estimate (revision 0) in early May. There are three major components to the estimate that are essential for RQE – schedule, cost and risk. Although OPG had reviewed many of the individual elements of the estimate prior to the submission, OPG and the JV had not reached agreement on most individual elements and this was the first opportunity for OPG to review the integrated and consolidated estimate (including cost, critical path schedule and risk). All three components of the Revision 0 submission were outside of OPG's planning basis, resulting in the need for detailed reviews and meetings between the JV and OPG. The Class 2 estimate (revision 0) as submitted by the JV is based on a P50 refurbishment outage duration of 1478 days. This was based on the JV's 'bottom-up' analysis. However, this duration is considerably more than OPG's goal of being better than Wolsong 1's performance (scaled up for 480 Darlington fuel channels versus 380 fuel channels) of 1212 days (which was their actual (P100) duration. This would require a P50 duration of about 1100 days. This resulted in a detailed review of each sequence to identify opportunities to reduce the duration. The main focus has been to identify sequence durations for which the JV was overly conservative in order to avoid hitting contractual disincentives. OPG has continued to work with the JV in obtaining a schedule that meets OPG's target by ensuring that the risks (in terms of days on the schedule) are held by the party most accountable to manage the risk.

In parallel with this detailed review of duration, the JV and OPG are performing similar analyses of the cost estimate and the allocation and monetization of risks. This review process will result in the JV submitting its Class 2 (revision 1) estimate in late August. Because of this late date, OPG has developed and is implementing a mitigation plan for the development of RQE by September 15<sup>th</sup>. This plan consists of:

- The JV will submit an updated Class 2 (Revision 0') estimate by July 15<sup>th</sup>, which will incorporate the 160 changes that have been agreed upon as a result of the on-going reviews and meetings.
- Contractual Amendments: OPG is working with the JV to develop a list of contract changes that will result in improvements to the cost and schedule, including changes intended to simplify the incentive/disincentive mechanism and ensure that risk is carried by the person best able to manage it. An agreement in principle on these proposed contract amendments will be complete by the end of July with approval of the contract amendments by August 20<sup>th</sup>.
- Detailed Estimate Review: OPG and the JV will work collaboratively to review and revise the Class 2 estimate by the end of August, by which

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time the JV will submit the Class 2 estimate (Revision 1). OPG will in turn validate and adjust the RQE submission during the first week of September and finalize the RQE for submission by mid-September.

- OPG RQE Development: OPG will develop the RQE duration, cost estimate and contingency based upon the submitted estimate (revision 0'), and incorporating the reductions in price and schedule that are expected to result from the contract amendments and the detailed estimate review. . Upon receipt of the Class 2 estimate (Revision 1) from the JV at the end of August, OPG will make any necessary adjustments to its RQE submission.

It is worth noting that the Class 2 (revision 0) issues that are under discussion are consistent with the improvement opportunities identified by the OPG/JV RFR Expert panel. This panel identified opportunities in the size of the Project Management organization, allocation of risk and resulting contingency funds and an overly conservative duration for the RFR critical path. This refinement of the RFR Class 2 estimate will likely continue into the fall.

- **Project Estimates.** By the end of this quarter, the vendors of the projects have submitted over 95% of the cost estimates and schedules and those submitted have been reviewed by the responsible OPG project managers. This represented a total of 341 cost estimates and 80 schedules. This information is in the process of being reviewed by the RQE team for acceptance.
- **Functional Estimates.** Along with the RFR project, the OPG functions represent the largest cost component of the refurbishment program. With the exception of the maintenance function, this cost is strictly support and does not touch the plant. As a result it is easy to have increases that individually do not seem significant but the aggregate can result in a more significant contribution to the overall cost of the program. Refurbishment senior management established a Functional RQE Review Team to critically analyze the individual functional submissions for savings. As a result, an opportunity to save nearly \$300M was identified which will bring the functional RQE value in line with the 4D estimate.
- **Contingency Funds.** Now that the project and functional estimates have been submitted, it is possible to focus on risks and their monetization. A series of workshops have been scheduled during July to examine the risks associated with the projects, the functions and the program. From these workshops, RQE contingency will be developed in terms of cost uncertainty, schedule uncertainty and discrete risks in projects and functions. Unrealized risks associated with the Campus Plan and SIO projects will be included in the RQE contingency determination.

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- **Assumptions and Bases.** The development of the RQE requires an understanding of its basis and associated project, functional and program assumptions. A basis item is a documented and approved condition, fact and/or strategy that describes how a cost estimate, schedule or other plan component was developed and documents the information used in support of RQE development. An assumption is a condition, item or information required in developing the program (or project/function) estimate that has yet to be completely defined and validated. Each assumption requires a validation plan. During the planning of the refurbishment program, a number of basis items and assumptions have been identified. During the development of RQE, these have been refined and modified, with additional ones identified. These will need to be finalized, with a summary report that clearly identifies the key basis items and assumptions for the refurbishment of the four Darlington units. The current date for this report is July 15<sup>th</sup>; however, this will continue to be updated through to the finalization of the RQE.
- **RQE Process.** The estimating processes used in the development of the estimates are based on AACE (Association for the Advancement of Cost Engineering) guidelines. Although there is a detailed plan to develop the RQE, it results in four major components – scope, schedule, cost and risk. These must be generated at both the project and function level and then integrated to provide the program product. To develop the program RQE, the inputs will be frozen as of July 9<sup>th</sup>. After that date any proposed changes must go through a documented change control process. The RQE process and key elements have a number of reviews in progress; including:
  - KPMG is performing an independent review of RQE. It contains two components – a review of the RQE processes and a review of their implementation through a deep dive in the RFR, Balance of Plant and Operations and Maintenance function estimates. The review of the RQE process has been completed with the report expected by the end of July. The conclusion of the review is that the RQE processes are consistent with industry practices and the effort is appropriate for a megaproject. A number of improvement opportunities are identified, but none impact the validity of the RQE.
  - Modus. Modus provides oversight on behalf of the OPG Board of Directors. They are monitoring the progress of the RFR JV Class 2 estimate and the RQE. They provide on-going recommendations to support the development of these products. Their focus is on the extent to which the process is aligned with the AACE guidelines and extent to which the results are defensible. Both of these are essential for an acceptable RQE.



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- BRG (Berkeley Research Group) was hired by the JV to provide an on-going, independent review of the RFR Class 2 estimate. The review was performed through selected submissions. However, the timing of the submissions lagged the schedule of the reviewers, resulting in comments focusing on the process and limited assessment of the quality of the product. They have delayed their final report until late July.
- RFR Expert Panel. The JV and OPG jointly established an Expert Panel to review elements of the Class 2 submission during its development. Members of this panel had experience with the re-tube of CANDU reactors, specifically at Bruce and Pt Lepreau. They identified three areas in which further work was required to obtain a reliable estimate. They were the excessive size of the project management organization for the project, the extent of contingency funding for the project and long duration of critical path. These items are included in the extensive reviews and meetings between OPG and the JV.

In conclusion, OPG has several challenges to overcome in a short period of time to meet the RQE timeline. However, it is on course to provide a defensible upper bounding RQE.

**Management of Engineering Workload**

The challenge related to large engineering workload associated with the core refurbishment projects and the ability to complete design engineering with high quality by the May target date. This stretch target date was not made. However, the impact on RQE is not significant. The organization will again be challenged to meet its milestone of completing design engineering packages by August 15, 2015 (with some approved exceptions related to computer software and the Re-tube Waste Processing Building (RWPB)). This challenge is highlighted in the following table that shows progress through the month of June. As can be seen, the number of design engineering packages forecast to be approved after the August 15<sup>th</sup> milestone has increased from 54 in mid June to 70 by the end of June.

	<b>Data as of June 11</b>	<b>Data as of June 16</b>	<b>Data as of June 26</b>
<b>ECs complete</b>	90	96	104
<b>ECs Remaining</b>	162	156	151
<b>ECs beyond August 15 milestone</b>	55	54	70

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	Data as of June 11	Data as of June 16	Data as of June 26
<b>ECs with finish Between August 15 and Dec. 2015</b>	25	23	37
<b>ECs finishing in 2016</b>	11	13	22
<b>ECs finishing in 2017</b>	0	0	3
<b>SCs without a finish date</b>	19	18	8

Refurbishment Engineering has taken several steps to drive the completion of design engineering packages; including:

- Implemented collaborative engineering by placing resident engineers at design agency locations to provide timely response to questions and requests.
- Increased the number of individuals with the Design Authority approval from 1 to 3.
- Established a daily engineering issue meeting to identify, assign responsibility for, and monitor the resolution of issues that prevent the completion of a design package.
- Have a weekly status meeting of status of engineering deliverables.
- Initiated regular executive reviews of the status of issue tracking files.

As previously stated, extending beyond the milestone will not have a significant impact on the quality of the Release Quality Estimate. Engineering has progressed sufficiently to allow for quality estimates. However, there are four potential areas that this delay can impact – cost of engineering, procurement of materials, generation of comprehensive work packages (CWPs), and quality of engineering.

The increased effort in collaborative engineering requires additional OPG and vendor resources and thus additional cost. Although the extent of the additional cost resulting from the current workload is not able to be separated, it is included in the overall costs for engineering provided in the RQE.

Refurbishment management recognizes the impact of late design engineering on the procurement of materials. They are in the process of implementing a Vendor Procurement Tracking and Forecasting tool. This will determine the date for Requests for Quotation and Purchase Orders are required to the support the scheduled work. It

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will also track the material through all stages from requisition to installation. Specifically, the seven prerequisite projects that are scheduled for 2015/2016 have their long lead materials already purchased. The one project that is currently challenged in this area is the Breathing Air modification.

CWPs cannot be completed without the completion of engineering. As with the procurement of materials, this represents a more significant risk for the prerequisite projects that are planned for execution in the 2015/2016 period. And as with procurement, refurbishment management will need to closely track their completion.

However, the risk from this engineering challenge is the potential impact on the acceptance of engineering deliverables from design agencies that do not meet quality requirements. By its nature, any perceived time pressure to complete a large engineering workload in a short period of time introduces a challenge to maintain high levels of quality. This feature combined with the latent nature of engineering errors results in the need for effective implementation of a rigorous and high quality process for the acceptance of engineering design deliverables. The latent nature of engineering errors in approved designs refers to the fact that the consequences of these errors are not realized immediately. They are seen in construction, commissioning and too frequently during plant operation. As a result, the MOE Independent Advisor has identified the potential risk associated with engineering quality as an element of management of engineering workload through 2014.

A quality indicator has been developed for the use in this quarterly report to provide trends in quality, starting in Q4, 2014. The following table provides the results to date.

Engineering Quality Indicator =  $100 - 15 \times (\text{L1 events (rejection by external approving authority + rework after field installation)}) - 10 \times (\text{L2 events (rejection by internal approving authority + rework during field installation + other event free day reset)}) - 5 \times (\text{L3 events (other rework (greater than \$10K)})} + 1 \times (\text{GC (documented good catches prior to submission for OPG review to maximum of 10)})$ . The following values are used for the colour rating:

Green: >80

White: 65 – 79

Yellow: 50 – 64

Red: <50

Month	Index	Rating	Basis
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Q4/14	57	Yellow	
Q1/15	57	Yellow	
April 2015	35	Red	1 L1 event, 3 L2 events and 4 L3 events
May 2015	20	Red	1 L1 event, 5 L2 events, 3 L3 events
June 2015	70	White	1 L2, 4 L3
Q2/15	42	Red	

The Q2 indicator of 42 continues to represent a potential concern for quality of engineering.

Although refurbishment engineering understands the risk of latent errors in design engineering, there are opportunities to strengthen the OPG process to accept design agency products and the rigour of its implementation. Such opportunities include:

- Clearly identify designs that are high risk, infrequently performed or first time performed, and specify specific additional verification requirements for them. INPO generated an industry operating experience document related to such engineering (IER L1 14-20, Integrated Risk – Healthy Technical Conscience), particularly recommendation 3, which deals with vendors conducting engineering work for the owner. Several designs fall into this category; including, Emergency Power Generator 3 (EPG3), Containment Filtered Ventilation System (CFVS), D<sub>2</sub>O Storage Building, access ports for the Steam Generators, the digital controllers for the Turbine/Generator and fire pumps as additional supply to the Emergency Service Water system.
- Verification that the design is consistent with INPO/WANO important operating experience (SOERs and IERs). Designs that have such operating experience include EPG3, digital controllers, and intake cooling water. In addition, there are several SOERs that are of value for the operation, maintenance and monitoring of equipment that is in the operating state or lay-up during refurbishment. An efficient way to verify consistency with SOERs (both in terms of design modifications, operating and lay-up is to review the Darlington station's response to the recommendations to ensure that they are still valid during the refurbishment of the unit, and if not specific actions to meet the recommendations. For the INPO operating experience and recommendations on digital controllers, a review of the documents will need to be performed with a response to how the recommendations are met.

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- Clearly identify key assumptions, critical calculations and other key elements in the design of a high risk, infrequently performed or first time modification. State in the design acceptance documentation the specific oversight activities taken to ensure and validate the quality of the deliverables. This should include the items that were independently verified by refurbishment engineering and the individual's name that performed independent verification for OPG as well as validation of the design agency's process was satisfied.
- Identify which references in the Requirements Traceability Matrix (RTM) were independently reviewed by OPG and the name of the individual. This can be done for the critical requirements, assumptions and calculations.
- It is recommended that the WANO Technical Support Mission, planned for September 2015, be requested to include a review of the rigour of the OPG process and its implementation related to the acceptance of design agency deliverables for high risk, infrequently performed and first time designs in conjunction with its review of the implementation of the recommendation 3 of IER 14-020.

**Incorporating Lessons Learned from the Campus Plan and Safety Improvement and Core Projects**

During more than twenty-four months of observations, a number of lessons learned from the Campus Plan and Safety Improvement Opportunity (SIO) projects have been identified by the Independent Oversight Advisor. In addition, the experience from the management of the engineering workload, the generation of estimates and field execution on the mock-up and the Re-tube Waste Process Building provide more lessons, as well as reinforce the need to aggressively address certain previously identified lessons learned to prevent recurrence once breaker opens and the full refurbishment project is started.

The following Lessons Learned have a low likelihood of recurrence with the current processes and management focus:

a. Poor cost estimates

Through the Release Quality Estimate (RQE) process, OPG will have a good quality estimate of the costs for 4-unit refurbishment project. RQE is the cost estimate for the core projects, the functional areas and the campus plan/SIO projects. It will be submitted to the OPG Board for review and acceptance in October and then presented to the Ministry.

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The following Lessons Learned have a medium likelihood of recurrence without on-going management focus and successful completion of planned actions:

b. Completion of engineering prior to the start of field execution

Many of the Campus Plan and Safety Improvement Opportunities (SIO) projects started and continued field construction without the completion of detailed engineering. This continues for some important projects such as EPG 3, CFVS, D<sub>2</sub>O Storage Building and the Auxiliary Heating System. This has contributed to on-going revisions to costs and schedules. These projects demonstrate the consequences of not starting field execution before engineering is actually completed. This was previously identified by OPG refurbishment management as one of the major lessons learned from previous refurbishment and large nuclear projects. Engineering must be completed prior to the start of field execution. As a result, OPG established a milestone for the completion of engineering of August 2015. Even with the current challenges in managing the engineering workload, there is sufficient float to complete engineering for the projects being executed after Unit 2 breaker open.

The current challenge is for core refurbishment projects that are being executed prior to Unit 2 breaker open. The RWPB has started construction without completion of engineering or nuclear safety analysis. It is recognized that engineering has been done for the portions of procurement and construction that have started, but this is not the standard of engineering complete prior to start of construction that refurbishment management is striving. It is not surprising that cost and duration estimates have been revised on a number of occasions. The current cost estimate is \$108M and target completion date of December, 2016.

In addition, there are several shutdown/layup/services and support projects to be executed in 2015 and 2016, as prerequisites to breaker open. These include Breathing Air installation, Service Air installation, Negative Pressure Containment modifications and several facilities. The August 15<sup>th</sup> milestone for completion of engineering will not be met for some of these projects and this results in downstream impacts of the procurement of materials and generation of CWP's. Refurbishment management is initiating a plan to manage the impact of the late engineering.

c. Poor engineering and field execution schedules

Through the duration of the Campus Plan and Safety Improvement Opportunity projects, the organization has been plagued with inaccurate and unreliable

schedules for engineering and field execution. Reliable schedules are still being developed for some of these projects. There is a now requirement for detailed schedules as part of the gate review process. The core refurbishment projects now have schedules for the completion of design engineering. Level 3 execution schedules are to be included in the estimates for the RQE. As with the completion of engineering, the RWPB and prerequisite projects will be challenged to have reliable schedules for the completion of engineering and field execution.

d. Availability of parts when required

There have been some examples of difficulty in obtaining the parts to support field execution. This has resulted in some delays and in some cases the acquisition of parts from the OPG warehouse. Refurbishment management recognizes the risk associated with this issue and has initiatives to support the timely procurement of parts.

Refurbishment management recognizes the impact of late design engineering on the procurement of materials. They are in the process of implementing a Vendor Procurement Tracking and Forecasting tool. This will determine the date for Requests for Quotation and Purchase Orders are required to the support the scheduled work. It will also track the material through all stages from requisition to installation. This process will be used for the procurement of materials associated with the prerequisite projects. If the procurement action plan is implemented as intended, this risk will become low.

e. Quality and timeliness of Comprehensive Work Packages (CWPs)

Once engineering is complete, the information is converted to a Comprehensive Work Package (CWP) that is used for field execution. CWPs require the review of several disciplines; including operations and engineering. The vendors for the Campus Plan and SIO projects initially had problems meeting the station expectations to obtain timely approval of some execution CWPs. As a result, it was not uncommon to have the field execution delayed while waiting for the completion, review and approval of the CWP. In response to this problem, refurbishment operations and maintenance personnel have provided support in the generation and approval of CWPs.

The core refurbishment projects will require vendors to generate CWPs. Some of these may be reviewed and approved by OPG refurbishment and likely in

some cases station organizations. There is a refurbishment guideline for the generation of these CWPs (D-GUID-09701-10037). This document provides a good list of the items that need to be considered in the development of a CWP. However, it provides little guidance as to quality expectations and review requirements for CWPs. Currently OPG Subject Matter Experts are reviewing a number of CWPs. This procedure is currently under revision to provide additional guidance. The prerequisite projects will be the first test of the ability of the refurbishment organization to obtain timely and quality CWPs for field execution

f. Integration with the station work management process

Once the unit is isolated from the other units there will not likely be much of a need to interface with the station work management process. However, between the need to perform prerequisites in support of the start of the outage, the work to be coordinated prior to isolating the unit and the return of the unit to service at the end of refurbishment there will be a significant amount of integration with the station and its processes. The P&M organization initially had trouble integrating its work through the station's on-line and outage processes. This resulted in an overreliance on the use of scope injection, which frequently was rejected.

Several of the prerequisite projects will be scheduled through the station work management process as well as is the test of the refurbishment work management and control processes. The ability to integrate with the station will be improved once refurbishment work management organization understands and addresses the problems and issues that the Campus Plan and SIO projects had. The test period will identify weaknesses in this area.

g. Not effectively using OPG processes

There are a number of OPG processes which are required to be used by the ESMSA contractors, but have not been fully and effectively implemented. These include work management processes, work protection, work authorization, event free challenge process, lifting and rigging, etc.

The Refurbishment Execution organization has documented a Darlington Refurbishment Execution Strategy for contractor's use. It provides a comprehensive list of the processes that will be used during the refurbishment project. However, it does not provide when information is an OPG expectation or guidance. In addition, it is unclear the method by which OPG will approve vendor processes when it is specified such approval is required. Specifically it is unclear



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if such approval is by the project or the subject matter expert and how that approval is documented. The test period will identify actual weaknesses.

The following Lessons Learned with high likelihood of recurrence without increased management focus and associated initiatives:

h. Coordination among contractors for common issues and processes

Several Campus Plan and SIO projects have had similar issues and problems, such as daylighting, dewatering, removal of contaminated soil, management of associated totes and unconditional release of materials. In general, rather than identify a lead organization or company for the management of such common processes, each project was left to its own to resolve the issues. This resulted in some delays, conflicts among contractors and likely some increase in costs.

For the core refurbishment projects, there will be common processes that will be used by multiple vendors; such as scaffolding, lifting and rigging, confined spaces, management of consumables, and FME, to name a few. A lack of coordination among contractors in such common processes increases the potential of delays, increased costs and issues. This coordination has begun in some areas. The execution strategy or other document does not provide guidance on such coordination to the vendors.

i. Effectiveness of PCC and POD meetings

The P&M's PCC and POD was not effective at meeting the objective of driving the Campus Plan and SIO projects to maintain schedule, to coordinate among projects, to prioritize issues and resources and to identify and resolve issues before they impact field execution. The meeting did significantly improve during first two quarters of 2015.

The prerequisite projects test period will have the PCC established and Plan of the Day meetings held. This will require the establishment of associated expectations, procedures and infrastructure.

It is noted that there is currently no daily status meeting for the current refurbishment work being executed – the RWPB. Also, since the P&M improvement initiative that started in early March, the RWPB has not been included in the P&M meeting.

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j. Requirements to restart work when stop work order is initiated

There have been events resulting in the stoppage of work. These have normally been associated with safety or environmental incidents. Normally, once the stop work has been issued, the P&M organization has struggled to identify what specific actions are required to be performed prior to restarting the work.

Refurbishment execution management recognizes the need for guidance on responding to incidents and returning to work in a controlled and timely manner. The project manager for the RWPB project has created a quick chart for the response to incidents. In addition, the Construction Execution group has produced a procedure for work stoppage, reporting and recovery. A number of tabletop exercises using this procedure should be done to ensure that it has sufficient detail and direction to ensure effective and timely response to stop work incidents.

k. Management of subcontractors

The ESMSA contractors have had issues with the performance of subcontractors in the engineering, procurement and field execution associated with the Campus Plan and SIO projects. Issues have included the delivery of engineering products in a timely manner, engineering quality problems, timely delivery of parts, some quality issues related to parts manufacture, field execution rework and safety performance.

The core refurbishment projects have had some similar issues, although with lower consequences. The Joint Venture (JV) has had some schedule and quality issues in tooling program. OPG project monitoring identified quality issues with one inspection technique associated with the Steam Generator project. ES Fox identified performance issues with the design agency for two services projects and replaced them with another company.

l. Performance of Contractors

[REDACTED]

[REDACTED] As with the management of subcontractors' performance, OPG is relying on accountability of the contractor, creation of the

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Vendor Leadership Forum and the execution construction organization's field presence as the strategy to address potential weaknesses by contractors. For core refurbishment projects, emphasis is being placed on having quality schedules and estimates for the completion of all aspects of the work and having the detailed schedules in place prior to a particular phase of the beginning.

m. Not responding to adverse trends in a timely and effective manner

These projects have had several, longstanding issues, starting with the D<sub>2</sub>O storage project, but also cost estimates, development of reliable schedules, completion of engineering, performance of subcontractors and interfacing with the station to execute field work. Many of these issues existed for several months – some years. The P&M organization has not been effective at identifying and addressing performance issues in a timely and effective manner in order to limit their impact on safety, quality, cost and schedule delays. This behaviour of not identifying and addressing performance issues is similar to the cause of the Pt LePreau calandria tube insertion production and quality event.

Refurbishment management's strategy to reduce this risk includes the following items:

- i. Establishing a meeting focus on performance against plan and the identification/resolution of issues.
- ii. The future creation of a project Change Control Board.
- iii. Creation of a Project Decision Making forum.
- iv. Formalizing the purpose and function of the 'contrarian' in the deliberations of important program and project decisions.
- v. Formalize the application and use of Event Free Challenge meetings for critical work.

These actions will support addressing this issue. However, there should be recognition and actions to improve the culture to drive issues to a more timely and effective resolution. The slow response to address the management of the large engineering backlog, the resolution of BOP and shutdown/layup/services contracts and the RWPB performance issues can be used to help refurbishment mid management understand the issue and the need for its reduction.

Opportunity to incorporate lessons learned

Refurbishment management has identified the opportunity to test several of its processes and infrastructure during the execution of the perquisite core projects that are scheduled prior to breaker open. This represents a valuable opportunity to understand the effectiveness of the implemented processes and to validate the extent to which these lessons have been addressed.

## **6. Status of Individual Projects**

The Darlington Refurbishment Program consists of seven individual projects and a number of infrastructure projects (also called Campus Plan) and Safety Improvement Opportunity projects:

- Re-tube and Feeder Replacement (RFR)
- Fuel Handling/Defueling (FH)
- Turbine Generator and Controls (TG)
- Steam Generator and Auxiliary Systems (SG)
- Balance of Plant (BOP)
- Islanding
- Shutdown, Layup and Services

The status of Campus Plan and Safety Improvement Opportunity projects is provided in the relevant section of the scorecard.

### **6.1 Re-tube and Feeder Replacement Project**

The Re-tube and Feeder Replacement (RFR) project represents the largest scope and cost component of the Darlington Refurbishment Project. The RFR project will define the project's critical path and thus duration. As demonstrated by the schedule delays, cost overruns and performance issues in previous CANDU refurbishment projects, the RFR project also represents the largest risk to the project being completed on schedule and on cost. The RFR project consists of the removal and replacement of 480 pressure tubes, 480 calandria tubes, 960 end fittings and 960 feeder pipes for each of the Darlington four units. This requires the development, testing, manufacturing and maintenance of specialized tooling; the generation and verification of specialized procedures; and the training of the staff that will perform the field work. The project also

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includes the construction of a realistic reactor mock-up for the purposes of tooling testing, procedure verification and staff training.

The Q2 focus areas and status for the RFR project were:

- As stated in the RQE challenge, there is currently a detailed review of the JV's Class 2 (revision 0) and discussion to close its gap with OPG expectations related to outage duration, costs and contingency funds. Resolution is expected to occur for the JV submission of its Class 2 (revision 1) estimate by August 31.
- The design and construction of the Re-tube Waste Process Building (RWPB). This is covered in scorecard under Prerequisite projects.
- The testing of tooling performance and time durations for individual series were completed in Q2.
- Completion of design engineering for Unit 2 modifications. 26 of the 61 design engineering packages have been completed.
- Order and management of procurement of major reactor components and other materials for Unit 2's re-tube and feeder replacement. Procurement of the OSM (Owner Supplied Material) is the responsibility of the Joint Venture. The key components include feeder piping, end fittings, pressure tubes and calandria tubes. Manufacturers have been identified for each component and pre-production qualification manufacturing for each component by each manufacturer is in progress. Although there are some challenges in this demonstration, they do not represent a significant risk to the project. In addition, the Inspection and testing Procedures for their manufacturing are in progress.

The use of the tooling represents about 30% of RFR's critical path time. The remainder is the movement, set-up and dismantle of the tools and work platforms, or individual sequences. These will not be fully validated prior to the submission of the Class 2 estimate, but should be fully explored and optimized in the 18 months leading to the start of the RFR execution.

## **6.2 Fuel Handling/Defueling Project**

This project consists of two main subprojects – the defueling of the reactor to start the outage and the refurbishment of the fuel handling equipment and associated systems.

The defueling of the reactor represents the first critical path activity for the project. It is currently estimated that the duration for defueling the reactor will be 113 days. This

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duration is based on a project report that makes a number of assumptions for success. Key assumptions include:

- The defueling will be conducted by station fuel handling operators around the clock, 7 days a week. The organization is currently obtaining sufficient qualified individuals to perform this work.
- The reliability of fuel handling equipment will be improved to support defueling with limited breakdown maintenance required.
- Testing and commissioning of tooling will be performed on available station equipment. This will require the return to service of the SARF (Service Area Rehearsal Facility), which the project has identified as currently at risk with a recovery plan.
- Sufficient maintenance resources to implement the current Preventive Maintenance Program and schedule for major overhauls, as well as support the defueling window. This has been identified as an at risk component of the plan.

The project has a Fuel Handling Defueling Readiness Plan that integrates the fuel handling equipment reliability improvement work with the work required to directly support the defueling of the reactor (such as SARF return to service and commissioning of tools on SARF).

The station has been successful in completing scheduled work to improve fuel handling equipment reliability. High reliability of the fuel handling systems is in order that the defueling project meets its objective of reactor defueling duration of 113 days.

	Jan – 15	Feb – 15	Mar – 15	April - 15	May - 15	June – 15
<b>ERI</b>	72	74	74	78	74	82

Equipment reliability improvements during the second quarter included:

- Power track upgrades continue, with the replacement of 810 feet of chain, 223 V-Groove wheels, and 20 rollers.
- Computer replacement project is 80% complete, with full completion in July.
- The FM Head program System Health has improved from Yellow to White.
- A reduction in the maintenance backlog to 60 work orders from 146 in February 2014.

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One risk associated with the project has been the ability to complete the testing and commissioning of tooling and procedures for defueling the reactor. The first set of tests is being performed at GE Hitachi (GEH-C) in Peterborough. The completion target for these has been revised from May 18<sup>th</sup> to July 10<sup>th</sup>. This represents a risk to the commissioning of the equipment on the Pressure Test Facility in August, 2015. In addition, commissioning of defueling equipment is planned to be performed on the SARF during Q4, 2015, with a contingency date of Q1, 2016.

To perform the commissioning on SARF, scheduled for September 2015, requires:

- The availability of a fuel handling trolley for the duration of commissioning.
- Sufficient verification and validation of the OPDATA software to permit commissioning on the SARF of the tooling. This will need to be provided by September 1, 2015.
- Rehabilitation and return to service of the SARF. This requires completion of a number of work orders by station staff.

The success of this project requires the coordination of work by the vendor (GEH-C), the refurbishment project team and the station. This coordination continued to improve during the second quarter.

### **6.3 Turbine/ Generator Project**

The scope of the Turbine/Generator includes:

- Steam Turbines and Turbine Auxiliaries: inspections, repairs, and/or replacements of generator components (including generator stator rewind) and a number of generator auxiliaries,
- Steam Turbines and Turbine Auxiliaries: inspections, repairs, and/or replacements of High Pressure (HP) and Low Pressure (LP) turbine components and a number of turbine auxiliaries;
- Moisture Separator Reheater (MSR): inspection, overhaul, and/or replacements of MSR internals and auxiliaries (e.g. strainers, valves);
- Turbine Control Upgrade: replacement of the obsolete analogue Steam Turbine Electronic Control (STEC) System, includes entire Turbine Supervisory System with modern design (digital system); and
- Generator Excitation Upgrade: replacement of the analog Generator Excitation system controls with a digital design and a set of additional Generator Excitation and Protection equipment to resolve obsolescence issues.

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A contract was awarded to Alstom for the design and delivery of the digital controllers as well as technical support during the execution of the project. The design work by Alstom is complete. It is noted that the digital controllers are not being included in unit 2's refurbishment outage. In addition, Alstom accomplished the following in Q2:

- TSSA pressure boundary registration has begun based on the approved design.
- Procurement of materials for Unit 2 outage is on schedule.
- Software qualification process for the digital controllers is in progress.

The TG engineering integration and field installation vendor (SNC/Aecon Joint Venture (JV)) submitted a Unit 2 Class 2 cost estimate and a level 5 schedule for field execution. It was accepted as noted by OPG. The Class 3 estimate and Level 4 schedule for the remaining units was submitted to OPG for acceptance. Because the Unit 2 refurbishment will not include the modifications designed by Alstom, the integration engineering packages have been delayed, and are scheduled to be completed by July 31, 2015.

This project is unique in that it includes one company (Alstom) providing the design and manufacture of equipment and technical expertise during the actual TG refurbishment and modifications, and one company (the Joint Venture) providing the interface engineering and the construction. This unique model requires increased oversight and integration by OPG and the project's senior management oversight committee, since the two companies are not fully integrated for the project.

There are 2 noteworthy risks for this project:

- Weaknesses in the replacement of analog controllers with digital controllers have resulted in several events in the industry both during commissioning and normal operation. This was the reason for OPG senior management to defer the introduction of digital controllers until the second unit's refurbishment, and back fit Unit 2 at a future outage. Although there is the opportunity to validate the design through the use of a simulator, it is not clear that these events (provided in INPO operating experience reports) have been studied during the design of the controllers and their integration with Darlington systems.
- Maintenance on the turbine, generator and stator systems is considered high Foreign Material Exclusion risk both because of the potential consequences of foreign material in the system when operating and the difficulty to retrieve foreign material, particularly in the generator and stator. OPG refurbishment will need to review these work plans for industry standards in the prevention of foreign material intrusion.



#### **6.4 Steam Generators**

The Steam Generator project consists of a series of modification and maintenance activities to fulfill the requirements of its Life Cycle Management Plan. The Engineer Procure Construct (EPC) contract has been awarded to a consortium of Babcock & Wilcox Canada and Candu Energy Inc. The project includes:

- Tube sheet waterlancing to address possible degradation from sludge accumulation. The DACVR meeting for Design Authority approval of the detailed design was successfully completed on March 10.
- Installation of access ports to improve secondary side inspection capabilities for future inspection outages. An enhanced COMS (constructability, operability, maintainability, safety) meeting was held on February 25, with no additional requirements specified.
- Primary side tube cleaning to improve overall thermal efficiency, increase neutron overpower margin and reduce radiation fields
- Divider plate leakage characterization to establish a baseline for cross flow between the cold and hot legs of the SGs
- Primary and secondary side ultrasonic, eddy current and visual inspections. These will be performed by the OPG Inspection, Maintenance Service organization.

With exception of installation of the access ports, the activities associated with this project are services performed during routine planned outages. There are two noteworthy risks that exist for this project:

- The tooling that is used for the waterlancing and primary side cleaning represent tooling entering systems that are required to be free of foreign material. Although designed to be fully intact, there is always the risk that a component may become loose and enter the primary side or secondary system. This would result in the need to develop and execute a recovery plan.
- The installation of 7 access ports into each steam generator represents cutting into a containment boundary. Although the contractor has successfully performed this installation at other plants, any time a containment boundary is modified is considered a risk.

#### **6.4 Balance of Plant Project**

The Balance of Plant (BOP) scope consists of plant modifications and maintenance work in the following areas:

- Pre-refurbishment work
- Safety and Control Systems
- Reactor component systems

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- Conventional Systems
- Common Systems

During the second quarter, the project worked closely with contractors to develop the cost estimates, schedules and risk profiles needed to support OPG's RQE. Although there was a need to provide considerable support to have estimates and schedules aligned to meet OPG's needs, the contractors did provide deliverables that were of sufficient quality to be included in the RQE. In addition, this quarter included the continuation of detailed design engineering. A number of BOP projects have been approved to extend beyond the August 15<sup>th</sup> milestone. BOP management continues its routine performance reviews of the project bundles. This oversight has contributed to the ESMSA contractor taking timely action to address identified issues. It is noteworthy that the ESMSA contractor has identified and initiated corrective actions when engineering performance is not meeting expectations. OPG project management is kept informed of issues and proposed actions.

Although not currently a risk, operating experience has indicated that Balance of Plant work can become the critical path to restarting the unit if not effectively scheduled and managed. One action taken by refurbishment management to reduce this potential is to not have work scheduled after the critical path is 60% completed. Exceptions would be limited to work that can only be done in the conditions that are provided after 60% completion. Additionally, Refurbishment Execution will perform an additional detailed review of the BOP work to verify that there are robust plans in place to complete the work without effecting critical path.

## **6.5 Station Readiness Projects**

There are a number of core refurbishment projects that are critical to support the refurbishment of the unit, but do not provide refurbishment of equipment. These are:

- Islanding projects. These projects are required to establish the physical and administrative separation of the refurbished unit from the operating plant, as well as separate a number of common areas for the duration of the refurbishment outage.
- Shutdown/Layup projects. These projects are in place to shutdown and layup individual systems at different stages and for different durations through the unit's refurbishment outage. This is required to protect the systems against corrosion and other damage mechanisms when not in normal operation.
- Services projects. These projects provide the needed services to support the unit's refurbishment outage. Such services include electrical, breathing air, service air, instrument air, and water.

In general, the Islanding projects are making use of the other contracts that align with its work in the same or adjacent area. For example, the EPC contract for the installation and removal of the bulkheads has been awarded to the R&FR Joint Venture (JV). This is a sound decision since the JV has the most to gain from the timely installation of the bulkheads, there is elimination of coordination issues in the vault, and the required capabilities for the two projects are similar.

The strategy for the Shutdown/Layup and Services projects is the same as for the BOP projects (use of the ESMSA contractors). These projects are also using the same ESMSA contractor as selected for several of the Balance of Plant projects. As a result, the engineering strategy and weekly meetings described for the Balance of Plant also exist for these projects. As with the Balance of Plant, this focus provides the ESMSA the opportunity to take timely corrective action when engineering performance does not meet expectations. This has been done for both Breathing Air and Service Air projects.

## **7. Oversight of the Darlington Refurbishment Program**

Both OPG and the Ministry of Energy (MOE) understand the need for a successful refurbishment for the Province, the company and the industry. In line with that importance, the Minister of Energy established the role of independent advisor and OPG established the role of an external independent oversight team reporting to the OPG Board. This team consists of individuals from the companies Burns & McDonnell and Modus.

The OPG external independent oversight team issued its Q2, 2015 at the May Nuclear Oversight Committee meeting. The focus of the report was the refurbishment team's preparation of the Release Quality Estimate. The following observations were identified in the report:

- The independent oversight team's review of the status of RQE concluded that the major projects and functions, which comprise of 92% of the overall project cost, are tracking on time to 2-3 weeks late with RQE inputs, while BOP and SD/LU continue to struggle.
- At the time of their report, the JV had just submitted its Class 2 estimate for the RFR project. The report acknowledged that there was a significant amount of vetting to be done until the Class 2 estimates is acceptable. The Class 2 estimate represents modest gains from its Class 3 estimate. A major gap is the JV's conservatism toward potential OPG delays.
- The JV's proposal for the RWPB still had not met OPG's quality standards. The JV's latest schedule that has a completion date of December 2016. The report did

identify that the estimating process was progressing without the final resolution of the seismic requirements for the building.

- The report recognized that the initial functional estimates for RQE would be greater than the value provided in the 4D Cost Estimate and reductions were required.
- The independent team stated that engineering was progressing sufficiently to support the RQE. Concerns were expressed with progress of BOP, Shutdown/Layup and the JV's design work to support the procurement of key components.
- The report does state that the project's Engineering Dash Board has highlighted a quality adverse trend in the areas of using under-qualified resources, over-specification of engineered materials, and other short-cuts that could result in downstream changes.
- The report expressed its on-going concern with the ES Fox's capability to perform quality cost estimates and schedules and then to meet them. The report focuses on the vendor, while the MOE Independent Advisor has focused on OPG's performance related to management of its contractors.
- The report has identified improved support of the refurbishment project by the corporate support organizations.

These observations are similar to those made by the Independent Oversight Advisor (IOA). Two challenges identified by the IOA have not been mentioned by the OPG independent oversight team. The risk associated with quality of design engineering deliverables by design agencies has been a common theme within these reports. The refurbishment VP of Engineering held an engineering stand down in response to an increase in quality issues. The second challenge related to addressing lessons learned from the Campus Plan and SIO projects is recognized by the VP Execution.

## **8. Alignment with the Principles of the Long Term Energy Plan**

The MOE's 2013 Long Term Energy Plan identified seven principles by which it expects OPG and Bruce Power to follow in the development and execution of their respective units. OPG performance to these principles is good, as can be seen through the review of this section.

Principle 1: Minimize commercial risk on the part of ratepayers and government.

The majority of DNR contracts are fixed/firm price with the remaining tied to cost and schedule performance. Commercial individuals have been embedded on each project team

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to manage commercial risk. Project scope has been defined to the component level, and detailed engineering will be completed prior to the start of construction. OPG has invested in a reactor mock-up and training facility, to perform full testing of the tools, processes and procedures, as well as train staff prior to performing work on the actual reactors. The contract with SNC/Aecon includes provisions for OPG to take over the tooling and the mock-up at the conclusion of the Definition Phase if the parties are unable to negotiate the target price contract for the Execution Phase.

Incentives in the RFR contract were established on the basis of four unit performance, allowing the RFR contractor to make-up cost overruns and schedule delays to the first unit on subsequent units. However, the LTEP prioritizes the importance of a successful Unit 2 refurbishment. This will need to be included in the target price for the RFR and TG projects.

Principle 2: Mitigate reliability risks by developing contingency plans that include alternate supply options if contract and other objectives are at risk of non-fulfillment.

One contingency action contributing to this principle is the decision to start the second unit after unit 2, rather than overlapping the units. In addition, the effort to improve the reliability of fuel handling equipment reduces the chance that fueling of the operating units will be reduced during the defueling of the refurbishment unit.

Principle 3: Entrench appropriate and realistic off-ramps and scoping.

Each contract has an off-ramp for termination. Reimbursement to contractors is limited to reasonably incurred costs. Each unit requires individual approval that provides well-defined off-ramps. The yearly release strategy and gating process for funding individual project initiatives has wide visibility and adherence within the DR Team. be done in drained/defueled state.

Principle 5: Require OPG to hold its contractors accountable to the nuclear refurbishment schedule and price.

Schedule accountability is built into each contract. The contractor is required to provide a detailed schedule for execution as an input into the Release Quality Estimate. Cost accountability is built into contracts to establish target cost and incentives/disincentives. Monthly project oversight meetings with OPG senior management and contractor senior management have improved oversight and contractor accountability. Quarterly CEO meetings reinforce this principle. OPG has chosen to perform the work in the Execution Phase on a target price basis which increases the contractors' transparency. This will enhance OPG's ability to resolve issues as they arise. This may result in OPG performing

specific work rather than use a contractor. For example, agreement could not be reached with a supplier of radiation protection services, resulting in OPG deciding to perform the services itself.

Principle 6: Make site, project management, regulatory requirements and supply chain considerations, and cost and risk containment the primary factors in developing the implementation plan.

Regulatory requirements were a primary input to the defined scope of the refurbishment outage and life extension projects. There is an agreement between the station and refurbishment on the condition that the unit will be turned over to the project and then returned to the station. The program is being managed in accordance with PM Institute standards and INPO project principles. The Release Quality Estimate process is using Association for Advanced Cost Engineering (AACE) best practices and is being monitored by KPMG. Risk management is recognized as a key element of success and the program is being well implemented.

One opportunity for improvement is the ability to identify and address adverse trends in performance in a timely and effective manner.

Principle 7: Take smaller initial steps to ensure there is opportunity to incorporate lessons learned from refurbishment including collaboration by operators.

To fully incorporate lessons learned from the first unit's (Unit 2) refurbishment, the second unit's (Unit 1) start has been delayed until the completion of the first unit. If appropriate, other units may be able to be delayed to continue this risk reduction. However, this will likely result in an overall increase in cost. To reduce risk for the first unit, the decision was made to install its digital controller in a future outage. To prevent the risk associated with single source suppliers of key reactor components, OPG has qualified second vendors for key components. This will help Bruce Power with an associated materials risk.

OPG and Bruce Power refurbishment management have met on three occasions to develop areas in which they can be mutually supportive. In addition, the engineering organizations have met to discuss opportunities to improve the efficiency and effectiveness of design engineering. The following are areas in which collaboration is being sought by senior management:

- a framework for collaboration
- Reviewing the significant work scope in each program
- Reviewing key performance and workplace challenges
- Reviewing planned trades work schedules

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- Reviewing resource leveling strategies and likely high resource demand periods
- Reactor Defueling planning and tools
- Plans and Lessons Establishing learned on systems layups and drying of systems that are drained
- Modifying field work controls on defueled units
- Lessons learned on transitioning into and out of Refurbishment
- Plans for completing Balance of Plant work without impacting critical path
- Performance of RFR tools and value of full mock-up of the reactor
- Close out issues and unit return to service challenges

Darlington Refurbishment has completed a comparative review between its and Bruce's assumptions related to defueling the reactor and installation of bulkhead. Refurbishment execution management understands the bases for the differences in durations of these sequences.

## **9. State of Readiness**

The Nuclear Refurbishment program is fully into its Definition Phase to support the successful execution of Unit 2, starting in October 2016. There are several areas that provide confidence that the organization is on track for breaker open; including:

- Regulatory approvals have been received for the Environmental Assessment, Integrated Safety Review, and the Global Assessment Report. There has been agreement with the CNSC on the Integrated Improvement Plan, with written acceptance tied to the Darlington operating license renewal process, scheduled in 2015.
- Scope for life extension and the work required to be performed during the refurbishment outage are defined and approved. The life extension work that is not included in the refurbishment outage will be performed by Projects & Modifications and the station.
- Although there is a challenge to meet the August milestone, engineering will be completed in sufficient time before breaker open to support downstream activities, such as order materials and generation of field execution instructions.
- The Release Quality Estimate is currently under development to meet its October 2015 milestone. The RQE will include the cost estimate for the four units, the Level 1 plan for the four units and Level 3 detailed schedule for Unit 2, the refurbishment outage scope for each unit and the execution strategy.

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- A number of products to support the RQE will define several key areas for success, such as scope and responsibilities of functional departments, assumptions on the support needed for each project and responsibilities for the transition of the unit between Darlington Operations organization and refurbishment organization.
- The assembly of the execution organization has started. There is the commitment to hire a construction management company to support the execution phase.
- Contracts are in place for all projects to complete the engineering and develop the estimate (cost and schedule) required for the RQE.
- The Class 2 (revision 0) estimate for the Re-Tube and Feeder Replacement project was submitted in May. There is a significant gap between it and OPG's expectations related to schedule, cost and contingency funding. Reviews and meetings are in progress to close the gaps, with a submission of Class 2 (revision) targeted for August 31.
- The RFR full scale reactor mock-up has been valuable in the verification of tool designs and validation of Tooling Performance Guarantee (TPG) durations. Its value will increase during the refining of procedures for the reactor face series, and the training of re-tube face and feeder replacement personnel.
- With the unsuccessful negotiation for a contract for radiation protection services, OPG has decided to self perform this function. This capability is progressing.
- Pre-production qualification runs for the major reactor components are well in progress. OPG implemented the strategy to have two vendors qualified for each major component. This will provide OPG the ability to mitigate significant quality issues with one vendor, as well as provide Bruce Power with the same flexibility in procurement of these critical components.

Although OPG is making good progress towards breaker open readiness, there are a number of issues that once resolved will increase the comfort level for the execution of the project. These include:

- Probably the most significant need is for the refurbishment organization to demonstrate effective execution of field work in 2015 and 2016. During the second quarter Refurbishment Execution senior management established a Ready to Execute Plan. This plan includes the use of Refurbishment managed prerequisite projects to test the processes, infrastructure, organization and oversight that will be used in full refurbishment outage. This is an excellent opportunity to identify needed improvements prior to the start of full execution at



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breaker open. The plan has 5 months to analyze performance and incorporate improvements prior to the October start of the full outage.

- Tied to execution is the fact some of the work is first time execution for the vendor, very infrequently performed or first of a kind. For example, this is the first time for the Joint Venture to execute a re-tube and feeder replacement, first time in a decade for B&W to clean the Darlington steam generators, first of a kind process for the handling and reduction of re-tube radioactive waste and some first of a kind turbine inspection at Darlington. Since refurbishments by their nature are infrequently performed, this is not a surprise. OPG has taken a number of actions to mitigate the associated risk – the most visible being the full-scale reactor mock-up. However, execution is significantly different than planning and the need for OPG to have effective oversight and the ability to identify and respond to degrading execution performance is emphasized.

OPG has the infrastructure and framework for execution of the outage. With the Ready to Execute Plan, the organization will monitor completion of prerequisite projects (including Campus Plan and SIO projects) and processes needed for the start of the Unit 2 outage, and test the processes, infrastructure, organization and oversight prior to the breaker open in order to implement desired improvements.

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**Report to the Minister of Energy on the Oversight of the  
Darlington Refurbishment Program**

**For the Quarter ending September 30, 2015**



Mike White  
CALM Management Consulting, Inc.  
October 5, 2015

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**1. Minister Summary**

This report provides the detailed quarterly review of trends, accomplishments and challenges related to the Darlington Nuclear refurbishment project. The project is reaching a critical phase, with completion of Definition Phase by yearend of 2015 and the start of execution of some core refurbishment projects. Between now and breaker open the refurbishment organization will be executing projects associated with the Re-tube Waste Processing building, refurbishment support facilities, services and shutdown/layout projects.

A number of achievements have been made in the progress towards being in a state of readiness for breaker open. This progress includes:

- Life to date total cost of the project as of the end of August 2015 is \$1,934M, which is \$214M below the plan of \$2,148M.
- The Release Quality Estimate has been developed with final reviews in progress for submission to the OPG Board by November 15, 2015. The RQE includes the cost estimate for the 4-units, including contingency, the detailed schedule for Unit 2 and the high level schedule for the other units, and the scope of the refurbishment outages.
- The Joint Venture (JV) submitted its revised Class 2 estimate (revision 1) for the RFR project and it has been accepted by OPG. Currently the JV and OPG are in discussions to resolve the gap in contingency funds to be assigned to the JV and completion of the contract amendment.
- The transition of the OPG Board's oversight from the Nuclear Oversight Committee to the Darlington Refurbishment Committee (DRC) has started, with its first meeting scheduled in August.
- Collaboration meetings with Bruce Power continue to explore and implement collaboration opportunities.
- OPG refurbishment management has declared success in meeting the August 15<sup>th</sup> milestone for completion of detailed design engineering. There remain 45 (17%) detailed engineering packages to be completed in 2015 and 2016. These packages were approved by execution and engineering vice presidents for completion after the milestone.

With the RQE being scheduled for submission in mid November, the focus of the refurbishment organization moves to demonstration of the readiness to execute the Unit 2 refurbishment outage. This demonstration is particularly important with the large

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number of issues associated with the planning and execution of the Campus Plan and Safety Improvement (SIO) projects. Areas that need to be included in this demonstration include:

- The lessons learned from the Campus Plan and SIO projects need to be addressed in a manner that provides confidence that they will not be repeated during the refurbishment outage. These are grouped under three categories (planning, execution and organizational effectiveness) as described in the challenge Readiness to Execute Unit 2 Refurbishment. Refurbishment management has developed a Readiness to Execute plan that identifies and schedules the activities that need to be accomplished to provide this confidence. This plan includes a five month test period during which the processes, infrastructure and organization developed for the refurbishment outage will be validated and verified for effectiveness.
- Tied to execution is the fact some of the work is first time execution for the vendor, very infrequently performed or first of a kind. For example, this is the first time for the Joint Venture to execute a re-tube and feeder replacement, first time in a decade for B&W to clean the Darlington steam generators, first of a kind process for the handling and reduction of re-tube radioactive waste and some first of a kind turbine inspection at Darlington. Since refurbishments by their nature are infrequently performed, this is not a surprise. OPG has taken a number of actions to mitigate the associated risk – the most visible being the full-scale reactor mock-up. However, execution is significantly different than planning and the need for OPG to have effective oversight and the ability to identify and respond to degrading execution performance is emphasized.

The challenges that were identified in the second quarter continue to exist with some change in focus. These challenges represent performance trends that should be addressed to reduce the possibility of becoming significant issues.

**Contractor Safety Performance**

Projects and Modifications (P&M) management and the ESMSA vendors have initiated a number of actions in response to the increase in contractor safety events. These actions have contributed to improved contractor safety performance during the third quarter. This improvement is based upon a reduction in the number safety incidents, as well as field observations showing improved behaviours related to working at heights and lifting and rigging. The current challenge is to incorporate these actions to ensure sustained performance.

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**Release Quality Estimate**

The development of the Release Quality Estimate (RQE) has been the major focus of the refurbishment organization through 2015. Its submission to the OPG Board of Directors has recently been revised back to the original milestone of November 15, 2015 from an early target of October 15, 2015. This will provide additional time to complete refinements and challenges, as well as include the results of the KPMG reports on the process and its implementation.

**Summary of Preliminary Results.** There may be slight changes as a result of the reviews and challenges to be conducted in October. The current preliminary cost information is:

- Total Cost: \$10.6B (2015\$) including \$0.2B of incurred interest and \$12.8B with inflation and future interest
  - \$2.3B estimated spent to 2015 yearend
  - \$4.3B external Engineer, Procure, Construct (EPC) vendors
  - \$1.9B OPG functions and project management
  - \$0.2B insurance and CNSC costs
  - \$1.9B Contingency
- The contracts with the EPC vendors are a combination of Target Price (53%), Cost + Mark-up (33%) and Fixed Price (14%)
- The duration of the refurbishment of the four units is based upon each unit's critical path duration and extent of overlap between units. The schedule is summarized below.

Unit	Planned Start	Planned Finish	High Confidence Finish	High Confidence Duration (days)
2	10/15/16	8/15/19	2/15/20	1,218
3	9/15/19	6/15/22	4/15/22	1,217
1	1/15/21	10/15/23	6/15/24	1,157
4	7/15/22	4/15/25	2/15/26	1,127
4 unit	10/15/16	4/15/25	2/15/26	3,410

The planned duration for Unit 2 is 1,034 days. The high confidence duration of 1,218 days includes the contingency resulting from program risks and discrete risks associated

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with the critical path.

The challenge section provides a summary of the status in each of the review areas for RQE.

**Management of Engineering Quality and Open Items**

With the OPG declaration of meeting the milestone for the completion of design engineering, there is the risk that quality issues, including a large number of engineering open items, may result in an increased demand and scope for field engineering, as well as delays and rework in construction execution. This risk has been identified for several quarters; specifically, the potential impact of the acceptance of engineering deliverables from design agencies that do not meet quality requirements. By its nature, any perceived time pressure to complete a large engineering workload in a short period of time introduces a challenge to maintain high levels of quality and an increase in the acceptance of engineering packages with open items to be completed. This feature combined with the latent nature of engineering errors results in the need for effective implementation of a rigorous and high quality process for the acceptance of engineering design deliverables. The latent nature of engineering errors in approved designs refers to the fact that the consequences of these errors are not realized immediately. They are seen in construction, commissioning and too frequently during plant operation.

**Ready to Execute Unit 2 Refurbishment Outage**

As stated above, refurbishment management's next critical step is to demonstrate that the organization is ready to execute the refurbishment of Unit 2. Refurbishment management has developed a Ready to Execute (RTE) Plan to have specific processes, infrastructures and organizations in place and validated for effectiveness prior to Unit 2 Breaker Open (start of the Unit 2 refurbishment outage). One important element to demonstrate readiness is the understanding and addressing of the lessons learned that plagued the Campus Plan and SIO projects. During more than thirty months of observations, a number of such lessons learned have been, and continue to be, identified by the Independent Oversight Advisor. In addition, the Vice President of Execution has requested that the refurbishment execution organization conduct a formal lessons learned review of the four projects that have had issues related to engineering, schedule, cost and quality (EPG3, D<sub>2</sub>O Storage, CFVS and AHS). These lessons learned can be divided into three general categories – preparations, execution and organizational effectiveness. The challenge section of this report reviews these lessons learned, identifies the level of risk and method by which OPG is addressing each, and



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the process to assess the extent to which each is addressed.

## 2. Purpose of Report

This quarterly report provides a more detailed review and expansion of the monthly reports to the Ministry of Energy of OPG management's progress to plan and execute a successful refurbishment outage of the Darlington nuclear units. Success is defined as the preparation and execution of 100% of the correctly identified project scope safely, on schedule, within budget and with quality. It is the belief of the MOE's Independent Oversight Advisor that the Refurbishment Program Challenges that are identified in Section 5 deserve consideration by OPG Refurbishment management. It is the intention to identify such challenges when they represent an early trend rather than wait until they become a significant issue.

## 3. Darlington Nuclear Refurbishment Scorecard

### Darlington Nuclear Refurbishment Scorecard – September 2015

	Current Month	Previous Month	Trend	Notes
<b>Unit 2 Readiness for Breaker Open</b>				
Safety Performance and Preparations for Unit 2	x	x	↗	An improvement plan has been developed by OPG and ESMSA vendors.
Regulatory Approvals	✓	✓	→	The approval of the IIP is expected as part of the renewal of Darlington's operating license.
Risk Management	✓	✓	→	
Release Quality Estimate	x	x	→	The date for submission of the RQE to the Board has been moved to its original milestone of November 15, 2015.
Cost Management	✓	✓	→	



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	Current Month	Previous Month	Trend	Notes
Unit 2 Refurbishment Core Projects Readiness	✓	✓	→	
Unit 2 Execution Readiness	*	✓	→	The need to focus on readiness to execute has been identified as a key focus for Q4 through to the start of Unit 2's outage.
Unit 2 Return to Service Readiness	✓	✓	→	
Unit 2 Execution Schedule Development	✓	✓	→	
Unit 2 Scope Control	✓	✓	→	
Resource Management	*	*	→	
<b>Field Execution</b>				
Performance of Campus Plan & Safety Improvement Opportunity Projects	*	*	↘	A number of quality issues occurred this quarter.
Unit 2 Prerequisite Work	*	*	→	
<b>Learning and Oversight</b>				
Operating Experience & Corrective Action	✓	✓	→	
Oversight	✓	✓	↘	

**Basis for Scorecard Ratings**

**Safety Performance and Preparations for Unit 2– YELLOW**

The adverse trend in contractor worker safety performance in the Campus Plan and Safety Improvement Opportunities (SIO) projects was identified as a challenge in the Q2 report. This trend includes incidents involving lifting and rigging, work at heights and vehicle movement. In addition, the Joint Venture has had safety incidents while working at the mock-up and the Re-tube Waste Processing Building. During this past quarter, an improvement plan has been developed for the ESMSA contractors. It is discussed in the challenge on contractor safety performance.

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ALARA committee meetings continued during the third quarter. The establishment of an ALARA committee during the planning phase is an excellent practice. However, it has set the end of Q1, 2016 as the target for a Unit 2 ALARA plan. This late date will provide little opportunity to have the ALARA plan influence the projects both in terms of dose reduction techniques during the execution of Unit 2's refurbishment, as well as minimize source term and radiological hazards during post refurbishment operation.

Regulatory Approvals – WHITE

The CNSC provided a letter to OPG stating that the revised Integrated Implementation Plan (IIP) meets the intent of CNSC regulatory document RD-360. The CNSC staff accepts OPG's IIP Revision 001 with implementation of specific changes that were documented in the letter. The changes are required to be made in the document's revision for submission to the CNSC in support of the 2015 licensing renewal for the Darlington nuclear plant. The IIP represents OPG's commitment to the CNSC in response to findings of the Environmental Assessment and Integrated Safety Review.

Risk Management – WHITE

Q3's focus in risk management was the development of the contingency estimate for the Release Quality Estimate. This included discrete risks for the individual projects and the risks for the functions, and the broader Program risks. The results are provided in the RQE challenge. The Key Risk Areas and their status did not change during this quarter.

- Availability/Retention of Key Staff (remained as a Yellow risk)
- Cost and Estimating Management (remained as a Yellow risk)
- Completion of Unit 2 Prerequisites (remained as a Yellow risk)
- Regulatory Approvals (improved from a Yellow risk to a Green risk)
- Fuel Handling Reliability (remained as a Yellow risk)
- Vendor Performance (remained as a Yellow risk)
- Integrated Schedule Development (remained as a Yellow risk)
- Materials not Procured Prior to Lead Time Expiry (remained as a Yellow risk)
- Completion of Engineering (remained as a Yellow risk)
- Integration with External Organizations (remained as a Yellow risk)
- Support Staff Resourcing (this is a new key risk area regarding the availability and retaining specialty support resources to support the refurbishment project.)

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Now that the project has a good understanding of the risks and contingency, it needs to focus on managing the risks. This should include:

- Monitoring the progress of the mitigating actions for the identified risks.
- Identifying those risks that are very low probability but a significant impact and developing strategies.
- Developing response plans for issues that are likely to happen and which could result in higher consequence if not effectively managed. An example of such an issue is the response to a radiological event.

Release Quality Estimate (RQE) - YELLOW

Progress towards RQE has been a major refurbishment focus during 2015. The RQE has four major deliverables:

- The cost estimate for the refurbishment of four units, including contingency. This requires a detailed understanding of the basis and assumptions for the outages and the associated risks.
- A schedule for the four units – detailed for level 2 and high level for the remaining units. This also requires an understanding of the basis and assumptions for the outages and the associated risks.
- Confirmation of the scope of the project and specifically Unit 2. This not only includes the scope of the refurbishment outage but also the commitments to the CNSC tied to the unit's return to service but assigned to the station.
- The Execution Strategy for Unit 2. This includes many items that have not been effectively implemented during execution of the Campus Plan (CP) and Safety Improvement Opportunity (SIO) projects. These are described in the challenge for incorporating lessons learned from the CP and SIO projects.

The RQE has not completely gone through its review and challenge process within the refurbishment organization. This will be completed for the November submission to the Board. RQE status is provided in the Challenge section of this report.

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Cost Management - WHITE

For the purpose of this scorecard, cost management has been separated from the risks associated with the basis and assumptions for the refurbishment project, which are captured under the RQE element. Life to date total cost of the project as of the end of August 2015 is \$1,934M, which is \$214M below the plan of \$2,148M.

Unit 2 Refurbishment Core Projects Readiness - WHITE

With the completion of design engineering and RQE submission in November, the core projects will need to focus on monitoring the procurement of parts, completion of Comprehensive Work Packages (CWPs) and assessing, and the management of the open engineering items remaining after the acceptance of design packages. These should be monitored through the weekly Project Schedule Review meeting. The effectiveness of the associated processes will be assessed during the test period that uses the prerequisite projects scheduled in 2016 prior to breaker open.

Unit 2 Execution Readiness - YELLOW

With the performance issues that have occurred during the Campus Plan and Safety Improvement projects, the refurbishment organization needs to demonstrate their readiness to execute to a high level of confidence. Management has developed a Readiness to Execute Plan, which includes a test period, for this purpose. Details are covered in the Challenge section of this report

Unit 2 Return to Service Readiness - WHITE

OPG refurbishment management recognizes the need to start the strategy to perform commissioning of systems and return the unit back to service upon the completion of each unit's refurbishment. This is seen in a Return to Service section reporting to the Refurbishment Director of Operations and Maintenance, as well as an associated functional management plan. It is expected that the Division of Responsibilities document that is currently under development will provide clarity of the responsibilities of refurbishment and station organizations.

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Unit 2 Schedule Development - WHITE

With the completion of RQE, a detailed schedule has been developed for the critical path and placement of the other project bundle windows for the Unit 2 outage has been developed. The non-critical path schedule can be examined for opportunities for resource balancing and verification that there are no impacts on work in one location from work in another location.

Unit 2 Scope Control - WHITE

The scope for the Unit 2 refurbishment outage is well defined, and is controlled by an established process and Unit Scope Control Board. This controls both the addition and removal of work to the outage. It is expected that some scope addition will occur as a result of discovery work associated with the core projects, as well as corrective maintenance on components that are planned to be operating during the outage. Some of this work will need to be done, and the RQE contingency funds will recognize this reality. The work performed within the core refurbishment projects is not the only source of work to be performed during the outage period. Additional work will be done as a result of:

- The Unit 2 cyclic outage will be performed during the unit's refurbishment outage. Its scope includes corrective maintenance and preventive maintenance activities that are not included in the core refurbishment projects, but necessary for the continued health of the asset. The scope of this outage is in the process of being defined and controlled through a separate scope control process. Its scope and associated estimate are required to support the submission of the RQE.
- There will be a number of projects managed by Projects and Modifications that will be conducted during the refurbishment outage period. They are not associated with the refurbishment outage and thus will not be part of RQE. However, the scope of work needs to be fully defined and controlled to prevent impact on the core refurbishment project.
- Although not funded by the refurbishment project or part of its scope, the station organization has a number of work activities for which it is responsible and has a CNSC commitment for completion prior to Unit 2 start-up. These will be managed through established station processes.

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Resource Management - YELLOW

The availability/retention of key project staff is identified as one of the program's Key Risk Areas. It consists of:

- The possibility of limited skilled trade resources and supervision for project execution is one of the highest program risks. With the slowdown in the economy, refurbishment management does not believe that this will be an issue for Unit 2. However, the risk will potentially increase with subsequent units, as a result of potential overlap with Bruce Power refurbishment project and any increase in infrastructure and industry projects.
- The potential that project leadership and specialized resources are **not** in place when required. There are a number of initiatives under development to reduce the significance of this risk. Refurbishment management is constrained through the need to implement the corporate policies and procedures that have been developed for operating facilities and small projects.
- The possibility of an insufficient number of Authorized Staff for both station and refurbishment needs. This is being addressed through a combination of increased number of candidates for the associated positions as well as challenging the extent of the need for such staff once the unit is defueled and isolated through the bulkhead.
- The potential of an insufficient number of qualified radiation protection coordinators to support project execution.

OPG refurbishment management is developing and implementing actions to ensure its leadership team is in place for the current outage and future leaders are identified and developed for the program's sustainability. However, this year's trend of key individuals leaving OPG or the project represents a degrading trend in this area. Movement of key, experienced personnel from the project is a risk not only because of the lost talent, but also because of the loss of project specific knowledge, including the basis of decisions and operating experience. In particular, this is the fourth DOM in the past two years.

Performance of Campus Plan & Safety Improvement Opportunity Projects - YELLOW

It is recognized within the OPG organization that the performance of the Campus Plan and Safety Improvement Opportunity (SIO) projects continues to be a challenge to OPG. The most important observations from this quarter are:

- The Joint Venture has challenged a number of aspects of the original engineering design of the D<sub>2</sub>O Storage Building that will require rework and

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potential delays in field execution. These include certain aspects of the civil design that do not meet code and the redesign of pipe runs through the Heavy Water Management Building (HWMB). These designs had been accepted by OPG. Although these do not represent a significant impact on schedule, this is the beginning of the JV's involvement in the project. OPG has revised its contingency plan for the storage of Unit 2 water in the event that the D<sub>2</sub>O Storage Building is not ready. The plan is to have space made available in the HWMB for unit 2's water. This plan will be monitored to assess its readiness for October 2016.

- A number of design engineering quality issues, including not addressing open engineering items, impacted field execution in terms of quality, cost and schedule. These impacted a number of projects; including D<sub>2</sub>O Storage Building, EPG 3, AHS, BUS 55/56, RPO, CFVS, and RFRISA. The issues are provided in the engineering quality challenge.
- OPG's forecast of May 2016 for EPG3 is significantly more optimistic than the contractor's forecast of September 26, 2016. This is an example in which OPG accepted the design (October 2014) and design packages are still being developed and submitted to OPG for approval. The forecast for the completion of engineering is December 18, 2015. Currently OPG has committed that this project (as one of the Safety Improvement Opportunity projects) will be completed prior to the start of the Unit 2 refurbishment outage. This risk will need to be managed by OPG and effectiveness reported in this report.

The current completion milestones provided to the OPG Board in its August meeting challenges for these projects are identified in the following table.

Project	Need Date	Current Forecast	Float to Need Date (months)	Notes (changes highlighted in bold)
Auxiliary Heating Steam		Oct. 2015		This project is not tied to the start of Unit 2 refurbishment. <b>The current forecast represents a delay of 1 month since the previous update to the Board. The vendor has a forecast to completion of December, 2015</b>
Heavy Water Storage and Drum Handling Facility	Feb. 2017	June 2016 (Partial) and May 2017 (full)	8	The partial is required to store Unit 2's heavy water. In addition, a contingency plan for Unit 2 water is under development. <b>The JV's schedule to</b>



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Project	Need Date	Current Forecast	Float to Need Date (months)	Notes (changes highlighted in bold)
				meet this forecast has not been finalized and thus reviewed.
Holt Road Interchange Improvements	Oct. 2016	Dec. 2015	10	
Electric Power Distribution	Sept. 2015	In service		The Available for Service declaration was not performed in June.
Operations Support Building Refurbishment		Sept. 2015		This project is not tied to the start of Unit 2 refurbishment.
Refurbishment Project Office	Oct. 2016	Sept. 2015	13	The RPO was partially available for occupancy on September 12, with the contractor projecting full occupancy by October 30 <sup>th</sup> .
Re-Tube & Feeder Replacement Island Support Annex	Oct. 2016	Nov. 2015	11	The vendor has a forecast to completion of February, 2016.
3 <sup>rd</sup> Emergency Power Generator	Oct. 2016	May. 2016	5	This forecast represents a delay of 2 months since the previous report to the Board. The contractor's schedule has the forecast completion as September 26, 2016. This represents virtually no float to Breaker Open for Unit 2.
Containment Filtered Venting System	Oct. 2016	May 2016	5	The contractor's schedule has the forecast completion as September 13, 2016.
Fire Water and Emergency Cooling		November 2015 (partial)	N/A	The strategy for this project has significantly changed. The replacement of emergency service water piping will be installed during the fall VBO and fully completed during Unit 2 refurbishment. Backup fire pumps, which are included in this project's scope, will move the start of Unit 2 refurbishment to the completion of the refurbishment outage.
Powerhouse Steam Venting System	Oct. 16	Oct. 2015	12	
Shield Tank Overpressure	April	December	N/A	The remaining units are tied to specific outages. Unit 2 is to be completed



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Project	Need Date	Current Forecast	Float to Need Date (months)	Notes (changes highlighted in bold)
Protection	2017	2015 for Unit 3		during the refurbishment outage. Unit 3's has been moved from June 2015 to December 2015 as a result of the change in the VBO from spring to fall.
Re-tube Waste Processing Building	July 2017	Dec. 2016	7	
Re-Tube Waste Storage Building.	July 2017	December 2016	7	<b>The contractor's schedule has the forecast completion as March 2017.</b>
Used Fuel Dry Storage Building	March 2016	December 2015	3	<b>The need date has been revised by OPOG from October 2016 to March 2016. The contractor's forecast for completion is March 30, 2016.</b>

The life-to-date costs for these projects, as of May month end, are \$601M, \$42M below plan.

Unit 2 Prerequisite Work

There is a large amount of work that needs to be completed at the station to support the start of the Unit 2 refurbishment outage. In addition to the visible Campus Plan and Safety Improvement Opportunity projects, other work that needs to be completed prior to the start of the unit 2 outage. These can be categorized as:

- Fuel Handling Reliability Improvement Work. There is a need to improve fuel handling equipment to support current operations and the defueling of the reactor. This work is being planned and executed by the station fuel handling organization. This work has progressed well during Q3, resulting in the health of all systems being declared as excellent (Green) or good (White)
- Fuel Handling Work to support Unit 2 Refurbishment Outage. In addition to the fuel handling equipment reliability improvement initiative, the station fuel handling organization is executing the work to support the Defueling project. This work has progressed well during Q3. Commissioning of tooling on the Service Area Rehearsal Facility (SARF) was completed in September 2015.
- Station Ready for Refurbishment Work. There is work that the station is responsible to complete that is required for the start of the unit 2

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refurbishment outage. This is related to improving the health of key systems, such as containment vapour recovery systems. If this work is not accomplished prior to the outage it will need to be completed at the start of the outage.

- Refurbishment Organization Work. There is some work for which the refurbishment organization is responsible. This work must be coordinated with the station schedule and use station processes. There are a number of work orders to be completed during the VBO.

In addition, the Refurbishment Core Project has several projects that must be completed prior to the start of the Unit 2 refurbishment outage. Field execution of these projects is scheduled through 2015 and 2016. Most of these are associated with Islanding, Shutdown/Layup and Balance of Plant and are summarized in the following table.

Core Project	Project	Status
Unit Islanding	Negative Pressure Containment Modifications	Field execution through 2015 and 2016. This includes 4 engineering packages.
	Area Islanding Barriers	Planned for execution in Q3, 2016. This represents 4 engineering packages.
	EFADS, PAMS and CLRTS modifications	Starts in VBO and continues through 2016
Refurbishment Support Facilities	Non-contaminated maintenance workshops and offices	This contains 7 engineering packages. Scheduled for Q1 and Q2, 2016.
	Wireless Network Infrastructure	This contains 1 engineering package. Scheduled for Q4, 2015.
	Turbine Cargo Elevator	This contains 2 engineering packages. Scheduled for Q1 and Q2, 2016.
	Work Control Area and Permit Preparation	This contains 2 engineering packages. Scheduled for Q4, 2015 and Q1, 2016.
	Radiation Protection Offices and Teledosimetry	This contains 2 engineering packages. Scheduled for Q1 into Q3, 2016.

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Core Project	Project	Status
	Contaminated Shops, decontamination and contaminated scaffold storage area	This contains 1 engineering package, although likely separate areas. Scheduled for Q2 and Q3, 2016.
Shutdown/Layup/Services	Breathing Air System	This contains 3 engineering packages. Scheduled for Q1 and Q2, 2016.
	Service Air System	This contains 2 engineering packages. Scheduled for Q1 and Q2, 2016.
	Washrooms – install and tie-in	Scheduled for Q3, 2016

As can be seen, 2015 and 2016 will have the four identified groups of station work, the identified core projects and the Campus Plan & SIO projects that will require integration, coordination and support from the station. This will have to be done in conjunction with the fall Vacuum Building Outage, a spring Unit 4 outage and the on-line work required for the continued safe operation of the plant.

A specific focus of the Refurbishment organization (particularly the R&FR project) is the planning, engineering and construction of the Re-Tube Waste Processing Building (RWPB). Although not required for Unit 2 breaker open, it is required prior to the start of removal of feeders and fuel channels, it is being planned and executed by the RFR Joint Venture, and thus is the first example of field execution by the Refurbishment Organization. This project has had some of the same issues seen in the Campus Plan and SIO projects that contributed to their cost increases and schedule delays. In response, refurbishment senior management has increased focus and oversight of this project starting in Q1. This oversight includes a weekly meeting with the Vice President, Execution and a weekly scorecard discussed on the Chief Nuclear Officer phone call. However, the project neither participates in the daily project Plan of Day meeting nor has the equivalent daily meeting or phone call with senior management. Because of the isolation of the management of this project, issues may not be identified to organizations (the station, Projects & Modifications or broader refurbishment) in a timely manner. For example, an adverse trend in vehicle contact with caissons was identified by the JV at an RFR Steering Committee meeting. There were no SCRs initiated and no discussion at the P&M Plan of the Day meetings.

Refurbishment senior management is using the prerequisite projects as an opportunity to test the processes, infrastructure and organization prior to the full execution in

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October 2016. It is unclear if the RWPB project will be included in this pilot in order that the JV is exposed to the processes prior to breaker open.

**Corrective Action Program and Use of Operating Experience – WHITE**

The refurbishment Corrective Action Program (CAP) and Operating Experience program (OPEX) represent nuclear industry standards and well implemented. Particular strengths are the quarterly trend reports and the Corrective Action Review Board. Both of these are consistent with OPG and industry standards. The challenge for the refurbishment organization is the integration of all sources of quality and human performance information into a broader trending product. For operating nuclear plants, the main source of quality and human performance information is the Station Condition Reports (SCRs). However, for the project this is only a small component of the available information on quality and human performance. Additional sources are the audits and surveillances performed by Supply Chain, receipt inspections of parts and materials, project oversight logs, and the corrective action program results for each vendor. To identify a potential adverse trend before it becomes a significant issue will require improved capability to trend across projects, vendors and programs.

**Oversight – WHITE**

During the Definition Phase, refurbishment oversight focused on the projects (engineering, estimating and commercial compliance) and the independent oversight team (Modus/Burns & McDonnell) that reports to the Nuclear Oversight Committee of the OPG Board of Directors. In addition, there have been a number of internal audits by various oversight organizations. As refurbishment transitions to planning and field execution of the prerequisite projects, there will need to be an increasing focus on both field execution and the horizontal oversight required to identify potential cross-cutting issues. With the establishment of a Quality Surveillance Group there is some confusion with the roles and responsibilities associated with horizontal oversight. This will be assessed during the fourth quarter.

**4 Accomplishments and Progress**

The following accomplishments were achieved during the third quarter of 2015:

- Life to date total cost of the project as of the end of August 2015 is \$1,934M, which is \$214M below the plan of \$2,148M.

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- The Release Quality Estimate has been developed with final reviews in progress for submission to the OPG Board by November 15, 2015. The RQE includes the cost estimate for the 4-units, including contingency, the detailed schedule for Unit 2 and the high level schedule for the other units, and the scope of the refurbishment outages.
- The Joint Venture (JV) submitted its revised Class 2 estimate (revision 1) for the RFR project and it has been accepted by OPG. Currently the JV and OPG are in discussions to resolve the gap in contingency funds to be assigned to the JV and completion of the contract amendment. These will permit the completion of the associated target price, which should be completed prior to submission of the RQE to the OPG Board.
- The transition of the OPG Board's oversight from the Nuclear Oversight Committee to the Darlington Refurbishment Committee (DRC) has started, with its first meeting scheduled in August.
- The replacement of Tom Mitchell as CEO has been announced. The new CEO, Jeff Lyash, has considerable utility, including nuclear, project management experience. This is a very good selection based on the importance of the Darlington refurbishment is to the health of OPG.
- Collaboration meetings with Bruce Power continue to explore and implement collaboration opportunities.
- OPG refurbishment management has declared success in meeting the August 15<sup>th</sup> milestone for completion of detailed design engineering. There remain 45 (17%) detailed engineering packages to be completed in 2015 and 2016. These packages were approved by execution and engineering vice presidents for completion after the milestone.
- A number of actions have been identified, with some started, to address the adverse performance in contractor safety related to the Campus Plan and Safety Improvement Opportunity projects. Improvement has been noted through the third quarter, with the need to have actions in place to ensure sustainability.

**5. Refurbishment Program Challenges**

Throughout the life of refurbishment program specific challenges have been, and will be, identified that in the belief of the Independent Advisor to the Minister of Energy should have actions by OPG Refurbishment Management to address them, before they become significant issues. The currently identified Refurbishment Program challenges are

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related to contractor safety performance, the development of the Release Quality Estimate (RQE), the management of the engineering workload, and demonstrating the refurbishment organization will be ready to execute by Unit 2 breaker open.

**Contractor Safety performance**

As identified in the Q2 report to the Ministry, the adverse trend in industrial safety practices seen in the Campus Plan and SIO projects includes Re-tube and Feeder Replacement (RFR) field activities. The adverse trend includes moving vehicles hitting site objects, as well as an increase in the number of improper practices related to working at heights without fall protection and lifting and rigging. These poor safety practices cut across the ESMSA contractors, the RFR contractor and a subcontractor directly managed by OPG.

Projects and Modifications (P&M) management and the ESMSA vendors have initiated a number of actions in response to the increase in contractor safety events. These actions have contributed to improved contractor safety performance during the third quarter. This improvement is based upon a reduction in the number safety incidents, as well as field observations showing improved behaviours related to working at heights and lifting and rigging. The current challenge is to incorporate these actions to ensure sustained performance. The activities to support improved performance include:

- There were initial meetings with supervisors and managers from each of the three vendors (ES Fox, Black & McDonald (B&M), and the Joint Venture) used for P&M projects. The observed meetings were the first ones and as a result there was little discussion among field supervisors.
- There is a safety management team established with senior managers from ES Fox, B&M and P&M organizations.
- An initiative to have P&M and vendor managers observe and coach pre-job briefings was started in August, 2015. A review of the August records shows that these were done and they identified some areas for improvement. Observing pre-job briefing provides insight into the focus on safety by the execution team and its supervisor. The next step is to periodically conduct observations of the work discussed in the pre-job briefing to verify that the discussed precautions and requirements are addressed during execution.
- ES Fox initiated a Health, Safety, and Human Performance plan with objectives and targets, as well as improvement in the supervisor oral review board and assessment process.



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- P&M and the contractors have initiated a poster program to support communication of safety issues.
- P&M has joined the Darlington station's campaign to reinforce human performance requirements and error reduction techniques. This includes a formal rollout of the 'Core 4' human performance program, which reinforces procedure use and adherence, pre-job and post-job briefings, verification practices and situational awareness.

An adverse trend in contractor safety was identified by OPG in February (SCR D-2015-04075) and investigated during April and May. A number of actions were identified to address the causes of the adverse trend. The following table shows the status of these actions.

Action	TCD	Status per action tracking	Notes
OPG ESMSA contractors complete and document two paired observations per month for each subcontractor for Q2, Q3 2015 and conduct quarterly trends.	9/30/15	Accepted	Although there is evidence that observations have been conducted by the ESMSA vendors, there is no evidence that these included with subcontractors.
OPG ESMSA contractors complete and document two paired observations per month for each foreman for Q2, Q3 2015 and conduct quarterly trends.	9/30/15	Accepted	Although there is evidence that observations have been conducted by the ESMSA vendors, there is no evidence that these included paired observations with foreman.
Communicate, monitor and reinforce the frequency of safety meetings as per corporate safety rules. Develop and implement meetings scripts for key meetings on the discussion of nuclear safety and oversight of high risk activities.	7/31/15	Notify	Observations of the Plan of the Day meeting show that the identification of high risk activities is identified with the name of an ESMSA oversight person. The lack of high risk jobs is not challenged. Follow-up on observations is not performed.
For current open level 2 causal evaluations, analyse the open actions and combine actions into a few initiatives for focus.	8/15/15	Complete	An analysis of events was conducted; however, actions from this analysis were not developed.
Conduct a joint CARB review in Q3 with Darlington CARB members to review P&M adverse trends for feedback on trends and recurrence actions.	9/30/15	Notify	A joint CARB meeting was conducted for the review of the common cause analysis from which this action was created. However, this specific meeting has not been held.

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Action	TCD	Status per action tracking	Notes
OPG ESMSA contractors implement subcontractor management plans to address gaps in subcontractor human performance.	9/30/15	Accept	The two original ESMSA contractors developed safety and human performance plans early 2015. It is not clear if they have been revised based on the results of this investigation.
OPG ESMSA contractors to implement a field observation program that includes paired supervisory observations.	8/28/15	Sent	Both ESMSA contractors have had observation programs that include paired observations.
Implement a nuclear safety culture plan for projects and modifications.	9/25/15	Sent	There has been the rollout of the Core 4 program, as well as mandatory safety meeting program.
P&M Corrective Action Review Board (CARB) to implement the improvement initiative that was completed at Darlington and other sites.	12/15/15	Sent	This is intended to improve the effectiveness of Project and Modification's CARB meetings, and does impact the drive to improve contractor safety.

A review of these actions identified that some characteristics of successful initiatives to improve safety performance can be strengthened in the current improvement efforts. Examples for consideration include:

- It is common to increase the number of field observations (in addition to pre-job briefings) of medium and high risk activities. Frequently, to drive this increase management will lower the threshold for high risk activities.
- Establish a routine forum in which observations of these activities are discussed among managers and supervisors, including first line supervisors.
- It is common to have an initiative to improve the observation and coaching standards and performance of both the owner and contractor management who perform field observations.
- It is common to increase the emphasis on quality pre-job briefings. On several occasions workers are provided a start of shift briefing and sent to work without an actual pre-job briefing. The characteristics of a good initial and update briefings are not well understood by many first line supervisors. Provide some fundamental training on pre-job briefings. In addition, conduct observations on pre-job briefings.



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- It is common to have the owner's organization conduct blitzes in areas of concern, in addition to management of the contractor.
- It is common to increase the engagement of first line supervisors in debriefing the lessons learned from human performance events. This is done by having them present at presentations to the station or project organization and/or present to their peers.

Although it will take awhile to demonstrate sustained performance in contractor safety, there are a number of areas that will provide increased confidence that the issue is being effectively addressed. Examples of such areas to provide increased confidence are:

- Confirmation that P&M and vendor managers have a good ability to conduct observation and coaching and a plan to improve any performance weaknesses.
- Confirmation that sufficient observations of high and medium risk activities (including pre-job briefings) are performed by vendor and OPG management.
- Confirmation that the results of observations and events are discussed with vendor field supervision and management on a regular basis.
- Because lifting and rigging is one of the areas of the adverse trend, confirm that the intent of WANO SOER 2008-1 recommendations is implemented by Projects and Modifications, and Refurbishment organizations.
- Confirmation that the actions identified in the adverse trend investigation report (SCR D-2015-04075) are being effectively addressed.

**Release Quality Estimate**

The development of the Release Quality Estimate (RQE) has been the major focus of the refurbishment organization through 2015. Its submission to the OPG Board of Directors has recently been revised back to the original milestone of November 15, 2015 from an early target of October 15, 2015. This will provide additional time to complete refinements and challenges, as well as include the results of the KPMG reports on the process and its implementation.

- **Summary of Preliminary Results.** There may be slight changes as a result of the reviews and challenges to be conducted in October. The current preliminary cost information is:
- Total Cost: \$10.6B (2015\$) including \$0.2B of incurred interest and \$12.8B with inflation and future interest

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- \$2.3B estimated spent to 2015 yearend
  - \$4.3B external Engineer, Procure, Construct (EPC) vendors
  - \$1.9B OPG functions and project management
  - \$0.2B insurance and CNSC costs
  - \$1.9B Contingency
- The contracts with the EPC vendors are a combination of Target Price (53%), Cost + Mark-up (33%) and Fixed Price (14%)
  - The duration of the refurbishment of the four units is based upon each unit's critical path duration and extent of overlap between units. The schedule is summarized below.

Unit	Planned Start	Planned Finish	High Confidence Finish	High Confidence Duration (days)
2	10/15/16	8/15/19	2/15/20	1,218
3	9/15/19	6/15/22	4/15/22	1,217
1	1/15/21	10/15/23	6/15/24	1,157
4	7/15/22	4/15/25	2/15/26	1,127
4 unit	10/15/16	4/15/25	2/15/26	3,410

The planned duration for Unit 2 is 1,034 days. The high confidence duration of 1,218 days includes the contingency resulting from program risks and discrete risks associated with the critical path.

The current status of the RQE elements is provided below.

- **Re-Tube & Feeder Replacement (RFR) Class 2 Estimate.** The Joint Venture (JV) submitted a Class 2 estimate (revision 10) on August 31, 2015. It is the result of a significant effort between the JV and OPG to resolve disagreements from the original Class 2 estimate submission provided in early May. This estimate represents a 'bottom-up' determination. There are three major components to the estimate that are essential for RQE – schedule, cost and risk. The class 2 target duration provided in the Class 2 estimate (revision 1) is 1,164 days for Unit 2. This duration is an input into OPG's RQE schedule and duration, and represents a good level of confidence for the duration of the R&FR critical path and a best guess for the duration of the critical path performed by OPG. The total project cost estimate execution in the JV's submission is \$2.71B. It is

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noted that the higher cost estimate in the RQE itself is because it includes the work (such as tool development, manufacture and testing) completed during the Definition Phase.

OPG has accepted the JV's Class 2 estimate (revision 1) and it is currently the basis for the final execution contract for the R&FR project. The final contract is expected (and needed) for the OPG Board meeting of November 15, 2015.

- **Project Estimates.** Each project bundle generated an RQE package that was reviewed and challenged by senior refurbishment management. This package included the scope, cost estimate, duration and location in the outage of the project bundle(s), and discrete project risks. In general, there was not a significant amount of follow-up work. The following table provides the cost estimate for each bundle, as identified in the RQE bundle. These costs include EPC labour, parts and materials, OPG support and oversight, and contingency.

Project Bundle	Cost Estimate	Confidence Level	Notes
Re-tube & Feeder Replacement	\$3,725M	High	The basis for this estimate is the JV's bottom-up Class 2 estimate. As the main scope of work and the project that defines the majority of critical path duration, it has been under scrutiny for the past 30 months.
Turbine Generator	\$862M	Medium	There was a lack of recognition in the package of the risk associated with the commissioning of the new digital controller systems during the unit's return to service. The first unit this impacts is Unit 3, since the modifications are not being done during the Unit 2 outage. As a result of management challenge, the project team was assigned an action to increase the contingency for this risk.
Balance of Plant (BoP)	\$641M	Low	7 of 17 project bundles had discrepancies in man-hour estimates between the RQE estimate and the resource loading graphs of greater than 15%. The estimating exercise was done late (the contracts were awarded late) and thus mostly reflect a lower level of confidence compared to the

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Project Bundle	Cost Estimate	Confidence Level	Notes
			other projects. Planning is immature. The main vendor has had problems with accurate cost and schedule estimates for the Campus Plan and SIO projects. This has resulted in a high contingency in percentage terms.
Defueling, Fuel Handling and Special Projects	\$381M	High	The estimate is based on previous history with experienced vendors. During the Definition Phase this project has successfully overcome problems to meet milestones. This project has demonstrated good coordination among the project, vendor and station.
Shutdown/ Layup, Services and Refurbishment Support Facilities	\$397M	Low	As with the Bop, many of these projects have just started, with immature planning resulting in incomplete estimates. The main vendor has had problems with accurate cost and schedule estimates for the Campus Plan and SIO projects. This has resulted in a high contingency in percentage terms.
Steam Generator	\$144M	High	The majority of this work involves common inspection techniques and a previously- implemented cleaning process. There is one modification that has been successfully done at several facilities. Very experienced vendors.
Unit Islanding	\$145M	Medium	With the exception of the Button Modifications, there is good agreement between the RQE man-hours and resource loading analyses. The reason for medium confidence is that this is the first time evolution at Darlington for Unit 2.
Campus Plan and Safety Improvement Projects	\$700M	Low	The RQE challenge meeting was held behind closed doors and no package has been provided. The estimate is the value provided to

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Project Bundle	Cost Estimate	Confidence Level	Notes
			the OPG Board at its October 1 retreat. Low confidence is based upon the performance of the contracts to date.

The projects that have lower confidence (Bop and Shutdown/Layup) have management actions to improve the confidence as well as higher contingencies to offset the level of confidence.

- Functional Estimates.** Along with the RFR project, the OPG functions represent the largest cost component of the refurbishment program. The cost estimates for each function have been presented to, and challenged by, senior refurbishment management. The total cost estimate of the functions for the refurbishment of the four units is \$2.6B, including \$0.6B spent by 2015 yearend for the Definition Phase. Refurbishment management's intention was to develop a bounding estimate that incorporates all necessary roles and responsibilities. During the RQE review process, some minor gaps in responsibilities were identified. Cost estimates have been included in the total estimate for the functions. A Division of Responsibility document is to be completed by yearend as part of the Readiness to Execute Plan. This is essential for the final organizational structure and numbers for the functions. Management recognizes its challenge to ensure that there is sufficient support to and oversight of the EPC contractors while maintaining a cost-effective organization within the functions.
- Contingency Funds.** The total value for RQE contingency funds is \$1.9B. This value is a result of identified risks in projects, and the programs that cut-across projects, including risks to the schedule. Contingency evaluations, including review of management reserve, will continue through October and be finalized by the November submission date. The following table summarizes the distribution of the contingency.

Bundle/Type	Contingency (\$M 2015)	% of Total Contingency
Re-Tube & Feeder Replacement	317	17%
Turbine Generator	205	11%
Balance of Plant	166	9%
Fuel Handling, Defueling and	43	2%

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Special Projects		
Steam Generator	21	1%
Shutdown, Layup & Services	69	4%
Campus Plan & SIO	67	4%
Functions Total	69	4%
Program (Schedule risk, discrete program risk, cost uncertainty)	924	49%
<b>Total Contingency</b>	<b>\$1,879</b>	<b>100%</b>

It is noted that the total contingency is about 40% of the total value of the EPC contractors' estimate for execution (\$4,300M). This is consistent with the current contingency for Watts Bar construction project, and presumably will be benchmarked by KPMG in their review reports on the RQE process and its implementation.

- **Assumptions and Bases.** The development of the RQE requires an understanding of its basis, as well as associated project, functional and program assumptions. A basis item is a documented and approved condition, fact and/or strategy that describes how a cost estimate, schedule or other plan component was developed and documents the information used in support of RQE development. An assumption is a condition, item or information required in developing the program (or project/function) estimate that has yet to be completely defined and validated. Each assumption requires a validation plan. During the planning of the refurbishment program, a number of basis items and assumptions have been identified. During the development of RQE, these have been refined and modified, with additional ones identified. These will need to be finalized, with a summary report that clearly identifies the key basis items and assumptions for the refurbishment of the four Darlington units. The current date for this report is July 15<sup>th</sup>; however, this will continue to be updated through to the finalization of the RQE.
- **RQE Process.** The estimating processes used in the development of the estimates are based on AACE (Association for the Advancement of Cost Engineering) guidelines. The RQE process and key elements have a number of reviews in progress; including:
  - KPMG is performing an independent review of RQE. It contains two components – a review of the RQE processes and a review of their



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implementation through a deep dive in the RFR, Balance of Plant and Operations and Maintenance function estimates. The process review report was issued on September 30<sup>th</sup> and thus not reviewed for this report.

- Modus provides oversight on behalf of the OPG Board of Directors. They are monitoring the progress of the RFR JV Class 2 estimate and the RQE. They provide on-going recommendations to support the development of these products. Their focus is on the extent to which the process is aligned with the AACE guidelines and extent to which the results are defensible. Their reports provide limited insight into the quality of RQE since they provided a mixture of oversight and consulting through the process.
- BRG (Berkeley Research Group) was hired by the JV to provide an on-going, independent review of the RFR Class 2 estimate. The review was performed through selected submissions. It is unclear of the status of the submissions and their actual use to support the RQE.
- RFR Expert Panel. The JV and OPG jointly established an Expert Panel to review elements of the Class 2 submission during its development. Members of this panel had experience with the re-tube of CANDU reactors, specifically at Bruce and Pt Lepreau. They identified three areas in which further work was required to obtain a reliable estimate - the excessive size of the project management organization for the project, the extent of contingency funding for the project and the long duration of critical path. These items were addressed in the JV's Class 2 estimate.
- **Conclusions:** The following conclusions are provided on the current status of the Release Quality Estimate:
  - The scope of the project has been defined for several quarters and, other than discovery work during the actual outage, is firm.
  - The total cost of \$10.6B (2015\$) or \$12.8B (including escalation and interest) includes the cost of planning and preparations, support facilities and SIO projects, other prerequisites, the project bundles, the functions and contingency. It is based upon a mixture of Class 2 to 4 estimates, but represents a high-confidence upper bound.
  - The duration of the Unit 2 outage is based on a bottoms-up critical path schedule. The planned duration is 1,084 days with a high confidence duration of 1,136 days. This compares well with the actual Wolsong 1 (W1) refurbishment outage duration of 839 days or corrected to 1,136

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days when corrected by the author for design differences (mainly the number of fuel channels in a Darlington reactor (480) versus the 380 fuel channels in W1). This corrected value is different than provided by the JV as a result of not increasing the impact of the calandria tube sheet bore issues and using the actual times in the Unit 2 schedule for OPG start-up. The difference does not detract from the duration estimate.

- The high confidence duration of the four-unit refurbishment outage is 112 months. It is based on Unit 2's detailed schedule and high-level adjustments for the remaining units. The most significant risk to duration for the remaining units is the return to service of Unit 3 after the first installation of the digital controllers for the turbine generator and exciter.
- Although the basis and assumptions are captured in a database, they are not in a format that can be easily reviewed for completeness.
- The KPMG reports on the review of the RQE process used by OPG and its implementation was issued on September 30<sup>th</sup> and thus not reviewed for this report.
- OPG will be in a position to submit a credible RQE to its Board in mid November, 2015.

**Management of Engineering Quality and Open Items**

With the OPG declaration of meeting the milestone for the completion of design engineering, there is the risk that quality issues, including a large number of engineering open items, may result in an increased demand and scope for field engineering, as well as delays and rework in construction execution. This risk has been identified for several quarters; specifically, the potential impact of the acceptance of engineering deliverables from design agencies that do not meet quality requirements. By its nature, any perceived time pressure to complete a large engineering workload in a short period of time introduces a challenge to maintain high levels of quality and an increase in the acceptance of engineering packages with open items to be completed. This feature combined with the latent nature of engineering errors results in the need for effective implementation of a rigorous and high quality process for the acceptance of engineering design deliverables. The latent nature of engineering errors in approved designs refers to the fact that the consequences of these errors are not realized immediately. They are seen in construction, commissioning and too frequently during plant operation.

A quality indicator has been developed for the use in this quarterly report to provide trends in quality, starting in Q4, 2014. The following table provides the results to date.



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Engineering Quality Indicator =  $100 - 15 \times (\text{L1 events (rejection by external approving authority + rework after field installation)}) - 10 \times (\text{L2 events (rejection by internal approving authority + rework during field installation + other event free day reset)}) - 5 \times (\text{L3 events (other rework (greater than \$10K))} + 1 \times (\text{GC (documented good catches prior to submission for OPG review to maximum of 10)})$ . The following values are used for the colour rating:

Green: >80

White: 65 – 79

Yellow: 50 – 64

Red: <50

Month	Index	Rating	Basis
Q4/14	57	Yellow	
Q1/15	57	Yellow	
Q2/15	42	Red	
July 2015	10	Red	0 L1 event, 4 L2 events, 6 L3 events
August 2015	65	White	1 L1, 2 L2, 2 L3
September 2015	40	Red	2 L1, 1 L2, 4 L3
Q3/15	38	Red	

The Q3 indicator of 38 continues to represent a potential concern for quality of engineering.

In addition to the above table of showing quality index, the challenge and associated potential risk is based on the following observations:

- It is an acceptable and common practice within OPG to accept a design package with open items in the design. There is no rigorous process to manage these open items to ensure they are addressed prior to the start of field construction.
- There are several Campus Plan and SIO projects that met their engineering complete milestone with open items for which there are impacts in field execution, resulting in delays and rework. Examples include Emergency Power

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Generator 3 (EPG3), Auxiliary Heating System (AHS), Containment Filtered Ventilation System (CFVS), D<sub>2</sub>O storage, and Re-Tube and Feeder Replacement Island Service Annex (RFRISA) building.

- Although OPG has responded to the IER 14-20 on Technical Conscience by the Institute of Nuclear Power Operations (INPO), there has not been a review of high risk, first-of-a-kind or first-in-awhile design agency work to validate the rigour and quality of the design agency and acceptance by OPG.
- The refurbishment Vice President of Engineering recently communicated his continuing concern about on-going quality issues, including open items, in the design agency products.
- There has not been a review to verify that designs have incorporated appropriate World Association of Nuclear Operators (WANO) and INPO significant operating experience recommendations.

Although refurbishment engineering understands the risk of latent errors in design engineering, there are opportunities to reduce the risk of impacting field execution as a result of design quality issues and unresolved open items. Examples of opportunities that would increase the confidence that engineering quality and open actions are being effectively managed are:

- Identify completed and in-progress designs that are high risk, infrequently performed (first in awhile) or first time performed. For each, specify additional verification and validation requirements. INPO generated an industry operating experience document related to such engineering (IER L1 14-20, Integrated Risk – Healthy Technical Conscience), particularly recommendation 3, which deals with vendors conducting engineering work for the owner. Several designs fall into this category; including, EPG3, CFVS, D<sub>2</sub>O Storage Building, access ports for the Steam Generators, the digital controllers for the Turbine/Generator and fire pumps as additional supply to the Emergency Service Water system.
- Consider including in the above verification and validation key assumptions, critical calculations and other key elements in the design. Include as an addendum to the design acceptance documentation the specific activities taken to verify and validate the quality of the deliverables. This should include the items that were independently verified by refurbishment engineering and the individual's name that performed independent verification for OPG as well as validation that the design agency's process was satisfied.
- Identify and document which references in the Requirements Traceability Matrix (RTM) were independently reviewed by OPG and the name of the individual. This can be done for the critical requirements, assumptions and calculations.

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- Develop and implement a process to manage the engineering open items that need to be addressed prior to ordering equipment, prior to assessing and CWP development and prior to field execution. Have this process be monitored through the weekly Project Schedule Review meeting and have the closure accepted by the Design Authority.
- Verification that the design is consistent with INPO/WANO important operating experience (SOERs and IERs). Designs that have such operating experience include EPG3, digital controllers, and intake cooling water. In addition, there are several SOERs that are of value for the operation, maintenance and monitoring of equipment both in the operating state and in lay-up during refurbishment. An efficient way to verify consistency with SOERs (both in terms of design modifications, operating and lay-up) is to review the Darlington station's response to the recommendations to ensure that they are still valid during the refurbishment of the unit, and if not take specific actions to meet the recommendations. For the INPO operating experience and recommendations on digital controllers, a review of the documents will need to be performed with a response to how the recommendations are met.

**Ready to Execute Unit 2 Refurbishment Outage**

Once a reliable RQE estimate is submitted and accepted, the next critical step is to demonstrate that the organization is ready to execute the refurbishment of Unit 2. Refurbishment management has developed a Ready to Execute (RTE) Plan to have specific processes, infrastructures and organizations in place and validate for effectiveness prior to Unit 2 Breaker Open (start of the Unit 2 refurbishment outage). One important element to demonstrate readiness is the understanding and addressing of the lessons learned that plagued the Campus Plan and SIO projects. During more than thirty months of observations, a number of such lessons learned have been, and continue to be, identified by the Independent Oversight Advisor. In addition, the Vice President of Execution has requested that the refurbishment execution organization conduct a formal lessons learned review of the four projects that have had issues related to engineering, schedule, cost and quality (EPG3, D<sub>2</sub>O Storage, CFVS and AHS). These lessons learned can be divided into three general categories – preparations, execution and organizational effectiveness.

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**Lessons Learned Associated with Preparations**

Lesson Learned	Risk to Refurbishment	Refurbishment Action	Refurbishment Validation	Notes and Status
Poor quality of cost estimates contributes in exceeding estimates, requesting additional funds and uncertainty in the estimate at completion.	Low	The RQE process is designed to provide a reliable cost estimate and contingency funds for each project bundle and function.	The cost estimate and contingency for each project bundle and function is presented to and challenged by senior OPG management as part of the RQE process.	The RQE is still being finalized. There is increasing confidence that the final RQE cost estimate will represent a bounding estimate.
Poor quality of schedules contributes uncertainty in milestones, poor compliance with initial milestones, extended durations and uncertainty in available for service dates.	Low	The RQE process is designed to provide a reliable base schedule and contingency duration for both critical path and system windows.	The location of the project bundle window and its duration are presented to and challenged by senior OPG management as part of the RQE process.	The RQE is still being finalized. There is increasing confidence that the final RQE will provide both a reliable base duration and appropriate contingency for all four units. In addition, the detailed schedule is being developed in order to show the location and duration for each project bundle window and other activities required for the refurbishment outage.
Engineering was not completed prior to start of the project and in some cases quality issues contributed to construction issues and rework (both engineering and construction).	Medium	The refurbishment project had an engineering complete milestone of August 15, 2015.	Through a weekly review meeting, engineering was sufficiently complete for OPG to declare the milestone was met.	OPG declared the engineering complete milestone complete with 45 (17% of) engineering packages approved to be completed after the milestone. Some of these are associated with prerequisite projects (Breathing Air). There is the risk that this engineering will not be complete prior to the scheduled start of construction. In addition, CP and SIO had some construction delays and rework resulting from open engineering items and engineering quality problems.
Some problems with timely procurement of the correct parts and materials have contributed to schedule delays and cost increases.	Medium	Refurbishment has established and initiated a process to track the status of the procurement of parts and materials by vendors. It is to be implemented for Campus Plan and SIO projects.	This is currently monitored at the weekly Project Schedule Review Meeting. The scorecard has been identified and data is being collected.	Currently there are several sharp waterfalls in the work down curves and not all information has been included. There is a scorecard for the projects in the test period, providing good visibility.
The timely completion and the quality of some Comprehensive Work Packages and assessing have	Medium	Refurbishment has provided guidelines to vendors on CWP content	Refurbishment has established a Look Ahead team and	The Look Ahead process and team are important to ensure that all preparations are

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Lesson Learned	Risk to Refurbishment	Refurbishment Action	Refurbishment Validation	Notes and Status
contributed to schedule delays, quality of field execution, including rework and cost increases.		and provides collaborative support.	process to validate that CWPs, assessing and materials are sufficiently in place to start the work as scheduled. This process and the CWP process will be assessed during the test period.	complete prior to the execution of work. This will need to be effective for a successful refurbishment.
P&M has had problems with integrating its work through the station's on-line work management process, resulting in some delays in having work placed on the station schedule. This impacts the duration and cost of the impacted project.	Low	The mitigation of P&M work management issues has been the use of refurbishment work management, operations and maintenance personnel to support meeting station requirements. In addition, there is limited work during the refurbishment outage that needs to be coordinated through the on-line process.	Coordination through the station process on-line work management process will be assessed during the RTE test period.	Most of the work will not need integration with the schedule station. There will be work requiring integration at the beginning of the outage and return to service. This integration will be required during the prerequisite projects and assessed during the RTE rest period.

**Lessons Learned Associated with Execution**

Lesson Learned	Risk to Refurbishment	Refurbishment Action	Refurbishment Validation	Notes
There are a number of OPG processes which are required to be used by the ESMSA contractors, but have not been fully and effectively implemented. These include work management processes, work protection, work authorization, event free challenge process, lifting and rigging, and Foreign Material Exclusion.	Medium	Refurbishment has identified 14 processes for which vendors will use the OPG process. That confirms consistency in programs, but not their effective implementation.	Some of the processes will be used on the projects for the RTE test period. Some will have to be validated through tabletop exercises.	Having a set of common processes to be used by all contractors will ensure common standards, expectations, and procedures. It will not ensure consistent compliance to them. The effectiveness of their rollout and compliance will be assessed during the RTE test period.

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Lesson Learned	Risk to Refurbishment	Refurbishment Action	Refurbishment Validation	Notes
The inability to effectively and efficiently address engineering issues during field construction has contributed to rework, schedule extensions and cost increases. The turnaround time for vendor engineering to address a field issue was frequently a week or more.	High		Performance of field engineering can be assessed during the RTE test period.	This is a lesson learned added in this quarter's report. It is a challenge acknowledged by the VP of Engineering. However the strategy to address it has not been clearly established and documented.
Several Campus Plan and SIO projects have had similar issues and problems, such as daylighting, dewatering, removal of contaminated soil, management of associated totes and unconditional release of materials. In general, rather than identify a lead organization or company for the management of such common processes, each project was left to its own to resolve the issues. This resulted in some delays, conflicts among contractors and likely some increase in costs.	Medium	Refurbishment management recognizes that there are processes that can have reduced cost and improved efficiency/effectiveness if one organization takes the lead. The opportunities need to be identified and a process implemented.	Some will be validated during the RTE test period. Others may be validated through tabletop exercises.	The strategy for common processes has not been clearly established. This will likely be included in the Construction Execution Strategy. This should also be included in the documentation for Division of Responsibilities.
The P&M's Project Control Centre (PCC) and Plan of the day Meeting (POD) meeting was not effective at meeting the objective of driving the Campus Plan and SIO projects to maintain schedule, to coordinate among projects, to prioritize issues and resources and to identify and resolve issues before they impact field execution. The meeting did improve during first two quarters of 2015.	Medium	The concept of a PCC has been accepted by refurbishment management. However, the details have not been finalized. The structure of a daily schedule review meeting (POD) has not been developed.	The effectiveness of the PCC and POD equivalent meeting will be assessed during the RTE test period.	The RTE plan has identified the use of a PCC and daily schedule reviews during the RTE test period.
There are common services that will need to be shared among the various project bundles and the station in a coordinated manner to ensure there is no impact on critical path, the ability to meet the service requirements and station targets. Examples include Active Liquid Waste (ALW), Breathing Air, Service Air, Temporary Power, Cranes (including Turbine Cranes) and storage locations within the station.	Medium	Refurbishment management has recognized the need to identify the need, capacity and coordination for most common services through the identification of a Single Point of Contact (SPOC). It is unclear if there is an identified SPOC for ALW and cranes.	There is likely limited opportunity during the RTE test period to validate the process. There will need to be a combination of field testing and tabletop testing.	Strategy and responsibilities have been developed for some (such as Breathing Air), but not as clearly defined for others (such as ALW). This needs to be clearly documented for all prior to the Unit 2 Breaker Open.
The P&M organization has not been effective at managing the ESMSA vendors in consistently meeting the	Medium	Refurbishment management has hired a consulting company	Initial validation will be assessed during the RTE test period.	It is important that refurbishment management demonstrates good



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Lesson Learned	Risk to Refurbishment	Refurbishment Action	Refurbishment Validation	Notes
high performance standards required for meeting safety, quality, cost and schedule goals.		(Kiewit) to support management of field execution and develop the capability within OPG.		performance in the management of contractor performance before the start of the Unit 2 refurbishment outage to provide the confidence that the contractors will perform to the required standards (safety, quality, schedule and cost).
The ESMSA contractors have had issues with the performance of subcontractors in the engineering, procurement and field execution associated with the Campus Plan and SIO projects. Issues have included the delivery of engineering products in a timely manner, engineering quality problems, timely delivery of parts, some quality issues related to parts manufacture, field execution rework and safety performance.	Medium	Refurbishment management has hired a consulting company (Kiewit) to support management of field execution and develop the capability within OPG.	Initial validation will be assessed during the RTE test period.	It is important that refurbishment management demonstrates good performance in the management of subcontractor performance before the start of the Unit 2 refurbishment outage to provide the confidence that that contractors will perform to the required standards (safety, quality, schedule and cost).
Campus Plan and SIO projects have not consistently been successful at having clean declarations of the completion of projects and acceptance of the Availability for Service by the station. This has contributed to missed milestones and some increased costs.	Medium	Refurbishment has developed a construction complete declaration (CCD) process and will follow OPG's Available for Service (AFS) process.	The effectiveness can be assessed during the RTE test period.	The effectiveness of the CCD and AFS processes will be monitored through the RTE test period and remaining prerequisite projects.

**Lessons Learned Associated with Organizational Effectiveness**

Lesson Learned	Risk to Refurbishment	Refurbishment Action	Refurbishment Validation	Notes
The Campus Plan and SIO projects have had problems with the correct number and capability of resources within the P&M organization to provide sufficient oversight and support to the contractors to have successful projects (where success is defined by safe, quality execution of projects on schedule and within budget).	Medium	Refurbishment senior management has identified as maintaining the leadership capability through the life of the project as a risk.		Management has identified construction execution management and oversight as a capability weakness and as a result has engaged Kiewit in a contract to provide support. The use of this contractor is under development. A review of capability of the other functions should be reviewed to ensure adequacy. Also the succession plan should be reviewed to ensure the project will be effectively staffed and

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Lesson Learned	Risk to Refurbishment	Refurbishment Action	Refurbishment Validation	Notes
				led through its life.
There have been events during field construction of Campus Plan and SIO projects resulting in the stoppage of work. These have normally been associated with safety or environmental incidents. Normally, once the stop work has been issued, the P&M organization has struggled to identify what specific actions are required to be performed prior to restarting the work.	Medium	Refurbishment has established a draft Work Stop/Start procedure to support timely resolution of stop work issues.	Validation will be made through a combination of tabletop exercises and actual stop work issues during the RTE test period.	The current version of the Start/Start procedure is not likely sufficient to cover likely scenario areas and be accepted by the station. This will be monitored through the tabletop validation exercises. The Division of Responsibility document may assist in this issue.
During refurbishment project there will be a number of technical decisions that will need to be made as a result of equipment inspections and/or equipment not meeting the desired performance level.	Medium			This is a recently identified lesson learned. The response to this OPG identified issue will be monitored for effectiveness. The Engineering Decision Making process is the default process to address this issue.
A common weakness in previous refurbishment projects as well as the Campus Plan and SIO projects is not identifying and addressing adverse performance trends prior to becoming a significant issue. This frequently results in safety and quality issues that result in schedule delays and cost overruns.	High	Refurbishment believes that this is addressed through the use of a contrarian at meetings, the formalization of the Event Free Challenge Meeting and the Change Control process. In addition, operational tools (Engineering Decision Making (EDM) and Operational Decision Making (ODM)) are available to the project.		If the adverse performance trend is identified, the current EDM and ODM processes would provide the correct challenges if used. However, the challenge is to identify the adverse trend sufficiently early so that it can be addressed prior to becoming an issue. This is a cultural characteristic and should be assessed through the first half of 2016. One test is the extent to which the organization develops a response plan for identified issues that it considers low probability and high consequence.
The current oversight model focuses on the individual projects. Although this provides good vertical oversight it does not provide senior management with the horizontal look to identify cross-cutting programmatic issues.	Medium	There is a plan to provide a quarterly report to the executive on the most significant cross-cutting issues for the project.	Validation of the new process and report is included as an activity in the RTE plan.	The plan to identify cross cutting issues is recently developed. Its implementation and response by the executive team will be monitored through the RTE test period.
With the changes being made to support a successful refurbishment project, there is the potential for divergence in the standards,	Medium	This is recognized by OPG and meetings on alignment have been initiated.		The implementation of alignment will be assessed through the Q4, with emphasis on impacts to contractors.



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Lesson Learned	Risk to Refurbishment	Refurbishment Action	Refurbishment Validation	Notes
expectations, processes and field oversight between the Refurbishment and P&M organizations. Since both organizations are using the same contractors and workers, this leads to the potential for human performance errors resulting from confusion among workers and supervisors.				
Although there is a set of principles on the state of the unit as received from and returned to the station, there are a number of areas in which alignment is required between the project and station.	Medium			There are examples of good alignment, such as the initiative to improve fuel handling equipment reliability and commission defueling tools on station equipment. There are also areas of potential misalignment, such as the detailed condition of the unit when returned back to the station. The project's challenge is to identify the areas needing alignment and then obtain it.
A mega project such as the refurbishment of the Darlington units involves a large number of project and functional groups within the refurbishment organization, several vendors (primary and subcontractors), the station and organizations within the nuclear fleet and corporate organization. The challenge is to ensure that the required responsibilities and activities are completed with minimal duplication.	Medium	Refurbishment management has initiated a Division of Responsibilities to document all organizations that can impact refurbishment work and the associated activities.		This is a good initiative. Ideally it would have been completed as an input into RQE. Although it will not meet this timeline, sufficient work has been done to identify gaps and ensure the associated funding is included in RQE. It is to be completed by the end of the year, at which time components can be validated during the RTE test period.

**Ready to Execute Plan**

A key element of demonstrating that the refurbishment organization has the organization, processes, infrastructure, and facilities (the total of which is the capability) to execute the Unit 2 refurbishment outage is the validation of its capability through a combination of a test period and other methods (including tabletop exercises and independent reviews). This is recognized by senior refurbishment management and the associated activities are identified in the Readiness to Execute (RTE) plan. This plan represents a significant, but necessary, amount of work. The organization will be challenged to complete this work with the necessary quality to provide the desired

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confidence. Although not resource loaded, the RTE activities are captured in a schedule. Milestone sheets are in the process of being completed.

The RTE plan includes a test period of 4.5 months (February – mid June, 2016). During this period a number of prerequisites projects can be used to assess the effectiveness of a number of the processes, the infrastructure and the execution organization. The projects currently scheduled to have field work performed during the test period include the RWPB, non-contaminated shops and work areas, work control area, service air, unit islanding associated isolations, some Vault Vapour Recovery System work, Negative Pressure Containment work, some fire protection work, radiation protection teledosimetry system, and decontamination shops. Although the test period will not involve all the vendors, combined with tabletop exercises and procedure reviews, it will provide sufficient validation of the processes, infrastructure and organization to assess the readiness of OPG to execute the refurbishment of Unit 2.

Conclusion

Although the Ready to Execute Plan has the right planning and execution elements, by itself it does not provide confidence in the organization's capability to perform the refurbishment project. The confidence is gained by its successful execution and validation of the processes, infrastructure and organization through the test period, tabletop exercises and independent reviews. In addition, the organizational effectiveness lessons learned are not likely to be tested during the test period. To support a high level of confidence that the refurbishment organization is ready to execute prior to Breaker Open, the following actions may be considered:

- Define success for the RTE Plan and test period.
- Identify which elements of the RTE Plan address lessons learned from Campus Plan, SIO and other nuclear projects. If there is a gap, create an action to address it or a basis for no action.
- Identify the elements of the RTE that will be validated through the test period and those that require another form of validation. Identify the method of validation (such as tabletop exercise and independent review) for each element not included in the test period.
- Verify that there are actions and validations to address the organizational effectiveness lessons learned.

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**6. Status of Individual Projects**

The Darlington Refurbishment Program consists of seven individual projects and a number of infrastructure projects (also called Campus Plan) and Safety Improvement Opportunity projects:

- Re-tube and Feeder Replacement (RFR)
- Fuel Handling/Defueling (FH)
- Turbine Generator and Controls (TG)
- Steam Generator and Auxiliary Systems (SG)
- Balance of Plant (BOP)
- Islanding
- Shutdown, Layup and Services

The status of Campus Plan and Safety Improvement Opportunity projects is provided in the relevant section of the scorecard.

**6.1 Re-tube and Feeder Replacement Project**

The Re-tube and Feeder Replacement (RFR) project represents the largest scope and cost component of the Darlington Refurbishment Project. The RFR project will define the project's critical path and thus duration. As demonstrated by the schedule delays, cost overruns and performance issues in previous CANDU refurbishment projects, the RFR project also represents the largest risk to the project being completed on schedule and on cost. The RFR project consists of the removal and replacement of 480 pressure tubes, 480 calandria tubes, 960 end fittings and 960 feeder pipes for each of the Darlington four units. This requires the development, testing, manufacturing and maintenance of specialized tooling; the generation and verification of specialized procedures; and the training of the staff that will perform the field work. The project also includes the construction of a realistic reactor mock-up for the purposes of tooling testing, procedure verification and staff training.

The Q3 focus areas and status for the RFR project were:

- As stated in the RQE challenge, the Class 2 estimate was submitted by the Joint Venture (JV) on August 31 and was used in the RFR estimate for RQE.

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- With the submission of the Class 2 estimate, the JV and OPG are completing negotiations to obtain the target price. There are three items to resolve for agreement on the target cost.
  - There is a fair gap in the value of contingency to be provided to the JV to manage their risks. This gap needs to be closed for RQE submission to the OPG Board to provide the confidence in the RQE.
  - There is a desire by the JV to have the assumptions that were agreed upon during the development of the Class 2 estimate formalized so they will not be changed in the future by OPG. This should not be an issue to address prior to RQE submission to the Board.
  - The Contract Amendment needs to be completed. This is mostly wording, with one item with monetary impact that needs agreement – the JV plan during periods that it is not working on RFR critical path activities.
- The Re-tube Waste Process Building (RWPB) estimate (cost, schedule and contingency) is in progress and the 'war room' process used for the Class 2 estimate has been established. This estimate should be completed by the end of October.
- The installation of the caissons for the RWPB is behind schedule. The JV has revised its schedule to bring the ground slab forward, removing caisson installation from critical path.
- As compared with other projects, the JV works relatively in isolation on the RWPB. As a result, the operating experience from this project is not shared in a timely manner with Projects & Modifications, the station and overall refurbishment organization. This was reported at the latest RFR Steering Committee meeting. An SCR was not initiated to communicate the lessons learned.
- Production tooling is entering the acceptance test phase with deliveries predominantly in 2015.
- Procurement of major reactor components and goods has had a schedule slippage, challenging the June 2016 milestone. Mitigating actions include the creation of a dashboard that highlights the risk for each component and the establishment of an OPG/JV 'war room' to resolve issues in a timely manner.

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**6.2 Fuel Handling/Defueling Project**

This project consists of two main subprojects – the defueling of the reactor to start the outage and the refurbishment of the fuel handling equipment and associated systems.

The defueling of the reactor represents the first critical path activity for the project. It is currently estimated that the duration for defueling the reactor will be 113 days. This duration is based on a project report that makes a number of assumptions for success. Key assumptions and their status include:

- The defueling will be conducted by station fuel handling operators around the clock, 7 days a week. The organization is currently obtaining sufficient qualified individuals to perform this work.
- The reliability of fuel handling equipment will be improved to support defueling with limited breakdown maintenance required. As of the end of Q3, the health of all fuel handling systems is either good (White) or excellent (Green). The Equipment Reliability Index at the end of Q3 was 81 against a target of 76. If the station executes the plan to sustain the equipment, it will be in a good position for high reliability during the defueling of Unit 2.
- Testing and commissioning of tooling will be performed on available station equipment. This was successfully accomplished on both the Pressure Test Facility (PTF) and the Service Area Rehearsal Facility (SARF). This supports the declaration of the tooling in Q1 2016.
- The engineering for the supporting software (OpData) was completed during this past quarter.
- Sufficient maintenance resources to implement the current Preventive Maintenance Program and schedule for major overhauls, as well as support the defueling window. This has been identified as an at risk component of the plan.

The project has a Fuel Handling Defueling Readiness Plan that integrates the fuel handling equipment reliability improvement work with the work required to directly support the defueling of the reactor.

The success of this project requires the on-going coordination of work by the vendor (GEH-C), the refurbishment project team and the station. This coordination continued to be very good during the third quarter.

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**6.3 Turbine/ Generator Project**

The scope of the Turbine/Generator includes:

- Steam Turbines and Turbine Auxiliaries: inspections, repairs, and/or replacements of High Pressure (HP) and Low Pressure (LP) turbine components and a number of turbine auxiliaries;
- Generator and Generator Auxiliaries: inspections, repairs, and/or replacements of generator components (including generator stator rewind) and a number of generator auxiliaries,
- Moisture Separator Reheater (MSR): inspection, overhaul, and/or replacements of MSR internals and auxiliaries (e.g. strainers, valves);
- Turbine Control Upgrade: replacement of the obsolete analogue Steam Turbine Electronic Control (STEC) System, includes entire Turbine Supervisory System with new digital system; and
- Generator Excitation Upgrade: replacement of the analog Generator Excitation system controls with a digital design and a set of additional Generator Excitation and Protection equipment to resolve obsolescence issues.

A contract was awarded to Alstom for the design and delivery of the digital controllers as well as technical support during the execution of the project. The design work by Alstom is complete. It is noted that the digital controllers are not being included in unit 2's refurbishment outage. In addition, Alstom accomplished the following in Q3:

- TSSA pressure boundary registration is in progress.
- The strategy for the deferral of Unit 2's digital controllers was finalized.

The TG engineering integration and field installation vendor (SNC/Aecon Joint Venture (JV)) had the following accomplishments in this quarter:

- Completion of design engineering.
- All CWP's for the Unit 2 outage have been submitted to OPG for review.
- The Unit 2 Class 2 cost estimate and a level 5 schedule for field execution have been accepted by OPG.
- The Class 3 estimate and Level 4 schedule for the remaining units have been accepted.

This project is unique in that it includes one company (Alstom) providing the design and manufacture of equipment and technical expertise during the actual TG refurbishment



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and modifications, and one company (the Joint Venture) providing the interface engineering and the construction. This unique model requires increased oversight and integration by OPG and the project's senior management oversight committee, since the two companies are not fully integrated for the project.

There are 2 noteworthy risks for this project:

- Weaknesses in the replacement of analog controllers with digital controllers have resulted in several events in the industry both during commissioning and normal operation. This was the reason for OPG senior management to defer the introduction of digital controllers until the second unit's refurbishment, and back fit Unit 2 at a future outage. Although there is the opportunity to validate the design through the use of a simulator, it is not clear that these events (provided in INPO operating experience reports) have been studied during the design of the controllers and their integration with Darlington systems. Refurbishment senior management recognizes the risks associated with the commissioning of digital controllers and return to service, and has increased the contingency funds for the associated risk.
- Maintenance on the turbine, generator and stator systems is considered high Foreign Material Exclusion risk both because of the potential consequences of foreign material in the system when operating and the difficulty to retrieve foreign material, particularly in the generator and stator. OPG refurbishment will need to review these work plans for industry standards in the prevention of foreign material intrusion.

#### **6.4 Steam Generators**

The Steam Generator project consists of a series of modification and maintenance activities to fulfill the requirements of its Life Cycle Management Plan. The Engineer Procure Construct (EPC) contract has been awarded to a consortium of Babcock & Wilcox Canada and Candu Energy Inc. The project includes:

- Tube sheet waterlancing to address possible degradation from sludge accumulation. The DACVR meeting for Design Authority approval of the detailed design was successfully completed on March 10.
- Installation of access ports to improve secondary side inspection capabilities for future inspection outages. An enhanced COMS (constructability, operability, maintainability, safety) meeting was held on February 25, with no additional requirements specified.
- Primary side tube cleaning to improve overall thermal efficiency, increase neutron overpower margin and reduce radiation fields.
- Divider plate leakage characterization to establish a baseline for cross flow between the cold and hot legs of the SGs

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- Primary and secondary side ultrasonic, eddy current and visual inspections. These will be performed by the OPG Inspection, Maintenance Service organization.

The following accomplishments were achieved during this past quarter:

- The 4-unit cost estimate and Unit 2 detailed schedule have been accepted by OPG.
- The vendor's Quality Assurance program is being aligned to agree with the requirements specified in the Purchase Order.
- The draft transportation analysis has been submitted to OPG.

With exception of installation of the access ports, the activities associated with this project are services performed during routine planned outages. There are two noteworthy risks that exist for this project:

- The tooling that is used for the waterlancing and primary side cleaning represent tooling entering systems that are required to be free of foreign material. Although designed to be fully intact, there is always the risk that a component may become loose and enter the primary side or secondary system. This would result in the need to develop and execute a recovery plan.
- The installation of 7 access ports into each steam generator represents cutting into a containment boundary. Although the contractor has successfully performed this installation at other plants, any time a containment boundary is modified is considered a risk.

## **6.5 Balance of Plant Project**

The Balance of Plant (BOP) scope consists of plant modifications and maintenance work in the following areas:

- Pre-refurbishment work
- Safety and Control Systems
- Reactor component systems
- Conventional Systems
- Common Systems

During the third quarter, the project worked closely with contractors to develop and submit the cost estimates, schedules and risk profiles needed to support OPG's RQE. Because of the delay in establishing the project contracts, the cost estimate and associated schedule were of less quality than for the other projects. However, OPG is confident that they are conservative, and will not be exceeded.



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Although not currently a risk, operating experience has indicated that Balance of Plant work can become the critical path to restarting the unit if not effectively scheduled and managed. One action taken by refurbishment management to reduce this potential is to not have work scheduled after the critical path is 60% completed. Exceptions would be limited to work that can only be done in the conditions that are provided after 60% completion. Additionally, Refurbishment Execution will perform an additional detailed review of the BOP work to verify that there are robust plans in place to complete the work without effecting critical path.

**6.6 Station Readiness Projects**

There are a number of core refurbishment projects that are critical to support the refurbishment of the unit, but do not provide refurbishment of equipment. These are:

- Islanding projects. These projects are required to establish the physical and administrative separation of the refurbished unit from the operating plant, as well as separate a number of common areas for the duration of the refurbishment outage.
- Shutdown/Layup projects. These projects are in place to shutdown and layup individual systems at different stages and for different durations through the unit's refurbishment outage. This is required to protect the systems against corrosion and other damage mechanisms when not in normal operation.
- Services projects. These projects provide the needed services to support the unit's refurbishment outage. Such services include electrical, breathing air, service air, instrument air, and water.

In general, the Islanding projects are making use of the other contracts that align with its work in the same or adjacent area. For example, the EPC contract for the installation and removal of the bulkheads has been awarded to the R&FR Joint Venture (JV). This is a sound decision since the JV has the most to gain from the timely installation of the bulkheads, there is elimination of coordination issues in the vault, and the required capabilities for the two projects are similar.

The strategy for the Shutdown/Layup and Services projects is the same as for the BOP projects (use of the ESMSA contractors). These projects are also using the same ESMSA contractor as selected for several of the Balance of Plant projects. As a result, the engineering strategy and weekly meetings described for the Balance of Plant also exist for these projects.

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**7. Oversight of the Darlington Refurbishment Program**

Both OPG and the Ministry of Energy (MOE) understand the need for a successful refurbishment for the Province, the company and the industry. In line with that importance, the Minister of Energy established the role of independent advisor and OPG established the role of an external independent oversight team reporting to the OPG Board. This team consists of individuals from the companies Burns & McDonnell and Modus.

The OPG external independent oversight team issued its Q3, 2015 at the August Darlington Refurbishment Committee meeting. The focus of the report was the refurbishment team's preparation of the Release Quality Estimate. The following observations were identified in the report:

- The independent oversight team expressed concern that the RQE results may not be totally vetted as a result of revising the milestone for submission to the OPG Board from November 15 to October 15. Since the issuance of this report, the decision to revert back to the original milestone was made.
- The report expressed that a risk should be generated to incorporate the experience of the Campus Plan and SIO projects – that the definition of 'design complete' needs to include the vendor/supplier procurement information. This is aligned with the IOA's engineering challenge as related to ineffective management of open engineering items.
- The report expressed concern for the submission of the JV's Class 2 estimate. This was submission after the issuance of the report. However, the remaining risk is agreement of contingency funds given to the JV and completion of the contract amendment for an acceptable target price prior to submission of RQE to the OPG Board.
- The independent oversight team identifies the need for the functions to right-size, define roles and responsibilities and finalize the refurbishment assumptions as part of the Unit 2 check estimate.
- The report states that the process for the development of contingency is strong, but expressed concern that the compressed schedule (when the submission milestone was mid October, versus the current milestone of mid November) will result in a challenge to the proper formation of contingency.
- The independent oversight team expressed its on-going concern with the Campus Plan and SIO projects – specifically the D<sub>2</sub>O Storage Building, the Auxiliary Heating System and the 3<sup>rd</sup> EPG.

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These observations are similar to those made by the Independent Oversight Advisor (IOA). Two challenges identified by the IOA have not been mentioned by the OPG independent oversight team. The risk associated with quality of design engineering deliverables by design agencies has been a common theme within these reports. The refurbishment VP of Engineering held an engineering stand down in response to an increase in quality issues. The second challenge is related to the need for the refurbishment organization to demonstrate it is ready to execute prior to the start of Unit 2's Breaker Open.

**8. Alignment with the Principles of the Long Term Energy Plan**

The MOE's 2013 Long Term Energy Plan identified seven principles by which it expects OPG and Bruce Power to follow in the development and execution of their respective units. OPG performance to these principles is good, as can be seen through the review of this section. Changes from the previous quarter are minimal.

Principle 1: Minimize commercial risk on the part of ratepayers and government.

The majority of DNR contracts are fixed/firm price with the remaining tied to cost and schedule performance. Commercial individuals have been embedded on each project team to manage commercial risk. Project scope has been defined to the component level, and detailed engineering will be completed prior to the start of construction. OPG has invested in a reactor mock-up and training facility, to perform full testing of the tools, processes and procedures, as well as train staff prior to performing work on the actual reactors. The contract with SNC/Aecon includes provisions for OPG to take over the tooling and the mock-up at the conclusion of the Definition Phase if the parties are unable to negotiate the target price contract for the Execution Phase.

Incentives in the RFR contract were established on the basis of four unit performance, allowing the RFR contractor to make-up cost overruns and schedule delays to the first unit on subsequent units. However, the LTEP prioritizes the importance of a successful Unit 2 refurbishment. This will need to be included in the target price for the RFR and TG projects.

Principle 2: Mitigate reliability risks by developing contingency plans that include alternate supply options if contract and other objectives are at risk of non-fulfillment.

One contingency action contributing to this principle is the decision to start the second unit after unit 2, rather than overlapping the units. In addition, the effort to improve the reliability of fuel handling equipment reduces the chance that fueling of the operating units will be reduced during the defueling of the refurbishment unit.

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Principle 3: Entrench appropriate and realistic off-ramps and scoping.

Each contract has an off-ramp for termination. Reimbursement to contractors is limited to reasonably incurred costs. Each unit requires individual approval that provides well-defined off-ramps. The yearly release strategy and gating process for funding individual project initiatives has wide visibility and adherence within the DR Team. be done in drained/defueled state.

Principle 5: Require OPG to hold its contractors accountable to the nuclear refurbishment schedule and price.

Schedule accountability is built into each contract. The contractor is required to provide a detailed schedule for execution as an input into the Release Quality Estimate. Cost accountability is built into contracts to establish target cost and incentives/disincentives. Monthly project oversight meetings with OPG senior management and contractor senior management have improved oversight and contractor accountability. Quarterly CEO meetings reinforce this principle. OPG has chosen to perform the work in the Execution Phase on a target price basis which increases the contractors' transparency. This will enhance OPG's ability to resolve issues as they arise. This may result in OPG performing specific work rather than use a contractor. For example, agreement could not be reached with a supplier of radiation protection services, resulting in OPG deciding to perform the services itself.

Principle 6: Make site, project management, regulatory requirements and supply chain considerations, and cost and risk containment the primary factors in developing the implementation plan.

Regulatory requirements were a primary input to the defined scope of the refurbishment outage and life extension projects. There is high level agreement between the station and refurbishment on the condition that the unit will be turned over to the project and then returned to the station. The program is being managed in accordance with PM Institute standards and INPO project principles. The Release Quality Estimate process is using Association for Advanced Cost Engineering (AACE) best practices and is being monitored by KPMG. Risk management is recognized as a key element of success and the program is being well implemented.

One opportunity for improvement is the ability to identify and address adverse trends in performance in a timely and effective manner.

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Principle 7: Take smaller initial steps to ensure there is opportunity to incorporate lessons learned from refurbishment including collaboration by operators.

To fully incorporate lessons learned from the first unit's (Unit 2) refurbishment, the second unit's (Unit 1) start has been delayed until the completion of the first unit. If appropriate, other units may be able to be delayed to continue this risk reduction. However, this will likely result in an overall increase in cost. To reduce risk for the first unit, the decision was made to install its digital controller in a future outage. To prevent the risk associated with single source suppliers of key reactor components, OPG has qualified second vendors for key components. This will help Bruce Power with an associated materials risk.

Refurbishment management has recently incorporated several lessons learned from the Campus Plan and SIO projects into its Readiness to Execute Plan.

OPG and Bruce Power refurbishment management have met on three occasions to develop areas in which they can be mutually supportive. In addition, the engineering organizations have met to discuss opportunities to improve the efficiency and effectiveness of design engineering. The following are areas in which collaboration is being sought by senior management:

- a framework for collaboration
- Reviewing the significant work scope in each program
- Reviewing key performance and workplace challenges
- Reviewing planned trades work schedules
- Reviewing resource leveling strategies and likely high resource demand periods
- Reactor Defueling planning and tools
- Plans and Lessons Learned on systems layups and drying of systems that are drained
- Modifying field work controls on defueled units
- Lessons learned on transitioning into and out of Refurbishment
- Plans for completing Balance of Plant work without impacting critical path
- Performance of RFR tools and value of full mock-up of the reactor
- Close out issues and unit return to service challenges

## **9. State of Readiness**

The Nuclear Refurbishment program is fully into its Definition Phase to support the successful execution of Unit 2, starting in October 2016. There are several areas that provide confidence that the organization is on track for breaker open; including:

- Regulatory approvals have been received for the Environmental Assessment, Integrated Safety Review, and the Global Assessment Report. There has been

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agreement with the CNSC on the Integrated Improvement Plan, with written acceptance tied to the Darlington operating license renewal process, scheduled in 2015.

- Scope for life extension and the work required to be performed during the refurbishment outage are defined and approved. The life extension work that is not included in the refurbishment outage will be performed by Projects & Modifications and the station.
- OPG declared success in meeting the August 15, 2015 milestone for the completion of design engineering. Although there remains a challenge with potential quality issues and the large number of open items, there is sufficient time before breaker open to support downstream activities, such as order materials and generation of field execution instructions.
- The Release Quality Estimate is near completion, with the final reviews to be completed before the November 15<sup>th</sup> submission to the OPG Board. The RQE includes the cost estimate for the four units, the Level 1 plan for the four units and Level 3 detailed schedule for Unit 2, the refurbishment outage scope for each unit and the execution strategy.
- A number of products to support the RQE will define several key areas for success, such as scope and responsibilities of functional departments, assumptions on the support needed for each project and responsibilities for the transition of the unit between Darlington Operations organization and refurbishment organization.
- The assembly of the execution organization has started. Kiewitt has been selected to provide support in construction management and oversight.
- Contracts are in place for all projects to complete the engineering and develop the estimate (cost and schedule) required for the RQE.
- The Class 2 (revision 1) estimate for the Re-Tube and Feeder Replacement project has been accepted by OPG. Resolution of contingency funds to the JV and completion of the contract amendment are required prior to RQE submission
- The RFR full scale reactor mock-up has been valuable in the verification of tool designs and validation of Tooling Performance Guarantee (TPG) durations. Its value will increase during the refining of procedures for the reactor face series, and the training of re-tube face and feeder replacement personnel.

Although OPG is making good progress towards breaker open readiness, there are a number of issues that once resolved will increase the comfort level for the execution of the project. These include:



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- Probably the most significant need is for the refurbishment organization to demonstrate effective execution of field work in 2015 and 2016. During the third quarter the Readiness to Execute Plan has been refined. This is an excellent opportunity to identify needed improvements prior to the start of full execution at breaker open. The plan has 5 months to analyze performance and incorporate improvements prior to the October start of the full outage.
- Tied to execution is the fact some of the work is first time execution for the vendor, very infrequently performed or first of a kind. For example, this is the first time for the Joint Venture to execute a re-tube and feeder replacement, first time in a decade for B&W to clean the Darlington steam generators, first of a kind process for the handling and reduction of re-tube radioactive waste and some first of a kind turbine inspection at Darlington. Since refurbishments by their nature are infrequently performed, this is not a surprise. OPG has taken a number of actions to mitigate the associated risk – the most visible being the full-scale reactor mock-up. However, execution is significantly different than planning and the need for OPG to have effective oversight and the ability to identify and respond to degrading execution performance is emphasized.

OPG has the infrastructure and framework for execution of the outage. With the Ready to Execute Plan, the organization will monitor completion of prerequisite projects (including Campus Plan and SIO projects) and processes needed for the start of the Unit 2 outage, and test the processes, infrastructure, organization and oversight prior to the breaker open in order to implement desired improvements.

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# **Report to the Minister of Energy on the Oversight of the Darlington Refurbishment Program**

## **Transitioning from Definition Phase to Execution**



Mike White  
CALM Management Consulting, Inc.  
January 8, 2016



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## **1. Minister Summary**

Previous quarterly reports provided a detailed quarterly review of trends, accomplishments and challenges related to the Darlington Nuclear refurbishment project. With the completion of the Definition Phase at 2015 yearend, the focus of the refurbishment project has transitioned into execution of its Ready to Execute (RTE) Plan.

A number of achievements have been made through the Definition Phase of the project; including:

- The Release Quality Estimate for the refurbishment of the four Darlington units was prepared and approved by the OPG Board of Directors. This included the estimated cost (including contingency) and duration for the defined scope of work for the four units.
- The OPG contracting strategy was developed and implemented. This contracting strategy is designed to retain vendors best qualified to perform the work contracted to them, while appropriately transferring risk and minimizing risk premium. The key risks are associated with safety, quality, cost overruns and schedule extensions. Of the \$12.8B high confidence total cost estimate of the Darlington Refurbishment Project, \$5.3B (including the \$0.8B spent to date) has or is to be spent by contractors for the engineering, planning, procurement and field execution of the five core refurbishment project bundles.
- OPG declared success in meeting the August 15, 2015 milestone for the completion of design engineering. However, this was accomplished with a large number of outstanding items for resolution. As stated in previous reports, the process to accept design agency deliverables may not be sufficiently rigorous to ensure high quality products. This risk has been realized in a number of projects, most recently the STOP (Shield Tank Overpressure Protection) project. The design was incorrect in assumptions regarding the size of the pressure pulse when switching pumps. This resulted in the field installation during the Unit 3 fall outage not being acceptable, removed from service, and the unit returned to service without the modification installed. The response to this event should include a review of the extent of condition and cause.
- OPG has received the required regulatory approvals for the refurbishment of the four units. This includes approval of the Environmental Assessment, the Integrated Safety Review that includes Component Condition Reports and the Global Assessment, and the Integrated

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Implementation Plan (IIP) that identifies and schedules any modifications, new systems, repairs, refurbishment and further inspections to address gaps in the Integrated Safety Review. In addition, OPG received a ten year license for the continued operation and refurbishment activities of Darlington Nuclear plant. This is a positive reflection of the high level of performance by Darlington.

- The Level 1 Plan for the execution of Unit 2 has been completed and basis for outage duration in the RQE. The planned critical path duration for Unit 2 is 1084 days, with high-confidence duration of 1218 days.
- The generation of field instructions (Comprehensive Work Packages) is on schedule.
- Procurement of Long Lead Materials and Tooling is progressing well. This includes the production of major reactor components (feeder pipes, pressure tubes, calandria tubes and end fittings) and the manufacturing of Re-tube and Feeder Replacement tooling.
- Campus Plan and Safety Improvement Opportunity Projects are continuing with field construction. There have been on-going problems with a number of these projects in their cost and schedule estimates, design engineering, procurement of materials and field execution. For a successful refurbishment outage, management needs to ensure that the lessons learned from these projects are fully understood and effectively addressed.
- There are several functions that support the planning and execution of the projects. During the Definition Phase the programs associated with these functions were developed and the organization and infrastructure obtained.

With the completion of the Definition Phase, the refurbishment organization's focus is demonstration of its readiness to execute the Unit 2 outage. A Ready to Execute plan has been developed with the activities that need to be successfully completed to demonstrate its ability to effectively execute the outage. The plan includes the completion of Campus Plan, Safety Improvement and Prerequisite projects, as well the development and validation of processes, infrastructure and organizational capability required for outage execution. Validation of some processes will be done through their implementation during a four-month Pilot

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Test period. Processes that are not used during this period will require a combination of tabletop exercise challenges and challenge meetings.

## **2. Purpose of Report**

With the approval of the Release Quality Estimate (RQE) by the OPG Board of Directors, the refurbishment project is now focused on detailed preparations for Unit 2 execution in October, 2016. This report provides a review of the achievements associated with the Definition Phase and a status of, and the associated challenges with, the refurbishment organization's Ready to Execute (RTE) Plan. During the first three quarters of 2016, OPG will need to complete preparations to execute each core project, to complete several field projects and activities that are identified as prerequisites to the start of the Unit 2 outage and validate a large number of processes that will be used during refurbishment execution. The performance of these three paths to October will provide Refurbishment management, the OPG Board of Directors and the Ministry of Energy with a level of confidence in OPG's ability to execute the Unit 2 refurbishment outage safely, with quality, on schedule and within budget.

## **3. Completion of the Definition Phase**

From 2012 through to the end of 2015, OPG completed the Definition Phase of the project. The key deliverables associated with the Definition Phase included:

- Release Quality Estimate
- Development and Implementation of the Contracting Strategy
- Completion of Design Engineering
- Regulatory Approvals
- Unit 2 Level 1 Execution Schedule
- Comprehensive Work Packages

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- Procurement of Long Lead Materials and Tooling
- Campus Plan and Safety Improvement Opportunity Projects
- Development of Functional Programs and Capability

**3.1 Release Quality Estimate**

The Release Quality Estimate (RQE) represents a significant deliverable of the Definition Phase. It encompasses the scope of the refurbishment project, the cost estimate, the duration and the risks for all four units. Although the development of the RQE package (cost, duration, risks and scope) was generated during this year, the preparations required for a rigorous and credible product started in 2008, with the initial technical reviews of critical station components, systems, and equipment. These reviews provided input into the initial planning and scope development that was the basis of the 2009 initial feasibility estimate. Since 2010, OPG has focused on completion of the detailed scope, selection of contractors, engineering, estimating and planning. The RQE was approved by the OPG Board of Directors at its November 2015 meeting. The elements of the RQE are summarized below.

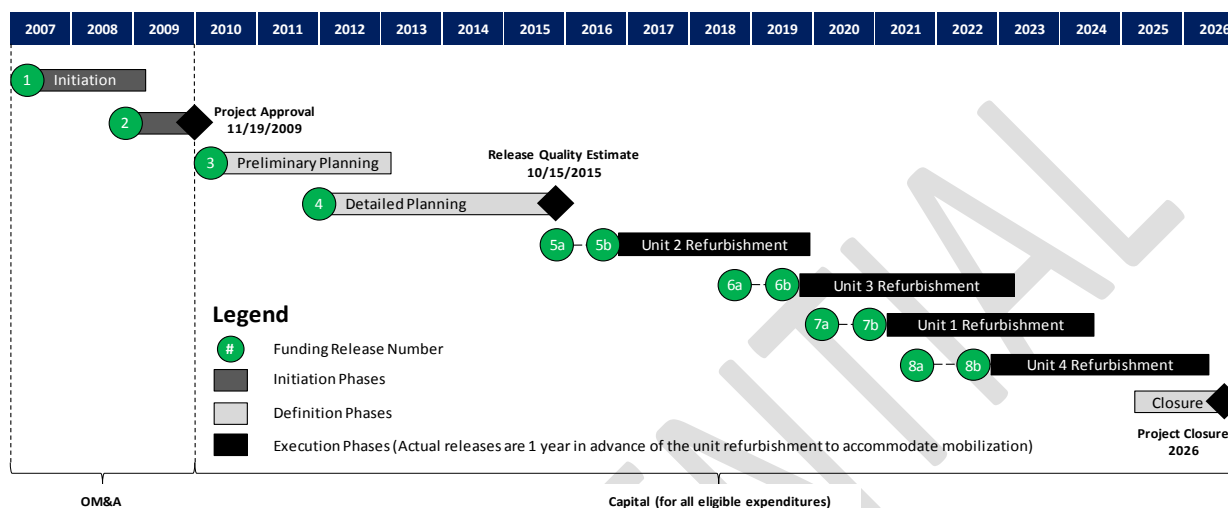
**Process:**

From the start of the refurbishment program, OPG was committed to have the RQE follow the Association for the Advancement of Cost Engineering International Recommended Practice (AACE IRP). This results in an estimate for cost (including contingency) and duration that has been based on sufficient planning and engineering to be considered reliable to a 90% confidence level (Class 3 estimate using the AACE classification terminology). The AACE-IRP is considered the best practice for the development of estimates for mega projects, such as the Darlington Refurbishment Project. Five cost estimate classes have been established by the AACE International to reflect the maturity of a project, starting with Class 5 for the feasibility of a project (representing 0% to 2% of project definition) to Class 1 for final check estimate (representing 70% to 100% of project definition). Class 3 represents the cost estimate that is appropriate for budget authorization and control.

The RQE includes the projected cash flow over the life of the four unit project and a funding release strategy that ensures a reconfirmation of the business case is undertaken at structured intervals prior to the release of the funds for the next unit. Funding for each unit is released in two parts; a planning phase release (12 to 18 months prior to the start of the unit outage) and an execution phase release (approximately 3 months prior to the start of the outage). This strategy is shown in the following diagram.

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OPG's due diligence included a third-party (KPMG) independent review of the RQE process to assess the extent to which the final RQE product followed AACE recommended practices. The audit report concluded that OPG demonstrated knowledge of the AACE guidelines and appropriately applied them to the Darlington Refurbishment Project (DRP). They noted particular strengths in the estimate classification system, historical knowledge of risks and opportunities, risk management framework and processes for conducting quality reviews of vendor estimates.

**Scope:**

The scope of the project has been defined since the fourth quarter of 2013 and is firm. The scope is based upon a well-established process that assessed the condition of equipment and components and identified the need for replacement, modification, repairs or maintenance. The scoping also assessed the optimum time for completion of each identified scope of work – during the refurbishment project or during normal station operations. The scope includes Safety Improvement Opportunity projects specified by the nuclear regulator (CNSC) and prerequisite projects for facilities and systems to support the efficiency and effectiveness of the refurbishment execution. As with any refurbishment project, and actually every outage for an operating unit, there will be some discovery work identified when equipment is disassembled. This is included in the contingency for the refurbishment program. The scope of the refurbishment project is outlined below:

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- Re-tube and Feeder Replacement (R&FR) is the largest individual project and includes the replacement of the major reactor components, the development and production of the tooling associated with this replacement, the associated procurement of replacement reactor components, the testing and procurement of new tooling for the replacement on a constructed reactor mock-up, and the management of the resulting waste.
- Turbine Generator includes a large amount of inspections and maintenance (mostly routine but also some that are first of a kind at Darlington) on the turbines, generator and auxiliaries. Digital controllers will replace the current obsolete analog ones during the refurbishment outages for Units 3, 1 and 4. These have deferred for Unit 2 to a future outage to reduce the risk for the first unit.
- Defueling project includes the production and commissioning of tooling required for the initial defueling of the reactor.
- Fuel Handling project will overhaul the systems and equipment associated with fuelling the reactor during its life extension.
- Steam Generator project will conduct comprehensive inspections of the steam generators, cleaning of internals to maintain high thermal efficiency and the addition of access ports to support future outages.
- Balance of Plant includes bulk work on valves, electrical systems, heat exchangers, as well as a number of specialized projects to replace important reactor support components.
- A number of prerequisite projects to support the shutdown and layup of the unit, separating the refurbishment unit from the operating units and support facilities for execution.
- Campus Plan projects that are buildings and infrastructure facilities to support the refurbishment program that are managed by OPG's Projects & Modifications organization.
- The Safety Improvement Opportunity projects that are commitments to the nuclear regulator (CNSC) that further enhance nuclear safety and are required for continued operation. They are also managed by OPG's Projects & Modifications organization.

**Outage Duration:**

As with other elements of RQE, the duration of the refurbishment for four units was developed with the application of techniques that are consistent with the AACE recommendations. The process involved the following steps that required close collaboration between OPG project managers and vendors, with independent review by RQE process experts and challenges by senior refurbishment management:

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- A detailed definition of each critical path task and its duration. The majority of critical path consists of defueling the reactor, preparing the vault for work, removal and installation of fuel channels (end fittings, pressure tubes and calandria tubes) removal and installation of feeders, and returning the reactor to service (fuelling the reactor, perform commissioning and conduct a series of test at various power levels).
- Sufficient development of the schedule for non-critical path projects in order to know their durations and their location in the overall schedule.
- Individual schedules for the Unit 2 outage for each project and sub-project.

The planned duration of the Unit 2 outage is 1,084 days, with high-confidence duration of 1,218 days. This compares well with the actual Wolsong 1 (W1) refurbishment outage actual duration, after adjustment for the difference in reactor size and scope of work

The high confidence duration of the four-unit refurbishment outage is 112 months. It is based on Unit 2's detailed schedule and high-level adjustments for the remaining units using AACE recommended practice. Given the operating assumption that each unit can operate to 235,000 Effective Full Power Hour (EFPH), the schedule for the four units has been developed to have no idle time on operating units (that is, each unit will start its refurbishment outage prior to reaching 235,000 EFPHs).

Risk Management:

From an RQE perspective, the result of the risk management program is the contingency fund and its basis. The risk management program and its implementation has been assessed on an ongoing basis by the Independent Oversight Advisor, the Burns and McDonnell/Modus team (independent oversight for the OPG Board) and included in the KPMG audit of the RQE process. In all cases the current assessment is that OPG's risk management is sound, rigorous and consistent with industry practice.

Conclusion:

Based upon observations of the RQE development process, the associated management oversight and the third party assessment, it is believed that the RQE is appropriate and provides confidence that the Darlington Refurbishment Project can be completed within OPG's cost and duration estimates. The contingency included in the project estimate is sound and developed on a basis of a rigorous risk management program.

3.2 Contracting Strategy

During the Definition Phase OPG established and implemented a contract strategy for the project. This contracting strategy is designed to retain vendors best qualified to



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perform the work contracted to them, while appropriately transferring risk and minimizing risk premium. The key risks are associated with safety, quality, cost overruns and schedule extensions. Of the \$12.8B high confidence total cost estimate of the Darlington Refurbishment Project, \$5.3B (including the \$0.8B spent to date) has or is to be spent by contractors for the engineering, planning, procurement and field execution of the five core refurbishment project bundles.

Given the unique nature and complexity of the program, operating experience of previous refurbishment projects, and contractor capability within Canada, OPG selected the multi-prime contractor strategy to balance cost, schedule, risk and quality. With this approach, OPG retains control over the management of overall program, while contracting out various specific scopes of work to contractors with expertise and resources to execute the work. In addition, OPG's contracting strategy is intended to fulfill the 2013 LTEP principles:

- Minimize commercial risk of ratepayers and government
- Mitigate reliable risks through contingency plans
- Entrenching appropriate and realistic off-ramps
- Hold contractors accountable to schedule and price
- Make site, project management, regulatory requirements, supply chain considerations and cost/risk containment the basis of the implementation plan.

The contracting strategy uses a combination of three contracting models for the five main refurbishment project bundles, summarized below:

<b>Contracting Model</b>	<b>Description</b>	<b>Advantages</b>	<b>Disadvantages</b>
Engineer-Procure-Construct (EPC)	Designers work under construction contractor; owner enters contract with single contractor.	Single point of accountability  Risk transfer to contractor	Higher cost due to risk transfer and resulting contingency carried by contractor
Extended Services Master Service Agreement	Time & Materials based EPC contracts directly awarded to preapproved contractors who earn a performance based fee	Develops expertise within a few contractors, while retaining the ability to perform secondary procurement competitions to ensure value for money.	Reduced supply base

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<b>Contracting Model</b>	<b>Description</b>	<b>Advantages</b>	<b>Disadvantages</b>
Engineering Service and Equipment Supply Agreement	High Quality Contractor (typically the OEM) focuses on their expertise, which is supplying equipment and engineering services, but not field execution which can be performed by a different contractor.	Benefit from engineering expertise of specific contractor	Increased handoffs if used in conjunction with separate EPC contractor.

The contracting strategy has been implemented using a combination of pricing strategies to optimize cost and risk transfer. A principle of pricing is that as risk is transferred to the contractor there is a corresponding increase in cost as a result of a higher risk premium and increased control of work by the owner. The pricing strategies used by OPG for the project bundles, in order of increasing risk transfer to the contractor, are “Cost + Mark-up”, “Target Price” (generally, with both cost and schedule incentives and disincentives) and Fixed Price. It is noted that within these categories of pricing models, the details of the pricing model were tailored for each contract and scope of work, to provide the most appropriate incentive/disincentive regime and risk transfer for the relevant scope of work. The relative complexity, size and uncertainty for each project bundle resulted in OPG’s selection of contracting strategy and pricing model. This is summarized below.

<b>Project Bundle</b>	<b>Description</b>	<b>Complexity</b>	<b>Size</b>	<b>Uncertainty</b>	<b>Contract Model</b>	<b>Pricing Model</b>
RFR Bundle 1	1. Definition Phase work  2. Removal and replace 480 fuel channels and 960 feeder pipes	High	High	High	EPC	Target price
RFR Bundle 2	1. Construction of mock-up facility  2. Design and production of tooling	Medium	High	Low	EPC	Fixed Price
RFR Bundle 3	Procurement of owner supplied materials (reactor components) and other goods	Medium	Medium	Low	EPC	Cost + Mark-up

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<b>Project Bundle</b>	<b>Description</b>	<b>Complexity</b>	<b>Size</b>	<b>Uncertainty</b>	<b>Contract Model</b>	<b>Pricing Model</b>
TG Bundle 1	1. Field execution for inspections, repairs and retrofits of hardware and hydraulics  2. Installation of digital controllers	Medium	Medium	Low	EPC	Target Price
TG Bundle 2	Engineering support and supply of equipment	Low	Medium	Low	ESESA	Fixed Price
SG	Inspections and maintenance work	Low	Low	Low	EPC	Fixed Price
FH	1. Defueling of reactor core  2. Refurbishment of fuel handling equipment	Medium	Medium	Medium	ESESA, ESMSA, Self Perform, EPC	Fixed Price
BOP	Various equipment repair and replacement and system upgrades	Medium	High	Medium	ESMSA	Target Price (cost plus performance fee at risk)

The distribution of the contract breakdown is:

- Target Price 53%
- Cost + Mark-up 33%
- Fixed Price 14%

The Target Price model provides value for money for the contracts where risk is shared between owner and contractor. In this case OPG and the contractor agree on a Target Price (excluding profit, risk and overhead) and Target Schedule. A Fixed Fee is agreed upon to compensate for profit, risk and overhead. The Target Cost and Schedule are the basis for the incentive/disincentive program. In the establishment of the Target Cost, 'allowed costs' and 'disallowed costs' are mutually established. Disallowed costs are not paid by OPG. If the total allowed costs paid are outside a neutral band, incentives/disincentives are incurred. Similarly, schedule incentives/disincentives are paid if the work is completed before or after the Target Schedule.

If disincentives are payable, they reduce the Fixed Fee. A significant portion of the Fixed Fee is at risk if the maximum disincentive is reached – to the point that the contractor will lose part of its overhead. In addition, because it is a Target Price model, the contractor does not earn overheads on costs beyond the Target Cost.

As part of OPG's due diligence, Concentric Energy Advisors Inc. was retained in 2011 to provide an independent review of the commercial and contracting strategies for the five refurbishment core project bundles in terms of reasonableness and prudence. The five resulting reports (issued in late 2013 and early 2014) concluded that each commercial strategy is appropriate, reasonable and prudent, given specific caveats.

Conclusion:

Based upon observations of current contractor performance, contract development, risk transfer through the RQE process and the conclusions of the independent review of the commercial and contracting strategy, it is concluded that OPG's contracting strategy is aligned with the Ministry of Energy's 2013 LTEP principles; specifically, minimize commercial risk on part of ratepayers and government (Principle 1), require OPG to hold its contractors accountable to the nuclear refurbishment schedule and price (Principle 5) and make site, project management, regulatory requirements and supply chain considerations and cost and risk containment the primary factors in developing the implementation plan (Principle 6).

3.3 Design Engineering

OPG declared meeting the milestone for the completion of design engineering in August 2015. In addition, the CNO milestones for the completion of design engineering were met for several of the Safety Improvement Opportunity (SIO) projects. Through 2014 and 2015, these reports have identified a risk associated with the potential impact of the acceptance of engineering deliverables from design agencies that do not meet quality requirements. This risk has been realized on several occasions through the execution of the Campus Plan and SIO projects. The latest example was the installation of the rupture disc required for the completion of the Unit 3 STOP project. The poor quality of design resulted in the work being stopped and rescheduled to a 2016 outage.

By its nature, any perceived time pressure to complete a large engineering workload in a short period of time introduces a challenge to maintain high levels of quality and an increase in the acceptance of engineering packages with open items to be completed. This feature combined with the latent nature of engineering errors results in the need for effective implementation of a rigorous and high quality process for the acceptance of engineering design deliverables. The latent nature of engineering errors in approved designs refers to the fact that the consequences of these errors are not realized

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immediately. They are seen in construction, commissioning and too frequently during plant operation.

The previously identified challenge and associated potential risk is based on the following observations:

- It is an acceptable and common practice within OPG to accept a design package with open items in the design. There is no rigorous process to manage these open items to ensure they are addressed prior to the start of field construction.
- There are several Campus Plan and SIO projects that met their engineering complete milestone with open items for which there are impacts in field execution, resulting in delays and rework. Examples include Emergency Power Generator 3 (EPG3), Auxiliary Heating System (AHS), Containment Filtered Ventilation System (CFVS), D<sub>2</sub>O storage, and Re-Tube and Feeder Replacement Island Service Annex (RFRISA) building.
- Although OPG has responded to the IER 14-20 on Technical Conscience by the Institute of Nuclear Power Operations (INPO), there has not been a review of high risk, first-of-a-kind or first-in-awhile design agency work to validate the rigour and quality of the design agency and acceptance by OPG.
- The refurbishment Vice President of Engineering recently communicated his continuing concern about on-going quality issues, including open items, in the design agency products.
- There has not been a review to verify that designs have incorporated appropriate World Association of Nuclear Operators (WANO) and INPO significant operating experience recommendations.

There is opportunity to reduce the impact of this risk during the 2016 Ready to Execute phase of the project. This is discussed in Section 4.

**Conclusion:**

Meeting the design engineering milestone provides the opportunity to complete the downstream preparation activities (such as completion of field work instructions and procurement of materials) in sufficient time to support field execution. However, the large number of open items and some realized quality issues highlights a possible risk associated with the completed design engineering. There is sufficient time to reduce this risk.

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**3.4 Regulatory Approvals**

OPG has obtained the necessary approvals from the CNSC to start the refurbishment. These included:

- Environmental Assessment. The approval of the Environmental Assessment included a commitment by OPG to complete a number of Safety Improvement Opportunity projects. The majority of these are committed to be completed prior to the start of Unit 2's refurbishment outage. They are managed by the OPG's Projects and Modifications organization.
- Integrated Safety Review and Global Assessment. This represented a major assessment of the condition of plant systems, equipment and components, as well as the rigor and effectiveness of plant processes, procedures and organizational structure. The Integrated Safety Review included a five set of Component Condition Assessments that documented the results of comprehensive set of inspections and analyses of performance of plant systems and components. Its approval is the first refurbishment project under the new CNSC requirements for plant life extension.
- Integrated Implementation Plan. One product of the Integrated Safety Review (mainly the Component Condition Assessments) is a plan for specific maintenance, replacement, upgrades and further inspections of components and equipment. This Integrated Implementation Plan (IIP) identifies both the scope of work to be completed during each unit's refurbishment outage and another scope of work that is to be completed during the overall life extension period, which ends after the first post-refurbishment outage of the last unit. Because of the complexity and duration of the project, it is recognized that there may be changes required to the IIP. Both the IIP and the process for such changes were approved by the CNSC in December, 2015.
- Darlington License Renewal. OPG applied for a 13-year license for Darlington Nuclear plant in 2015. Normally, licenses are provided by the CNSC on a five-year basis. In December, the CNSC issued a 10-year license. This is recognition by the CNSC of the current level of performance of Darlington plant and organization. This extended license will permit OPG to have one less major task during the majority of the refurbishment outage.

**Conclusions**

The regulatory approvals for the refurbishment project have been obtained.

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**3.5 Unit 2 Level 1 Execution Schedule**

Through 2015, the project developed and refined the execution schedule for Unit 2. The status as of the end of the year is the release of the Level 1, Rev. B version. The development of this revision required the development of detailed resource-balanced schedules (Level 3) from the contractors. These were submitted as input into the latest revision of the schedule. This schedule continues to provide high confidence in OPG's duration for the Unit 2 refurbishment outage that was provided in the Release Quality Estimate. It provides more detail in the critical path components and more detail in the non-critical path windows. The schedule has not been optimized for placement of these non-critical path windows to ensure compatibility with critical path and to ensure each is well protected from becoming critical path.

**3.6 Comprehensive Work Packages**

Comprehensive Work Packages (CWPs) are the field instructions to be used by the trades in the execution of refurbishment work. The CWPs are written by the contractor performing the work and reviewed and accepted by OPG operations and engineering. The CWPs include the hold points for quality inspections and required testing. The milestone for the completion and acceptance of the CWPs is March 2016. There will likely be some refinement during the on-going preparations until actual field use.

**3.7 Procurement of Long Lead Materials and Tooling**

An important component of the planning and preparations for the Unit 2 refurbishment outage is the procurement of parts, materials and tools. These are procured by the contractors responsible for the work, to OPG specifications. The focus during the Definition Phase was:

- OPG established a tracking system to monitor the status of parts and materials from identification of need to delivery to the designated warehouse. This requires close collaboration with the contractors to ensure accurate understanding of the current status.
- The identification, ordering and monitoring of manufacturing of long lead materials. These include, but not limited to, the major reactor components, such as feeder piping, pressure tubes, calandria tubes and end fittings.

- The development, prototype testing and production of tooling required for refurbishment projects. Although the majority of tooling is associated with the Re-tube and Feeder Replacement project, other projects require the use of tools for execution.
- Quality inspections and oversight of manufacturing contractors and sub-contractors. The industry has had problems with poor quality parts and materials, including fraudulent manufacturing and test results. The main contractor for each project has the responsibility to obtain the parts and materials to support field execution for the modification, repair or replacement. This usually involves procuring parts and materials from a subcontractor and ensuring that they meet the required quality level and specifications. This requires the contractor to execute a robust quality oversight program of the sub-contractor's quality program and implementation. As the owner, OPG must ensure that this overall process is robust and effectively implemented to ensure that installed components and equipment meet the standards required for continued safe and reliable operation.

### 3.8 Campus Plan and Safety Improvement Opportunity Projects

During the Definition Phase a number of projects were started to support the execution of the refurbishment project (Campus Plan projects) as well as to meet the commitments of the Environmental Assessment (Safety Improvement Opportunities). These projects are managed by OPG's Projects and Modifications organization. Issues related to these projects have been documented in reports to the Ministry since 2013. In 2015, the focus of these reports to the Ministry shifted from the performance of these projects to the effectiveness of the refurbishment project organization to understand and address the lessons learned from these projects. In response to these problems, refurbishment management developed a Ready to Execute plan that addresses several of these lessons learned.

### 3.9 Development of Functional Programs and Capability

A project of this magnitude requires a significant infrastructure and support organization. OPG recognized this and established organizations in the key functional areas; including project and controls, engineering, procurement, operations, maintenance, chemistry, safety (both conventional and radiological), corrective action program, risk management, operating experience, regulatory



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affairs and contract management. These functions cut across and support all refurbishment projects. As a result of lessons learned from the Campus Plan and Safety Improvement Opportunity projects, these functions transitioned from strictly establishment of standards and oversight of contractors to a more collaborative approach with contractors. This is recognition that OPG will not have a successful refurbishment of the units without the contractors being successful, and the contractors need support in meeting the standards required for such a large and complex project in an operating nuclear power facility. This collaboration has been successful in improving contractor's performance in planning, estimating, scheduling and engineering.

Conclusion:

The refurbishment organization has met its main objectives for the Definition Phase of the Refurbishment Project, and has a plan to transition to the execution phase in October 2016.

**4.0 Transition to Execution**

With the completion and Board approval of the Release Quality Estimate (RQE) and the Definition Phase of the project, the organization's challenge is to be ready, and demonstrate it is ready for the October start of the Unit 2 refurbishment outage. Even with the success of the Definition Phase, including high level planning, readiness to execute will be a significant effort with a number of challenges. Refurbishment management has developed a Ready to Execute (RTE) plan to drive the physical work that represents prerequisites to the start of the outage as well as the development of the processes and organization infrastructure to effectively manage the execution of the outage. Some of these processes will be verified through a Pilot Test period that involves the execution of a number of prerequisite projects. Others will not have the opportunity to be verified through this Pilot Test period and will need to be validated in other ways, such as tabletop exercises and challenge meetings. The following list provides a number of the key deliverables and activities to demonstrate readiness to execute Unit 2 refurbishment outage.

- There will be a check estimate submission and OPG Board approval for the cost of Unit 2's refurbishment outage. This should be a relatively straight forward update of the RQE for unit 2 based on refinement of the outage schedule and resource requirements for execution of each project

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and function. The milestone for approval of the Unit 2 check estimate is August 15, 2016.

- Each project will need to continue to prepare for outage execution. This includes the completion of field instructions (CWPs), procurement of materials, obtaining and training trades and completion of detailed schedule. This requires close collaboration between the refurbishment project and each contractor.
- The current Unit 2 execution schedule is a high level schedule (Level 1). It will need to be further developed to a detailed schedule (Level 3) that includes logic ties, prerequisites and resources. This again requires close collaboration and alignment among the refurbishment work management organization, contractors and each project. The milestone for the detailed schedule is August 31, 2016.
- It was recognized in 2015 that roles, responsibilities and accountabilities were not sufficiently defined at the lower levels to prevent confusion during execution. This has resulted in documenting these in a 'Division of Responsibilities' (DoR) document. Not only will the DoR document the roles and responsibilities within the Nuclear Refurbishment, but it will also define the interfaces among the project and its contractors, the station and corporate support organizations. A draft has been completed, with reviews and challenges in progress. The planned date for final issuance of the document is August 2016.
- There are several processes that need to be finalized and validated. Some of these will be validated through a four month Pilot Test period, while others will need to be validated through tabletop exercises and challenge meetings. Some of the more challenging ones are:
  - The strategy for obtaining alignment among contractors and OPG programs and processes is documented in the refurbishment Execution Strategy. Sections of this will be validated during the Pilot Test period, while other sections will require table top exercises and challenge meetings.
  - Verification that the work is ready to be executed when scheduled including proper work instructions, hold points identified, resources available, materials in place and prerequisites completed.

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- Refurbishment construction execution organization plans to establish a collaborative and supportive approach to field execution with the contractors.
  - The processes to monitor and report daily progress. This usually involves updating the detailed schedule to show progress and a plan of the day meeting to review progress and plans.
  - The process to get field workers to the job site, including start of shift briefings, pre-job briefings, work authorization and work protection.
  - Response to field issues that stop work.
  - The physical establishment and operation of the Project Control Centre.
- As the start of the Unit 2 refurbishment approaches, work needs to progress on the specifications and processes associated with the commissioning of equipment and systems, process to determine systems are available for service, and the turnover of the unit back to the station.
  - Timely and effective decision making during project execution is essential to maintain the schedule, cost and quality. There will be events for which a decision that may impact schedule will be made to ensure quality. The process to identify and address adverse performance trends prior to them becoming an issue will need to be effective.
  - Although the design engineering milestone of August 15, 2015 was met, there is a risk that the number of open items combined with potential quality issues as seen in the SIO projects may result in engineering rework and resulting impacts on schedule and cost. This risk is not likely to impact the basis of the RQE for duration and costs.
  - Design engineering is not the only engineering activities that will need to be in place for the project. Several engineering activities will need to be conducted to support execution, such as responding to technical issues, responding to obsolete parts and the implementation of field changes. These will be used during the Pilot Test period.
  - The Pilot Test period will provide OPG with an assessment of several of the processes that are planned to be used during the refurbishment outage. This period has a number of small prerequisite projects that will be field executed. They include the installation of work areas (Work Control Area and Radiation Protection offices and monitoring area),

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installation of shops and work areas, and the installation of service air system for increased capacity.

- There are several additional prerequisite projects that the need to be completed prior to the October start of the outage. Some of these are scheduled to be completed just prior to breaker open. These include maintenance and modifications to the vault vapour recovery system, installation of additional breathing air capacity, unit power distribution system modifications, steam generator recirculation skids, installation of other skids and the installation of barriers to designate the unit under refurbishment.
- The Projects and Modifications (P&M) organization has a number of Campus Plan (CP) and Safety Improvement Opportunity (SIO) projects in progress that will be challenged to meet their need date. These include the SIO Projects related to Containment Filtered Venting System, Emergency Power Generator #3, and Emergency Heat Sink, as well as the CP project - D<sub>2</sub>O storage building. In addition to monitoring progress, OPG will need to consider contingency plans in the event one or more is not completed.
- The finalization of system layout plans, as well as the processes for control of chemicals, foreign material exclusion and heat transport system start-up is essential for the health of the unit both during refurbishment and life extended operation. This should be completed prior to the start of the unit outage.
- There are several processes associated with field execution that require a final decision as to whether OPG's process will be used or the contractor's process. This work is in progress and several can be validated during the Pilot Test period.
- Performance metrics and reporting will have to be developed for the execution phase of the project. This will need to be in sufficient detail to permit analysis of potential issues. This work is in progress and several can be validated during the Pilot Test period.
- OPG's expectation is that each contractor will implement a robust problem identification and corrective action process. An effective process is required to identify and correct adverse performance trends before they become a significant issue. This work is in progress can be validated during the Pilot Test period.

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- As the owner, OPG has the ultimate responsibility for the quality of field execution and resulting modifications, repairs and replacements. This is recognized by refurbishment management and a quality management program and organization has been started. This requires collaboration with the contractors to ensure that field work instructions include test and inspection hold points, including points requiring OPG to witness. This capability may be partially validated during the Pilot Test period.
- Human Performance, including the use of event free tools, has been an important program within the nuclear industry for more than 25 years. The principles and techniques are well engrained within operating nuclear plant organizations. However, it is not fully engrained within projects and contractors organization. Refurbishment management recognizes the need for high levels of human performance is required for safe, quality work. A contractor's human performance program initiative has been started.
- In addition to human performance, effective first line supervision of field execution is essential for a successful refurbishment project. This is recognized by OPG refurbishment management, who have initiated a supervisory training program for contractors' supervisors. Training will be co-delivered by OPG and the contractors. The qualification process will include an Oral Review Board administered by the contractors and monitored by OPG. Although the program will not be fully implemented for the Pilot Test period, the effectiveness of field supervision can be assessed.
- The process for tracking and reporting the status of procurement will have the opportunity to validate its effectiveness during the Readiness to Execute period of January through September.
- There are several lessons learned from the problems incurred during the planning and execution of the Campus Plan and Safety Improvement Opportunity projects. These have been identified in the most recent reports to the Ministry. Some of them are addressed in the Ready to Execute Plan. There should be a review of all lessons learned to identify the associated risk to the successful execution of the refurbishment project and for those that are not addressed, a mitigation plan or acceptance of the risk should be documented.

**Conclusion:**

OPG refurbishment management has a Ready to Execute plan that includes the elements for Unit 2 refurbishment execution. The extent to which the plan is

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effectively implemented will provide a significant input as to the the level of confidence that the organization is adequately ready to execute a successful refurbishment outage.

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## Attachment 28

### Ontario Power Generation Darlington Nuclear Refurbishment (DNR) Findings Nuclear Oversight (2014-2016)

Audit/ Assessment Title	Finding	Management Actions	Risk Rating*
<b>Audits</b>			
2014-018 Environment Program  May 15, 2014	Governance Changes have not been fully implemented with the new Centre-led Environmental Management System. The Environmental Program Management Plan referenced in the Refurbishment - Project Environmental Management Plan could not be found in OPG's electronic record system.	Review governance affected by the change to center led and initiate the required changes. Ensure references within documents are connected to appropriate issued procedures and not the obsolete versions. All actions found to be complete.	3
2016-001 Health & Safety Management System Program  July 8, 2016	Requirements of the Safe Work Planning process have not been effectively implemented. Safe Work Plans prepared by DNR contractors did not always address: <ul style="list-style-type: none"> <li>• emergency response for jobs working at height</li> <li>• individual hazards on Safe Work Planning</li> </ul>	Revise governance to simplify and clarify the current safe work process and identify and implement changes to the affected Nuclear Safety related documents. This will include but is not limited too Pre-job Briefing and Post-Job Debriefing. Actions on track, TCD Mar 2017.	3
2016-004 Equipment Reliability  June 30, 2016	Some DNR staff with their qualifications not fully documented in OPG's qualification tracking software system were performing the role of System Engineer without written evidence of oversight by fully qualified mentors.	The training of existing System Engineers are on target, this assignment is initiated to review and update the existing training plan for all staff working in both DNR-Sys departments. This action was completed in 2016/08/12.	3

**Attachment XX**

**Ontario Power Generation  
Darlington Nuclear Refurbishment (DNR) Findings  
Nuclear Oversight (2014-2016)**

<b>Audit/ Assessment Title</b>	<b>Finding</b>	<b>Management Actions</b>	<b>Risk Rating*</b>
2016-014 Environmental Management  May 20, 2016	Gaps were identified in contractors' environmental awareness and Environmental Management Plans at DNR. The Project Manager's assessment of the Environmental Aspects and potential Environmental Impacts were not properly documented for some projects. This assessment is to be integrated into the contractor's Environmental Management Program which provides the Project Manager with an understanding of the environmental risks of the project.	Initiate document change to ensure that DNR leadership staff complete Nuclear Refurbishment Awareness training. Initiate paired observations with Construction Execution and Field Support to support improvements to environmental awareness prior to breaker open. Submit environmental recommendations and revision inputs to Construction Execution and Field Support to improve observations walk-down. Actions on track, TCD Dec 2016.	3
2016-015 Conduct of Maintenance  July 25, 2016	Gaps exist in DNR Foreign Material Exclusion (FME) work planning and reporting. DNR FME work orders were inappropriately set to ready with no holds to indicate FME planning was still in-progress. The work order tasks did not contain the FME information and instructions required to set the tasks to ready status. Additionally, prerequisite DNR FME work reports did not meet the work reporting requirements for FME.	FME single point of contact to create a presentation reviewing FME requirements and expectations. Roll out to Assessing and planning departments to both OPG and contract staff.  Actions on track, TCD Oct 2016	3
2016-020 Work Management  June 24, 2016	DNR prerequisite work completion is not meeting target. A Memorandum of Understanding between Darlington Nuclear Generating Station and DNR supersedes some governance requirements and documents agreed to variances. Specifically, the agreement directs that the above mentioned prerequisites should not be treated as normal outage prerequisites and provides an allowance for bundled T-meetings. Although completion of Nuclear Refurbishment prerequisite work prior to the Unit two breaker open has averaged less than 50% compliance to schedule there has been improvement observed. Recent performance of up to 78% completion notes a trend toward the 90% compliance target.	Implement a periodic meeting to review upcoming work weeks for outage pre-reqs. Begin reporting of Refurbishment pre-req Dashboard Develop and communicate Refurbishment indicators, data metrics gap.  All actions found to be complete.	3



**Attachment XX**

**Ontario Power Generation  
Darlington Nuclear Refurbishment (DNR) Findings  
Nuclear Oversight (2014-2016)**

<b>Audit/ Assessment Title</b>	<b>Finding</b>	<b>Management Actions</b>	<b>Risk Rating*</b>
2016-029 DNR Conduct of Engineering  August 16, 2016	OPG has accepted two pressure boundary Technical Specifications prepared by the vendor for the Feeder Assembly without specifying some information required for inspections and measurements.	Confirm Control Notices placed on current revisions of affected comprehensive work packages capture outstanding reviewer comments from the technical specification compliance review. Confirm final revisions of affected comprehensive work packages contain adequate detail for measurements and address audit report findings. Actions to be completed by 2017/02/15.	3
	OPG has accepted some Inspection and Test Plans for the EPG3 project, which do not specify clearly the characteristics to be inspected, acceptance criteria and inspection procedures.	Review audit report in conjunction with the CNSC Type II Reactive Inspection findings for compliance to code and governance. Action to be completed by 2016/11/25.	3
<b>Assessments</b>			
2014-200 Darlington Nuclear Refurbishment Engineering Activities  July 31, 2014	The implementation of the Change Management Plan has gaps that may represent a risk to the success of the plan. Amongst those gaps, there are critical activities that are late (some by more than 4 weeks when compared to the original plan) or haven't started yet and these include: "Contractors to input their level 3 schedules into P6" and "Projects and Modification to execute Project Change Authorization for each DNR project requiring Contractor to produce new schedules based on the new engineering strategy".	Create metrics in order to gauge the success of the Collaborative Approach. The action is arising from the "Assessment on Refurbishment Changed Contractor Interfaces" and the "DNR Engineering Status Review" memo which found that reliable metrics were not yet available. Action was completed on 2014/10/31.	3
	Actions identified in the memo "Level 1 Plan for Managing the Emerging Risks Related to Increasing Refurbishment Engineering Project Costs" are past their target completion dates. These actions may impact the effectiveness of the change management plan, specifically Collaborative Front End Planning and One Time Scope Approval.		

**Attachment XX**

**Ontario Power Generation  
Darlington Nuclear Refurbishment (DNR) Findings  
Nuclear Oversight (2014-2016)**

<b>Audit/ Assessment Title</b>	<b>Finding</b>	<b>Management Actions</b>	<b>Risk Rating*</b>
2014-204 Darlington Performance Assessing – DNR Work Management  December 19, 2014	This performance based assessment has found a number of issues where the current system processes and behaviours are not fully effective. Weak process implementation early in the scheduling process is resulting in work compression and non-compliances close to execution. Weak adherence to scheduling and milestone discipline results in late injection of work. This, in addition to work not executed on-time, is creating delays which contribute to a rising bow-wave. This poses risk for Refurb to come in on time while meeting budget and scope. Additionally, metrics quality is currently such that these issues are somewhat obscured.	Issue a set of Pre-Refurbishment Project Metrics. Metrics may include: Scope Phase Assessments, Group Breakdown Graphs, Assessments, Scope Variance, Prerequisite Schedule Development, Schedule Development, Group Breakdown Graphs, Pre-Req Workdown, Pre-Req, Daily Completions, and Pre-Req Graph Data. Roll out “Adherence Manager’s Briefing Card” to all project staff to ensure understanding of expectations and schedule requirements. All actions found to be complete. Effectiveness review found actions effective in resolving the identified issue.	3
2015-202 Darlington Nuclear Refurbishment Chemistry  August 18, 2015	DNR Chemistry requirements and contractors accountabilities have not been effectively communicated to contractors working on DNR projects. a) The Contract/Owner Interface Requirements documents and oversight plans do not provide contractors with the necessary information on the DNR Chemistry Program requirements. b) Project Managers are not effectively and consistently ensuring that contractors are aware of the DNR Chemistry Program requirements during the execution phase. c) The DNR Chemistry organization did not identify the gaps related to the DNR Chemistry Program requirements in the applicable DNR Projects.	Supply Chain to complete document change request. The purpose of this change is to include chemistry and environment requirements in the applicable documents. Action was completed on August 22, 2016.	3

**Attachment XX**  
  
**Ontario Power Generation**  
**Darlington Nuclear Refurbishment (DNR) Findings**  
**Nuclear Oversight (2014-2016)**

<b>Audit/ Assessment Title</b>	<b>Finding</b>	<b>Management Actions</b>	<b>Risk Rating*</b>
2015-205 DNR – Engineering  August 24, 2015	There are risks to the completion of engineering change design packages as per schedule. The assessment has identified the following risks to meeting the current work down curve as per the plan: <ul style="list-style-type: none"> <li>• Quality and schedule issues exist in engineering change design packages;</li> <li>• Collaborative approach has not been fully effective;</li> <li>• There is governance weakness with collaborative approach;</li> <li>• Engineering change completion rate for the first two months of 2015 was low.</li> </ul>	Carry out a self-assessment on engineering status to: (i) determine the validity of reported engineering forecasts. (ii) determine the impact to Release Quality Estimate and Unit 2 execution for the engineering changes that have missed the completion milestone. Action was completed on 2015/08/07.	3
2015-321 Human Performance Follow-up  December 18, 2015	The assessment has determined that the corrective action plans for the Human Performance Audit have resulted in improvements. Specifically DNR organization has been attending the Darlington station Human Performance committee meetings. Suggest that DNR become a quorum member to this committee for further improvement.	Review Human Performance Program Guideline, and Nuclear Peer Team Terms of Reference. Ensure alignment and consistency in the requirements for Human Performance Peer team meetings, site Working Committee and Steering Committee meetings with respect to DNR involvement. Actions on track, TCD Dec 2016	3
2016-208 Pressure Boundary Darlington Refurbishment  August 5, 2016	The Retube and Feeder Replacement Project has not identified and documented how the requirements for the operation and maintenance of Pressure Boundary systems in the Refurbishment Waste Processing Building will be met and implemented. None of the documents reviewed by the assessment clearly define the interface, accountabilities and responsibilities between OPG and Joint Venture for future operation and maintenance of Pressure Boundary systems in the Refurbishment Waste Processing Building during the life of the DNR Project.	Prepare a Memorandum of Understanding that shows what steps are required for Joint Venture to obtain the required qualifications to operate the Refurbishment Waste Processing Building (scheduled for July 2017). Action due on 2017/02/28.	3

**Attachment XX**  
**Ontario Power Generation**  
**Darlington Nuclear Refurbishment (DNR) Findings**  
**Nuclear Oversight (2014-2016)**

Audit/ Assessment Title	Finding	Management Actions	Risk Rating*
	<p>The DNR Design Authority Expectations are not always followed for the acceptance and storage of some vendor documents.</p> <ul style="list-style-type: none"> <li>Some design documents reviewed have not been issued in OPG's electronic record system or as part of a Design Engineering Change package. In addition, it cannot be demonstrated that these documents have been accepted by OPG;</li> <li>Some registration packages sampled did not have OPG's acceptance indicated on the supporting design documents as required.</li> </ul>	<p>Update Engineering Change Control graded approach approval memo to explicitly address applicability to pressure boundary requirements. Action was completed on 2016/10/10.</p>	3

**\*Significance Level** 1 (very high), 2 (high), 3 (medium), or 4 (low) is assigned to an adverse condition reflecting either consequences or potential consequences of a personnel, programmatic, or equipment deficiency to cost or production or radiological, nuclear, industrial, or environmental safety.

**Ontario Power Generation**  
**Internal Audits on Darlington Nuclear Refurbishment (“DNR”)**  
**Period: January 1, 2014 to September 30, 2016**

Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
14-15 Administration of Contractual Documentation – Refurbishment (August, 2014)	<p><b>Supply Chain and Nuclear Projects Document Management Accountabilities are not fully defined</b></p> <p>Accountabilities for the monitoring and management of contract documentation have not been defined at the detailed task level between the Supply Chain and Nuclear Projects groups.</p> <p>Documents such as the Technical Contractor Management Process guide (N-GUID-00150-10002-R000) outline overall accountabilities, but do not define them at the task level. For instance, it is unclear as to who is responsible to monitor and validate that:</p> <ul style="list-style-type: none"> <li>• Vendors comply with the insurance requirements that are outlined in the contract (throughout the term of the contract);</li> <li>• Letters of Credit are provided, filed and maintained current;</li> <li>• Expiration dates of contracts are effectively monitored;</li> <li>• Warranty provisions in the contract are monitored; and</li> <li>• Documents required in the contract file are clearly defined, and are up-to-date and available.</li> </ul> <p>Task level accountability is central to the understanding of expectations and the establishment of responsibilities regarding contract management. For instance, vendor subscription to ISNetworld is required to participate in the RFP process. Further, vendors that score an “F” rating are classified as “Do Not Use (Restricted)”. It is unclear as to who has the</p>	<ol style="list-style-type: none"> <li>1. A briefing card will be issued to all Supply Chain Staff to identify accountabilities for monitoring contract documentation as a supplement to OPG-PROC-0058.</li> <li>2. Nuclear Projects will develop a task level accountability matrix that will help ensure the proper transition of documentation accountabilities from Supply Chain to the project.</li> </ol> <p>Action Plan Status: Closed</p>	Moderate

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	accountability for the ongoing monitoring of insurance/WSIB compliance, documentation requirements and the mitigation process (after the contract is awarded) should one of the vendors not comply with the contractual obligations. The mechanism and frequency of ongoing monitoring through ISNetwork has also not been defined.		
14-17 Finance’s Controls over Darlington Refurbishment (December 2014)	<p><b>Some of finance’s controls in certain key risk areas were not formally defined and documented.</b></p> <p>In recognition of the strategic importance of its financial challenge role, Finance has implemented controls to review, assess, and provide oversight on major aspects of the program. However, some of the controls relating to Finance’s oversight of program and release estimates, contingencies, scope changes and performance monitoring, have not been formally defined and documented, to ensure that they are performed consistently as intended, with the desired frequency, and appropriate timeliness.</p> <p>During interviews and walkthroughs with Finance, some control activities could not be clearly described and specifically linked to certain key risk areas. There was also lack of clarity as to what documentary evidence supported the existence and performance of those key controls.</p>	<ol style="list-style-type: none"> <li>1. Finance Management will work with IA and the Project to clarify finance’s roles and accountabilities relating to release estimates, contingencies, scope changes and performance monitoring.</li> <li>2. Based upon an agreed understanding, Finance management will review project and finance governance to identify any gaps that exist to ensure alignment of roles and accountabilities.</li> <li>3. Finance will ensure all key controls are defined, documented and mapped to key risk focus areas.</li> </ol> <p>Action Plan Status: Closed</p>	High
14-17 Finance’s	<b>Documentary evidence to demonstrate performance of</b>	Determine and implement an appropriate	Moderate

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Controls over Darlington Refurbishment (December 2014)	<p><b>certain key controls was not consistently retained.</b></p> <p>Throughout the audit, evidence was not easily retrievable and/or available during interviews and walkthrough of controls, or within a reasonable time upon request. As such, performance of some key controls was not clearly evident. There was also difficulty in demonstrating the results of the review or challenge within controls due to lack of documentation, which ultimately hinders the ability to demonstrate that these key controls have been performed as designed.</p> <p>The issue noted in finding 4.1 may contribute to this lack of control documentary evidence.</p>	<p>documentation retention policy.</p> <p>Action Plan Status: Closed</p>	
14-18 Turbine Generator (“TG”) Critical Parts Procurement – Darlington Refurbishment Project (December, 2014)	<p><b>Insufficient tools, processes and oversight deployed by the Vendor and OPG to effectively plan, execute, and control TG’s detailed procurement efforts.</b></p> <p>The Audit has noted the following:</p> <ul style="list-style-type: none"> <li>• Project Schedules used by both the Vendor and OPG to manage the TG Project do not contain a sufficient level of detail to ensure that procurement efforts are (or, will be) monitored, tracked, and managed effectively.</li> <li>• Tools and processes deployed by the Vendor and OPG to plan, execute, and control detailed procurement efforts are insufficient and need to be strengthened and formalized.</li> <li>• Oversight efforts to date have not focused on the Vendor’s</li> </ul>	<p>As the vendor transitions from the engineering phase through to procurement / manufacturing phase of the project, oversight efforts and plan will focus on this area and include:</p> <ol style="list-style-type: none"> <li>1. Deployment of tracking tools for the Original Equipment Manufacturer (“OEM”) parts which are to be delivered by the vendor associated with Unit 2 Refurbishment TG project</li> <li>2. Additional progress schedule activities / level of detail to monitor overall progress of procurement / manufacturing the TG OEM</li> </ol>	High

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	<p>Procurement Planning, Execution, and Control processes in sufficient detail.</p> <p>Procurement efforts for the TG project are generally modeled using only summary bars for each of the Work Breakdown Structure (WBS) Elements associated with the project without driving down to Work Packages, Assembly/Kit/Part Bundles within each Work Package, and the status of critical toll gates for each part number within a given Assembly/Kit/Part Bundle. This approach will not enable effective schedule management of the procurement detail on the TG project. In addition, the Vendor and OPG have not yet established, agreed upon and formalized the processes it intends to use to plan, execute and control the detailed procurement efforts on the TG Project.</p>	<p>parts associated with Unit 2 Refurbishment</p> <p>3. TG Project Management Plan to be updated to reflect oversight related to monitoring / tracking of OEM parts associated with above items</p> <p>These TG oversight efforts will include the integration of the Installation vendor as well as the OEM vendor to ensure that the actual need dates for the parts are accommodated / considered in oversight activities. This will also inform the risk associated with any delays.</p> <p>Action Plan Status: Closed</p>	
14-26 Darlington Station Readiness for Refurbishment (January, 2015)	<p><b>Readiness process does not incorporate a schedule to highlight periods of high concentration of planned station activities.</b></p> <p>Currently there is no schedule used for planning and executing actions from Department Ownership Transfer Plans (DOTPs) to highlight periods of high concentration of station activities. Planned readiness actions involve multiple departments and occur during other station activities (such as outages, vacation, and training) which may challenge resources or completion of activities.</p>	<p>1. Darlington Refurbishment Interface Department to work with Nuclear Refurbishment Programs to review the Department Ownership Transfer Plan Actions matrix for doability issues. The potential issues identified will be reported at the Refurbishment work program integration meeting.</p> <p>2. Darlington Refurbishment Interface Department will ensure Nuclear Refurbishment Programs will instruct all DOTP owners to include as a focus area, a</p>	Moderate



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	<p>Actions have been managed to date using DOTP Action Request (AR) tracking on a spreadsheet and common milestones are tracked in the Refurb integrated schedule and reviewed at the Refurb Work Program Alignment meeting, however, these methods will not easily identify potential resource related rub-points or feasibility issues between departments during forecasted high concentration periods for example, the 2016 spring outage and months just prior to breaker open.</p> <p>In addition, although ARs have been developed for the period leading up to Breaker Open, and Return To Service (RTS) related activities are factored into DOTPs, ARs have generally not been created for the period of DNRU2 execution to breaker close. Therefore, these actions would not be visible to facilitate schedule planning during this period.</p> <p>Increased visibility of the work requirements during high concentration periods will allow early opportunities to address potential issues noted above and facilitate review of progress throughout the full Refurb outage period.</p>	<p>doability analysis of all Action Requests as part of their upcoming revision of their plans. They will ensure doability of all actions and support of completion of these actions by integration with other groups where required. This will be reported to the Refurbishment Work Program Integration meeting team.</p> <p>Actions will be tracked through SCR D-2015-01367.</p> <p>Action Plan Status: Closed</p>	
14-26 Darlington Station Readiness for Refurbishment (January, 2015)	<p><b>There is a misalignment on start and end dates between the Station and Refurb in terms of dates submitted to the System Operator and the dates being used by Refurb.</b></p> <p>Currently the dates for the DNRU2 outage in the OPGN Long Range Outage Plan Overview Schedule differ (by two weeks) from the planning dates that the Refurbishment organization is actively working towards and incorrect dates have been submitted in the outage request to the Independent Electricity</p>	<ol style="list-style-type: none"> <li>1. Darlington Refurbishment Interface Department will work with CFAM work management to initiate correction Unit 2 Refurbishment dates in ROMS and Station business plan dates to those in Refurbishment planning.</li> <li>2. Darlington Refurbishment Interface Department will work with Refurbishment to perform an extent of condition review to</li> </ol>	Moderate

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	<p>System Operator (IESO). The current integration process does not consider alignment with existing Nuclear Outage and Generation Planning processes which resulted in this misalignment of dates.</p> <p>The station is responsible for updating OPG Electricity Sales &amp; Trading and the IESO with outage requests by entering an Equipment Outage Slip in the Real-time Outage Management System (ROMS) database. The dates in the Long-Range Outage Plan were sent to Darlington Work Management and used to update ROMS (October 1, 2016 to September 30, 2019) differ from dates used in Refurb planning (October 15, 2016 to October 15, 2019). Outages submitted in ROMS are time-stamped and requests are reserved on a first come, first serve basis based on these times. Data needs to be accurate because any revisions to outages times on ROMs will create a new time-stamp.</p>	<p>identify any other potential gaps (e.g. dates, processes).</p> <p>Actions will be tracked through SCR D-2015-01371.</p> <p>Action Plan Status: Closed</p>	
15-17 Engineering, Procurement and Construction (“EPC”) Contractor Procurement Review – DNR Project (October 26, 2015)	<p><b>Procurement oversight activities for suppliers have not yet been centrally coordinated or standardized.</b></p> <p>OPG uses a risk-based approach to select DNR project suppliers and sub-suppliers that require oversight. For example, all suppliers of nuclear grade and pressure boundary materials are subject to OPG oversight. Other factors and input considered include the component type, supplier history, results from prior oversight activities and discussions with stakeholders.</p>	<p>Management agrees with the recommendation provided by Internal Audit as it aligns with the current initiative to develop a single source of coordination and documented guidance to ensure component manufacturing related risks across each of the project bundles is mitigated consistently.</p> <p>Action Plan Status: Closed</p>	Moderate

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	<p>Currently, each project bundle uses different methodologies and criteria to assess component manufacturing related risks and as a result, oversight activities can vary between the bundles. This largely results from OPG not having a finalized single source of coordination and documented guidance to govern this specific area of oversight. Management is currently developing this guidance which will be used to facilitate the allocation of resources, and to prevent oversight gaps and duplication.</p> <p>It should be noted that management has established various other controls and procedures to mitigate DNR project procurement risks and to manage supplier oversight.</p>		
15-17 Engineering, Procurement and Construction (“EPC”) Contractor Procurement Review – DNR Project (October 26, 2015)	<p><b>An access control and monitoring plan has not been implemented for the Procurement Tracking Tool (“PTT”).</b></p> <p>OPG technology assets and data should be appropriately secured through the application of general computer controls, logical access provisioning and security monitoring activities. Standard OPG processes and procedures have not yet been implemented to facilitate security/data integrity monitoring and the maintenance of the PTT. This includes processes to utilize the built-in database audit logs and the formal procedures for periodically validating user access. Additionally, during the database development period, 11 users have been provided with more than one access / security role in the PTT.</p> <p>It should be noted that the functionality of the database has been successfully tested and that the database is still in a</p>	<p>Management agrees with the recommendation provided by Internal Audit and agrees that the risk, as described, is low given the non-commissioned status of the tracking tool. The issue of having multiple profiles has been resolved and will be re-validated prior to commissioning.</p> <p>Additionally, management will apply the standard OPG security protocols as part of the commissioning process.</p> <p>Action Plan Status: Closed</p>	Low

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	“development” phase and not in production. Additionally, the majority of users (63%) currently in the PTT have read-only access.		
15-24 Invoice Review & Approval Process – DRP Projects (June 24, 2015)	<p><b>Invoice payments were not in accordance with the Payment Milestone Schedule (“PMS”) specified in the contract.</b></p> <p>The Steam Generator (“SG”) contract with the joint venture of Babcock &amp; Wilcox and Candu Energy Inc. has a PMS that governs the timing and amounts upon which the vendor is to be paid for completing firm price work. Any change to this schedule requires mutual agreement by OPG and the vendor, documented change control approvals by Contract Management and Supply Chain and an amendment to the contract.</p> <p>For three out of 10 SG project milestone invoices sampled, the amounts and timing of payments were not in accordance with the contract PMS. The vendor had been using a revised PMS that had been agreed to in emails between OPG and the vendor project managers. The exceptions represented 66% (approximately \$3.1M) of the total value of invoices sampled in the SG Project. The agreement and approval for this change had not been processed through proper contract change control but instead were captured through e-mail correspondence between OPG and vendor project managers via OPG’s approved vendor document submission &amp; acceptance system, EDMS. A Project Change Directive (“PCD”)</p>	<ol style="list-style-type: none"> <li>1. Contract Management will modify the contract management guide and rollout the contract change requirements to project managers to reinforce/ensure changes to contracts are reviewed and assessed by key stakeholders.</li> <li>2. Contract Management will meet with project managers to review existing contracts to ensure changes have been processed through approved change control mechanisms.</li> <li>3. SG Project will update the contract to incorporate the changes to the PMS.</li> </ol> <p>Action Plan Status: Closed</p>	Moderate

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	or amendment to the original contract was not executed as required.		
15-47 Extended Services Master Services Agreement (“ESMSA”) Recovery Negotiations Audit – Follow up on 2013 Auditor General Findings (January 4, 2016)	<p><b>Differences in interpretation of contract terms have resulted in delays for negotiating recoveries.</b></p> <p>There have been multiple iterations of Deloitte’s report spanning several months due to differences of interpretation of the ESMSA contract. This has also contributed to delays in the recovery negotiations with the vendors.</p> <p>Management has developed action plans, with target completion dates, to address Deloitte’s findings. One of these actions is to clarify contract ambiguities identified by Deloitte. However, until the clarifications are made and communicated to all the stakeholders, there may still be a potential for findings. As part of Management’s action plan, all clarifications are expected to be in place by January 31, 2016.</p>	<p>In order to reduce the risk potential of this finding, Management will complete all the clarifications identified in the Deloitte Report per the agreed-to Management Action Plans (MAPs).</p> <p><b>Note:</b> Some of the MAPs have already been completed, e.g. approval of the Contract Compliance Audit Plan, set-up of Tier I sub-contractors (with the exception of Ellis Don, whose relationship ends in January 2016), and communication of individual rate change pre-approval process to all contractors.</p> <p>Action Plan Status: Open, Target Completion Date 11/15/2016</p>	Moderate
15-47 ESMSA Recovery Negotiations Audit – Follow up on 2013 Auditor General Findings (January 4, 2016)	<p><b>Balance of identified overbillings need to be recovered expeditiously.</b></p> <p>In its November 2015 report, Deloitte identified \$3.6M in potential overbillings by [REDACTED] and [REDACTED] and their Tier I sub-contractors. IA noted:</p> <ul style="list-style-type: none"> <li>A recovery credit of \$573K from [REDACTED] and its sub-contractors was realized in December 2015. Negotiations for the balance of \$838K against [REDACTED] and its sub-contractors are still in progress;</li> </ul>	<p>As part of its Deloitte MAPs, Management will continue to pursue recoveries from vendors and document the recovery process including accountabilities and next steps.</p> <p>Action Plan Status: Open, Target Completion Date 11/15/2016</p>	Low

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	<ul style="list-style-type: none"> <li>A settlement agreement with [REDACTED] for \$2.1M has been provided to [REDACTED] for sign-off. Negotiations for the balance are in progress.</li> </ul> <p>Of the total identified of \$3.6M, recovery action on \$953K (or 26%) is yet to be completed.</p>		
16-07 DNR – Project Management Audit (March 31, 2016)	<p><b>Some project changes were directed to Contractors for execution prior to receiving DNR Change Control approval.</b></p> <p>Project Change Directives (“PCD”) are the mechanism stipulated in the contract for OPG to formally direct Contractors to make project changes. PCDs should be issued after receiving appropriate approval, as per the current approved Nuclear Refurbishment Program Change Management Manual. Change Control Forms (“CCF”) facilitate this approval process and are used as a basis to update project performance baselines and earned value calculations.</p> <p>Our testing identified certain project changes that were directed to Contractors for execution prior to having approved CCF’s. However, there was no significant financial impact noted as no additional funding was required for the project changes sampled. The issue was remediated with the NR Program Change Control Manual implementation in Q4 2015. The updated Manual requires that directed changes also be documented and authorized through a CCF. No exceptions were noted since its implementation.</p>	<ol style="list-style-type: none"> <li>Enhancements to the Project Change Control process were identified in 2015 and the NR Change Control Manual N-MAN-00120-10001-PC-12-R000 was approved and communicated to the project teams in late Q3 2015 and it is now fully implemented and operational. The updated Change Control Manual requires that a Change Control Form be submitted for every PCD going forward.</li> <li>The R&amp;FR team has acknowledged the opportunity to optimize information on the change log and will incorporate details of the project change history.</li> </ol> <p>Action Plan Status: Closed</p>	Moderate

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	<p><u>Re-tube and Feeder Replacement (“R&amp;FR”) Project:</u></p> <ul style="list-style-type: none"> <li>For Project Gate #3 approved on February 1, 2016, 10 of the 18 PCDs were issued for execution without approved CCFs. Consequently, cost baseline changes had not been input into the Proliance system at that time. The 10 PCDs had a value of \$25M and were issued prior to the current Program Change Manual implementation.</li> <li>CCF 715 (\$21.8M) was submitted and approved in October 2015, 4 months after the respective PCD was issued to the vendor. While it was noted that the PCD cost estimate and schedule were not finalized until October 2015, the CCF should be submitted when the change is first identified to ensure accurate reporting.</li> </ul> <p>It was also noted that the R&amp;FR Project Change Log did not have details of the project change history such as the date a PCD was approved and issued, status (pending, approved, cancelled, implemented) and the linkage to the CCF or Project Gate approval.</p> <p><u>Emergency Power Generator (“EPG”) 3 Project:</u></p> <ul style="list-style-type: none"> <li>CCF 834 (\$15.5M) was submitted in December 2015 and approved in March 2016. Within the CCF there were 2 PCDs with a total value of \$316K previously issued to the Contractor. These PCD’s included changes where the work had already begun and in some cases finished.</li> </ul> <p><u>Heavy Water Storage and Drum Handling Facility (D2O) Project:</u></p>		

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	<ul style="list-style-type: none"> <li>One PCD (\$450K) out of 10 sampled required a CCF, however it had not been filed.</li> </ul>		
16-07 DNR – Project Management Audit (March 31, 2016)	<p><b>Earned Value reporting inaccuracies were detected.</b></p> <p>The approved project scope is broken down into work packages with the cost estimate defined for each. Planned Values (“PV”) are calculated on the work package level based on established rules for each deliverable and the planned progress per baseline schedules. As the project progresses and actual costs (“AC”) are incurred, earned value (“EV”) is reported against the respective work packages for Schedule Performance Index (“SPI”) and Cost Performance Index (“CPI”) calculations.</p> <p>In reviewing earned value reporting for the DNR program and projects life to date December 2015, we noted the following:</p> <ul style="list-style-type: none"> <li>Actual project costs that are not mapped to a work package in Proliance accumulate as suspense items in Finance Generated Accounts (“FGA”). This can happen when contractor invoices are not coded to an existing work package due to error or additional project scope not yet updated in Proliance. These accounts have not been consistently reviewed and cleared to ensure EV reporting is complete and accurate. The FGA balances under R&amp;FR sub-bundles were reported as \$4.25M as at December 2015 and \$6.1M as at February 2016 month end and were not included in EV calculations. \$188K of the suspense items was over 6 months old; \$5M was between two and six months old; and \$892K were current; and</li> <li>Testing identified a \$9M error in Earned Value (“EV”)</li> </ul>	<ol style="list-style-type: none"> <li>Clearing of suspense items is a known initiative in Nuclear Refurbishment which has shown significant reduction and has been largely resolved over the past year and is not viewed as impactful to current EV measurement. There remain occasional errors that result in suspense items generation that must be resolved. Review of FGA clearing for potential thresholds and aging management will be conducted and changes implemented as necessary.</li> <li>A review will be conducted to determine who can change the EV exclusion flag, and changes will be implemented as necessary.</li> </ol> <p>Action Plan Status: Closed</p>	Moderate



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	<p>metrics reported in December 2015 due to the incorrect inclusion of the R&amp;FR EPC reimbursable expenses. The error was corrected in subsequent reports. This occurred due to an inadvertent work package status change in Proliance that caused its inclusion in the EV calculation. As a result, the sub-project CPI for December 2015 was reported more favorable by 0.03 and SPI by 0.01, with no impact to the total RF&amp;R bundle metrics reported.</p>		
<p>16-07 DNR – Project Management Audit (March 31, 2016)</p>	<p><b>The use of the Risk Management Oversight (“RMO”) tool is inconsistent with the Risk Management Manual.</b></p> <p>OPG management’s expectations regarding the use of the Risk Management Oversight (“RMO”) tool, an application used to perform and document project risk management activities, are outlined in N-MAN-00120-100001 RISK, NR Risk Management Manual.</p> <p>IA noted that the use of the RMO tool to reflect the status of the ongoing project risk management activities, review of project assumptions and completion of assigned actions is inconsistent. Examples noted include:</p> <ul style="list-style-type: none"> <li>The requirement for a “Risk Review” by owners on a monthly basis is not consistently met. The Risk Dashboard report as of January 2016 indicated 0% of Fuel Handling project risks and 7% of Balance of Plant (“BoP”) risks were reviewed in the prior month. Additionally, the requirement to reference actions for mitigated risks is not consistently met e.g. Balance of Plant (“BOP”) 43%, Turbine Generator 50% and R&amp;FR 83% of the mitigated risks have mitigating</li> </ul>	<ol style="list-style-type: none"> <li>SVP, Nuclear Projects has communicated the expectations of risk management compliance as the project has progressed to execution, and more actions are being taken. These include risk reviews in the weekly issues/opportunities meeting starting March 21 2016, seconding risk program support expertise to the execution organization.</li> <li>Metrics will be reassessed to ensure the proper performance drivers and alignment with the risk manual. Appropriate metrics will be widely distributed from the Risk Management organization (i.e. “push notifications”) to RMO item owners.</li> </ol> <p>Action Plan Status: Open, Target Completion Date 10/31/2016</p>	<p>Moderate</p>

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	<p>actions identified;</p> <ul style="list-style-type: none"> <li>• Of the 61 Program and Project Risks sampled, the “Post Mitigation” risk score was lowered with no mitigating actions assigned for 5 of the risks with the “Risk Treatment” response of “Monitor” or “Accept”. This is not compliant with section 4.1.4 of the manual which indicates that the residual risk should reflect the current risk score, if nothing is actively done to reduce the risk. IA was informed that in two of the instances related to the R&amp;FR project, the lowered residual score is correct due to mitigating actions identified, which have not yet been updated in the RMO tool;</li> <li>• The RMO tool is not consistently used to document the review of project assumptions. Upon review of the R&amp;FR and BOP project assumptions logged in the RMO tool, there is no Target Completion Date (“TCD”) identified for re-validation or assignment of the associated actions. The RMO tool is not used for the Campus Plan projects (i.e. Heavy Water Storage &amp; Drum Handling Facility (“D2O”) and EPG3) to log and manage project assumptions; and</li> <li>• As of March 1, 2016, it was noted that 34% of Actions in the RMO tool with a status of “In Progress” or “Not Started” are past their due date.</li> </ul> <p>The monthly QUAD Chart reports include a Risk Performance section, which lists the top three risks for each project or bundle. The selection of the risks from the RMO Risk Log is subjective, based on what the project owners deemed to be most critical. There are insufficient details in the reports to</p>		

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	provide insight into the project’s risk profile and status of the risk response.		
16-07 DNR – Project Management Audit (March 31, 2016)	<p><b>Monthly project performance reports do not sufficiently explain variances, including contingency drawdowns.</b></p> <p>The monthly QUAD reports are a key tool used by the Refurbishment Program executive team to monitor project performance. There is a requirement to provide an explanation of project performance variances in these reports for the metrics used such, as CPI, SPI and performance against the control budget.</p> <p>From the review of three monthly QUAD reports for the DNR project bundles, IA noted the following:</p> <ul style="list-style-type: none"> <li>• Explanations of variances were not clear or did not provide sufficient insight to determine the contributing factors. The explanation comments referred to “pending baseline revisions due to project changes” and “Gate approval”. However, we did note that the quarterly DNR Program reports to the ELT and the Board provided an adequate explanation of project performance.</li> <li>• Detailed reporting of contingency drawdowns against program and bundle contingency reserves was not in place during the Definition phase. Contingency reporting exists only at a high level in the “Release 4D Program Contingency” as part of the quarterly DNR Program reporting package. There is no contingency detailed by project in the QUAD Chart reports.</li> </ul>	<ol style="list-style-type: none"> <li>1. Management will re-issue and re-communicate clear variance explanation guidelines, including showing what “excellent looks like”.</li> <li>2. Management will define the usage of contingency reports is meeting packages in line with the Integrated Reporting Plan.</li> </ol> <p>Action Plan Status: Closed</p>	Low

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Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
	Management is working on a new contingency management model and status report that will be available online in Q2, 2016.		
16-07 DNR – Project Management Audit (March 31, 2016)	<p><b>Lessons Learned are not collected, shared and incorporated in a timely manner.</b></p> <p>Lessons Learned (“LL”) are an important component to validate decisions and help other Project Managers avoid similar difficulties going forward. This process facilitates the identification and dispositioning of risks, issues, errors and the respective corrective actions.</p> <p>There are no clearly documented criteria and accountabilities to ensure that LL related to Project Management are documented in the RMO tool. No accountabilities or guidelines are currently in place to ensure that lessons learned are shared and institutionalized by relevant groups through formally monitored action plans.</p> <p>Observations noted include:</p> <ul style="list-style-type: none"> <li>• LL documented in the RMO tool are not consistently addressed with action plans. From a sample of 15 of the 29 LL Reports, only two of the 15 had actions generated from the recommendations identified in the reports; and</li> <li>• Metrics for LL performance have not been collected and reported since July 2015, and the guidance document which provided the required metrics is no longer in effect.</li> </ul>	<p>Up to Release Quality Estimate (“RQE”), a very robust LL program was in place in the Planning and Control organization. It was decided at RQE that the LL program would be managed and administered by the Managed Systems Oversight (“MSO”) organization.</p> <p>MSO will secure a dedicated resource and re-establish the program.</p> <p>Action Plan Status: Open, Target Completion Date 11/15/2016</p>	Low
16-08 DNR – Contractor	<b>Invoices for some of the Owner Specified Materials (“OSM”) and goods were not submitted with the contractor’s invoice.</b>	Going forward, the RFR Project Oversight team will require the contractor, as part of the monthly	Moderate

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**Ontario Power Generation**  
**Internal Audits on Darlington Nuclear Refurbishment (“DNR”)**  
**Period: January 1, 2014 to September 30, 2016**

Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
Invoicing Audit (March 31, 2016)	<p>The Engineering, Procurement and Construction (“EPC”) agreement for the Re-tube and Feeder Replacement (“RFR”) project requires that the contractor provide copies of invoices for all OSM and goods purchased as part of their monthly invoice submission. These invoices should expressly set out the actual costs, net of all discounts, rebates and refunds.</p> <p>IA noted that the SLN-Aecon Joint Venture did not provide invoices for OSM and goods purchased as part of its monthly RFR invoice submission. Currently, OPG requests the contractor to supply copies of invoices for significant items of OSM and goods. In 2015, procurement costs on this project, including OSM and goods, were \$28.9M. A sample of five monthly RFR invoices representing approximately 60% of the total procurement costs were reviewed (OSM - \$14.7M and goods - \$3.2M).</p> <ul style="list-style-type: none"> <li>• Of the \$14.7M OSM invoices reviewed, 99.98% were well-supported with documentation;</li> <li>• However, of the \$3.2M of goods reviewed; approximately \$383k (12%) did not have supporting invoices.</li> </ul> <p>For significant items, invoices were provided by the contractor and no exceptions were noted in the sample of OSM and goods invoices reviewed.</p>	<p>invoice submission, to provide copies of invoices for:</p> <ol style="list-style-type: none"> <li>1. all OSM line items;</li> <li>2. all goods line items above a certain threshold; and</li> <li>3. a sample of goods line items below the threshold, upon request.</li> </ol> <p>Additionally, the contractor will be requested to provide copies of invoices of all OSM and goods for the year 2015, which have not been previously included in the monthly invoice packages.</p> <p>Action Plan Status: Closed</p>	
16-08 DNR – Contractor Invoicing Audit (March 31, 2016)	<b>The review frequency for changes in labour rates and potential overbilling across DNR projects was not clearly defined.</b>	<p>Nuclear Projects Controllershship will establish an appropriate review frequency of:</p> <ol style="list-style-type: none"> <li>1. consistency of labour rates; and</li> <li>2. employee hours for overbilling across DNR</li> </ol>	Moderate

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**Period: January 1, 2014 to September 30, 2016**

Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
	<p>In supporting OPG Project Managers in their review of reimbursable salary costs for the RFR project, the Senior Financial Analyst periodically verifies that the hourly rate for each employee was consistently charged month over month and that pay rate changes were justified. There is also a periodic review of each employee’s hours across different DNR projects to detect overbilling of hours.</p> <p>IA noted the following issues:</p> <ul style="list-style-type: none"> <li>• The review of the month over month changes to labour rates was not performed in 2015; and</li> <li>• The review of employee hours for overbilling across DNR projects was performed only once in 2015.</li> </ul> <p>The monthly billing of reimbursable salary costs for the RFR project ranged from \$3M to \$5M. As part of the RFR contract audit, an external audit firm, KPMG, has been engaged to validate that salary charges were consistent with the amounts paid to employees and were supported by approved time records. An audit is currently under way.</p>	<p>projects.</p> <p>Action Plan Status: Closed</p>	
16-08 DNR – Contractor Invoicing Audit (March 31, 2016)	<p><b>Retention requirements for the supporting documentation of contractor invoices were not fully established.</b></p> <p>Supporting documentation for contractor invoices, including statutory declaration forms, milestone completion certificates, salary details and invoices for expenses, contains valuable information that support effective management of the DNR program. Such documentation may be required for future reference in the event of a legal dispute and should therefore</p>	<p>Management will establish a document management process for the retention of the supporting documentation for contractor invoices, including:</p> <ol style="list-style-type: none"> <li>1. details of documents to be retained;</li> <li>2. location of the document repository; and</li> <li>3. document retention period.</li> </ol> <p>Action Plan Status: Closed</p>	Low

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**Ontario Power Generation**  
**Internal Audits on Darlington Nuclear Refurbishment (“DNR”)**  
**Period: January 1, 2014 to September 30, 2016**

Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
	<p>be retained over the duration of the DNR program and a number of years thereafter. The retention process should ensure that the records can be readily accessed and retrieved as needed.</p> <p>IA noted that the supporting documentation for contractor invoices was not retained through a process that ensured their accessibility and retrievability in the future. These documents were kept in the DNR Contract Management shared folder for the respective major project bundles, which was not subject to an established controlled process. FIN-0003 of the Corporate Records Retention Schedule (“CRRS”) for Accounts Payable Invoices and Vouchers, which requires a retention period of six years, does not meet the requirements of the DNR program and does not specifically cover invoice supporting documentation. Though the relevant documents were available for the sample of invoices reviewed, their future availability may not be ensured.</p>		
16-08 DNR – Contractor Invoicing Audit (March 31, 2016)	<p><b>Certain reimbursable work for the Defueling project was billed at invalid labour rates.</b></p> <p>Reimbursable labour costs are payable to the contractor either on an actual cost incurred basis, which is the case for the RFR project or based on rates defined in the contract, as in the case of the Defueling project. The Engineering Services and Equipment Supply Agreement (“ESA”) for the Defueling project established labour rates for engineering grades E1, E2, E3 and E6.</p>	<p>The Defueling Project Oversight Team will:</p> <ol style="list-style-type: none"> <li>1. verify that the labour rates for reimbursable work are consistent with the approved rates as per the contract; and</li> <li>2. request the contractor to issue a credit for the overbilling against the next invoice.</li> </ol> <p>Action Plan Status: Closed</p>	Low

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**Ontario Power Generation**  
**Internal Audits on Darlington Nuclear Refurbishment (“DNR”)**  
**Period: January 1, 2014 to September 30, 2016**

Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
	In reviewing the sampled invoice for Defueling reimbursable costs, IA noted that one individual was charged under an E4 rate, which is not an approved contract rate. The identification of an invalid labour rate prompted a review of all invoices for reimbursable work, which started in 2015. It was then reported that invalid E4 and E7 rates were also charged in two other invoices. In total, reimbursable work on the Defueling project was overcharged by approximately \$2,000 out of \$2.1M paid to date.		
16-09 DNR Onboarding (March 29, 2016)	<p><b>Some contract employees were working and granted IT access prior to being security cleared.</b></p> <p>OPG contract employees are contractually required to comply with OPG’s Clearance Process (PROC-0119), which requires clearance for:</p> <ul style="list-style-type: none"> <li>• All contractors working at OPG sites, and;</li> <li>• Requiring access to OPG IT assets.</li> </ul> <p>Through data analysis of the Nuclear Onboarding System (“NOS”), a sample of 50 OPG contract employees was selected to confirm that they had obtained security clearance prior to working on OPG jobs. Audit testing noted four exceptions:</p> <ul style="list-style-type: none"> <li>• Three individuals were working before they had obtained their required security clearance, one of whom has been billing OPG since 2011; and</li> <li>• Two individuals (one of which was included in the three above) had access to a key IT system (i.e. Asset Suite) prior to being security cleared.</li> </ul>	<p>Management has sent out communications to DNR staff to reinforce security clearance requirements for contractors. Management will also formally re-communicate with contractors the importance of obtaining security clearance before any OPG work begins including granting access to AS7 or the OPG LAN.</p> <p>Action Plan Status: Closed</p>	Moderate



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**Ontario Power Generation**  
**Internal Audits on Darlington Nuclear Refurbishment (“DNR”)**  
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Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
	Contractor companies and the related OPG sponsors confirmed that none of the identified individuals related to trades people or those working in the protected areas of the nuclear sites. Security & Emergency Services (“SES”) personnel confirmed that security clearance had been obtained before issuing site access cards.		
16-09 DNR Onboarding (March 29, 2016)	<p><b>There is not an independent confirmation of NGET by SES at site.</b></p> <p>Prerequisite training (i.e. Nuclear General Employee Training “NGET”) must be completed before an access card to the site is issued. Data in the NOS tool or a paper form (N-FORM-10913-R010) are relied upon by SES at the site identification office to signal NGET has been completed. The contractor coordinators (Black &amp; MacDonald, ES FOX, and JV) co-located to the Nuclear Onboarding Centre (“NOBC”) routinely select “NGET Confirmed – On request” into the NOS system. There is no independent confirmation by OPG that the NGET training has been completed by the contractors.</p> <p>IA tested a sample of 25 individual’s NOS training records to Training Information Management System (“TIMS”) training records and no discrepancies were noted.</p>	<p>SES will undertake a self-assessment of the confirmation process, including additional comparison of contractor approved training records to TIMS records. The results of this self-assessment will determine what changes are needed.</p> <p>Action Plan Status: Closed</p>	Low
16-13 DNR Contractor and Subcontractor Management Audit	<p><b>A formal process has not been established to facilitate Contractor notification and OPG adjudication of former OPG employees hired by Contractors.</b></p>	People & Culture – Talent Management, in conjunction with DNR, will review the Rehiring Procedure and related labour and legal matters to determine how the notification and approval	Moderate

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**Ontario Power Generation**  
**Internal Audits on Darlington Nuclear Refurbishment (“DNR”)**  
**Period: January 1, 2014 to September 30, 2016**

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(June 13, 2016)	<p>Re-hiring Of Former OPG Employees governance (OPG-PROC-0145 ) requires that indirect employees hired by a vendor in a “managed task” arrangement or who work without direct supervision of OPG management shall not be hired within six months from the date of termination or retirement.</p> <p>Consistent with this procedural document, Nuclear Refurbishment contracts evaluated during this audit required Contractors to disclose in writing to OPG: “The names of each of the contractor’s personnel who will be providing Work at the Site continuously, who is a former OPG employee and who received a severance package from OPG, is receiving pension payments from OPG or is receiving a non-working pension bridge from OPG”.</p> <p>However, with the exception of the Extended Services Master Service Agreement (“ESMSA”) contract, a procedure has not been established to facilitate contractor notification and formal OPG assessment of Contractor placement of former OPG employees in DNR work.</p>	<p>process for contractors rehiring former OPG employees can be standardized.</p> <p>Action Plan Status: Open, Target Completion Date 12/16/2016</p>	
16-13 DNR Contractor and Subcontractor Management Audit (June 13, 2016)	<p><b>A formal dispute resolution document is not utilized across all Nuclear Refurbishment contracts.</b></p> <p>Disputes between OPG and the contractors are expected to be resolved cooperatively and in a timely manner. Disputes not resolved within 10 Business days, for Nuclear Refurbishment contracts and 30 days, for the ESMSA contract, will be brought to the attention of the Steering Committee to attempt to resolve the dispute.</p>	<p>Each major Refurbishment contract will be reviewed for a dispute tracking mechanism. An evaluation will be made to determine whether potential amendment to the contract is required (i.e. amendment to the mechanism or establishment of a new mechanism).</p> <p>Action Plan Status: Open, Target Completion Date 12/16/2016</p>	Low

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**Ontario Power Generation**  
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**Period: January 1, 2014 to September 30, 2016**

Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
	<p>However, with the exception of the “ESMSA Dispute Resolution Record”, formal documentation and tracking for disputes are not in place. As the Refurbishment project move into the execution phase, it is anticipated that the number of contractual disputes with our Engineering, Procurement and Construction (“EPC”) contractors will increase significantly. Failure to utilize a formal tracking mechanism and collect and retain proper documentation could affect the timeliness of the Steering Committee’s involvement and impair their ability to reach a final decision.</p>		
<p>16-23 DNR – Re-tube &amp; Feeder Replacement (“R&amp;FR”) Construction and Tooling Audit (June 30, 2016)</p>	<p><b>Validation that the Contractor has provided all required project deliverables to escrow has not been performed.</b></p> <p>Tooling Intellectual Property (“IP”) Rights are retained by the Contractor under the R&amp;FR Engineering, Procurement and Construction (“EPC”) Agreement. In order to provide OPG with access to the Tooling IP documentation in case of Contractor default, the Contractor is obligated to deposit the up-to-date IP documents (designs, drawings, software, licenses, manuals, etc.) into escrow monthly. Upon receipt, the third party escrow agent performs validation and verification of the received items against the list provided by the Contractor.</p> <p>IA noted that neither the escrow agent’s nor existing OPG oversight activities validate that all required files have been deposited into escrow for each Tooling package. While the OPG Project team members review the deliverables in the</p>	<p>Tooling project team will conduct an oversight activity to validate whether IP documents in escrow align with Final Design and Manufacture Complete documentation requirements. This will include a review of history dockets provided by the Contractor.</p> <p>Strategic Oversight 00000441 was created in RMO on May 25, with a target start date of June 15, 2016.</p> <p>Action Plan Status: Open, Target Completion Date 10/31/2016</p>	<p>Moderate</p>

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**Internal Audits on Darlington Nuclear Refurbishment ("DNR")**  
**Period: January 1, 2014 to September 30, 2016**

Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
	<p>Contractor's network space, no oversight has been performed to validate completeness of such documents in escrow.</p> <p>Per the Risk Log in the Risk Management Oversight ("RMO") tool i.e. Risk #11476, OPG oversight activity of IP escrow completed in 2014 identified issues with completeness of documentation. Since then, no subsequent escrow audits or oversights have been performed. IA was not able to verify that a comprehensive list of IP documents required to be in escrow has been compiled.</p> <p>IA also noted that no oversight has been established to ensure Tooling history dockets containing traceability of materials documentation have been turned over to OPG permanent records or deposited into escrow. The retention requirements of Tooling history dockets in OPG space are unclear.</p>		
16-23 DNR – Re-tube & Feeder Replacement ("R&FR") Construction and Tooling Audit (June 30, 2016)	<p><b>The R&amp;FR Tooling Project team is not consistently documenting and dispositioning open items arising from oversight activities.</b></p> <p>NK38-PLAN-09701-10126 R&amp;FR Project Oversight Plan identifies three levels of oversight for the R&amp;FR project: "In-Process", "Routine" and "Strategic". All DNR Project Teams are expected to fully utilize the RMO tool to document their activities for project oversight. RMO is an application tool used to track multiple project activities in a centralized repository (i.e. Risk, Actions, Decisions, Assumptions, Oversight, OPEX and Lessons Learned).</p>	<p>The Project team will document and assign actions arising from oversight findings in RMO or other management systems, and track them to completion to demonstrate relevant evidence going forward.</p> <p>Action Plan Status: Closed</p>	Moderate

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**Ontario Power Generation**  
**Internal Audits on Darlington Nuclear Refurbishment (“DNR”)**  
**Period: January 1, 2014 to September 30, 2016**

Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
	<p>We noted during the audit that the disposition of open items resulting from oversight activities and use of RMO are inconsistent:</p> <p><u>In-Process oversight (70% of the oversight effort)</u>  Ten of the sample of 20 Daily Logs for the R&amp;FR Tooling Project documented in RMO had identified oversight concerns that did not appear to be effectively dispositioned. We noted actions that are not assigned in the RMO for the log entries, and the reports attached to the logs indicated that they are forwarded for review without actions assigned.</p> <p><u>Strategic Oversight (10% of the oversight effort)</u>  The use of the RMO tool was inconsistent in assigning actions to address identified concerns in the Actions Tab. One exception noted that a strategic oversight activity that could not be completed by the OPG R&amp;FR Project team due to a lack of Contractor response. Although an SCR was filed for trending purposes, the oversight activity was not repeated or rescheduled.</p> <p><u>Routine oversight (20% of the oversight effort)</u>  The RMO tool is not utilized to document activities related to this level of oversight activities. Comments and deficiencies arising from the routine oversight of contractor deliverables are currently tracked to completion through the Comments and Disposition Sheets (“CDS”).</p> <p>Although exceptions are noted on the oversight activities</p>		

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**Internal Audits on Darlington Nuclear Refurbishment (“DNR”)**  
**Period: January 1, 2014 to September 30, 2016**

Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
	associated with the development of the R&FR tooling, it should noted that the tools have now successfully completed Factory Acceptance Testing and have been signed off by OPG.		
16-24 DNR – Turbine Generator Engineering Audit (June 28, 2016)	<p><b>Vendor schedules integrated to the OPG master program do not meet quality standards.</b></p> <p>██████████ each have their own Primavera P6 schedules which set out and track project activities, tasks, deliverables and milestones. These schedules are updated by the contractors on a monthly basis and provided to OPG for project oversight and integration into OPG’s level 3 integrated schedule for the DNR program (the “overall program schedule”).</p> <p>Prior to integration into the overall DNR Program schedule, OPG’s schedule management team performs a quality check to validate whether the schedules received from vendors meets quality control standards, using an industry-recognized standard for reviewing schedules (DCMA 14-point assessment). It is noted that a limited quality check was conducted on ██████████ schedule.</p> <p>We performed a quality check on each of the ██████████ Definition Phase schedules and noted the following integrity issues:</p> <ul style="list-style-type: none"> <li>• Schedule activities/tasks identified do not have predecessors and/or successors identifying inter-dependencies;</li> <li>• Activities identified with high floats (i.e. total float</li> </ul>	<ol style="list-style-type: none"> <li>1. ██████████ is addressing the noted issues within the Definition Phase schedule, focusing on key/substantial items.</li> <li>2. Going forward (i.e. for the Execution Phase and Unit 3 Definition Phase schedules), we will ensure the schedules meet the stated quality control requirements.</li> </ol> <p>Action Plan Status: Closed</p>	Low

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**Internal Audits on Darlington Nuclear Refurbishment (“DNR”)**  
**Period: January 1, 2014 to September 30, 2016**

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	<p>greater than two months); and</p> <ul style="list-style-type: none"> <li>Activities identified with a negative float (i.e. where negative float is the amount of time that must be recovered from subsequent tasks in order to meet the project’s overall completion timeline).</li> </ul> <p>The PMT is aware that [REDACTED] Definition schedule does not meet OPG quality standards, and understands and accepts the various reasons leading to non-compliance. To mitigate these issues and to ensure on-time delivery of the definition phase, OPG conducts weekly project update meetings with [REDACTED] design team to discuss progress of activities/tasks, reported variances and recovery plans to overcome any delays. Furthermore, the overall accuracy of the [REDACTED] schedule (i.e. reported timelines) was verified through substantive testing against the Submittal Tracker which tracks deliverables and no issues were noted. [REDACTED] is currently on track to meet their contractual deadlines.</p> <p>While quality issues were identified on the [REDACTED] Unit 2 Definition schedule, it should be noted that this phase is coming to an end.</p>		
16-25 DNR – Integrated Database (“DB”) for Project Reporting Audit (June 24, 2016)	<p><b>A review of OPG user access was not performed timely, in accordance with OPG-STD-0035 Identity and Access Management.</b></p> <p>Select users within NHSS and OPG have access to the IDB environment, for the purposes of developing and maintaining</p>	<p>Remove the individual account-level access to the IDB for the exceptions identified.</p> <p>Complete and issue the Reporting Team IDB Admin User Guide, which will set out the process for quarterly review of the system-generated</p>	Low

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Audit Title/ Reporting Date	Finding	Management Action Plan	Risk Rating
	<p>the database, and creating standard reports, respectively. Both NHSS and OPG user access to the IDB is provisioned upon approval from the requesting user’s direct supervisor and requires the user to have a valid OPG network account. Users are then assigned access based on pre-defined roles.</p> <p>OPG-STD-0035 Identity and Access Management section 2.2 (a) requires “Regular review and, if required, realignment of the access rights [...] annually, as a minimum, and more frequently based on the criticality/sensitivity of the application module involved based on a risk assessment.” While NHSS performs periodic reviews of NHSS users’ access, a similar review had not been performed by OPG for a period of approximately 18 months during which time the database was actively used to develop reporting.</p> <p>Management’s review of user access during the audit execution period identified three exceptions:</p> <ul style="list-style-type: none"> <li>• One terminated user whose access to the IDB was retained after their departure from the organization approximately two years ago. Although the user’s read-only access to the IDB was still provisioned, the associated OPG network account had been deactivated; and</li> <li>• Two OPG staff had account-level read-only access. This does not align with the IDB access management approach where access is provisioned based on pre-defined roles.</li> </ul>	<p>listing of access privileges.</p> <p>Action Plan Status: Closed</p>	



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**Internal Audits on Darlington Nuclear Refurbishment (“DNR”)**  
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<b>Audit Title/ Reporting Date</b>	<b>Finding</b>	<b>Management Action Plan</b>	<b>Risk Rating</b>
16-39 DNR Contractor Procurement – Retube & Feeder Replacement Project Audit (September 20, 2016)	No findings.	N/A	N/A

### Nuclear Oversight Rolling Audit Schedule Q3 2016 – Q3 2017

The Nuclear Oversight Rolling Audit Schedule is a 5 quarter rolling schedule.

#### Changes Since Last Revision

NO-2016-009 Pandemic Planning – Moved to 2017

NO-2016-031 DNR – Emergency Preparedness – Removed from audit schedule. Will now be an Assessment.

NO-2017-022 DNR – Engineering Change Control – Changed to Engineering Change Control / Design Management

#### Audits Added:

NO-2017-009 Environmental Qualification

NO-2017-011 Conduct of IMS

NO-2017-012 Pressure Boundary Program

NO-2017-015 Conduct of Engineering: Design Authority

NO-2017-019 Projects & Mods

NO-2017-020 Conduct of Engineering: Research & Technology

*For information about a specific audit, please contact the Audit Team Senior Manager or Audit Team Leader of the audit.*

Prepared by:



Sylvia Thornton, Nuclear Oversight

Date:

Sept. 1, 2016

Approved by:



Mark Knutson, Director  
Nuclear Oversight

Date:

Sep 9, 2016

Nuclear Oversight Rolling Audit Schedule Q3 2016 - Q3 2017

ID	Audit #	Task Name	Start	Finish	PNGS	DNCS	P&M	CORP	NWMD	DNR	IMS	Qtr 3, 2016			Qtr 4, 2016			Qtr 1, 2017			Qtr 2, 2017			Qtr 3, 2017		
												Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1																										
2	2016-015	Conduct of Maintenance	Mon 4/18/16	Fri 7/22/16	X	X		X	X	X																
3		Audit Conduct	Mon 5/30/16	Fri 6/24/16																						
4	2016-016	Records & Document Control	Mon 4/25/16	Fri 7/22/16	X	X	X	X	X	X	X															
5		Audit Conduct	Mon 6/6/16	Fri 6/24/16																						
6	2016-029	DNR - Conduct of Engineering	Mon 5/30/16	Fri 8/5/16							X															
7		Audit Conduct	Mon 6/13/16	Thu 6/30/16																						
8	2016-013	Risk & Reliability	Mon 5/16/16	Fri 8/12/16	X	X		X	X	X																
9		Audit Conduct	Mon 6/27/16	Fri 7/15/16																						
10	2016-010	OPG NIEP EVALUATION	Mon 9/12/16	Fri 9/16/16																						
11	2016-005	Major Components	Mon 6/27/16	Fri 9/23/16	X	X		X		X	X															
12		Audit Conduct	Mon 8/8/16	Fri 8/26/16																						
13	2016-021	Work Protection	Mon 6/27/16	Fri 9/30/16	X	X		X		X																
14		Audit Conduct	Mon 8/8/16	Fri 9/2/16																						
15		IAEA Operational Safety Review Team (OSART)	Mon 9/19/16	Thu 10/6/16	X																					
16	2016-028	DNR - Project Management	Mon 8/1/16	Fri 10/28/16							X															
17		Audit Conduct	Mon 9/12/16	Fri 9/30/16																						
18	2016-019	Pressure Boundary Program	Mon 8/1/16	Fri 10/28/16	X	X		X	X	X	X															
19		Audit Conduct	Mon 9/12/16	Fri 10/7/16																						
20		DNCS NSRB	Mon 10/3/16	Fri 10/28/16		X																				
21	2016-006	Fire Protection	Mon 9/12/16	Fri 11/25/16						X																
22		Audit Conduct	Mon 10/10/16	Fri 10/21/16																						
23		PLANNED OUTAGE - P1671	Thu 9/1/16	Thu 12/8/16	X																					
24	2016-017	Components & Equip Surveillance Program	Mon 9/12/16	Fri 12/9/16	X	X		X	X	X	X															
25		Audit Conduct	Mon 10/24/16	Fri 11/11/16																						
26	2016-025	Fuel Handling - Main Control Room	Mon 8/29/16	Fri 12/9/16	X	X																				
27		Audit Conduct	Tue 10/11/16	Fri 11/4/16																						
28	2016-022	Human Performance	Mon 9/19/16	Wed 12/21/16	X	X	X	X	X	X	X															
29		Audit Conduct	Mon 10/24/16	Fri 11/18/16																						
30																										
31		2017 AUDITS	Mon 1/2/17	Sun 12/31/17																						
32																										
33	2017-020	Conduct of Eng - Research & Technology	Tue 1/3/17	Fri 3/3/17					X																	
34		Audit Conduct	Mon 1/16/17	Fri 2/3/17																						
35	2017-016	Conduct of Maintenance	Tue 1/3/17	Fri 3/31/17	X	X		X	X	X	X															
36		Audit Conduct	Mon 2/13/17	Fri 3/3/17																						
37		PLANNED OUTAGE - P1751	Thu 1/5/17	Sun 4/9/17																						
38	2017-022	Engineering Change Control / Design Management	Mon 1/16/17	Fri 4/14/17	X	X	X	X	X	X	X															
39		Audit Conduct	Mon 2/27/17	Fri 3/17/17																						
40	2017-013	Training	Mon 1/9/17	Fri 4/21/17	X	X		X	X	X	X															
41		Audit Conduct	Tue 2/21/17	Fri 3/17/17																						
42		PLANNED OUTAGE - D1711	Mon 2/13/17	Sat 5/13/17																						
43	2017-019	Projects and Mods	Mon 3/6/17	Fri 6/2/17	X	X	X	X	X	X	X															
44		Audit Conduct	Mon 4/17/17	Fri 5/12/17																						
45	2017-010	Environmental Management	Mon 3/13/17	Fri 6/23/17	X	X	X	X	X	X																
46		Audit Conduct	Mon 4/24/17	Fri 5/19/17																						
47		PLANNED OUTAGE - P1711	Thu 3/23/17	Fri 6/30/17																						
48		PLANNED OUTAGE - P1742	Mon 5/22/17	Fri 6/30/17																						
49	2017-021	Conduct of Operations	Mon 4/17/17	Fri 7/28/17	X	X		X	X	X																
50		Audit Conduct	Mon 5/29/17	Fri 6/23/17																						
51	2017-015	Conduct of Engineering - Design Authority	Mon 5/22/17	Fri 8/4/17	X	X	X	X	X	X	X															
52		Audit Conduct	Mon 6/19/17	Fri 7/7/17																						
53	2017-008	Nuclear Security	Mon 5/15/17	Fri 8/25/17	X	X	X	X	X	X	X															
54		Audit Conduct	Mon 6/26/17	Fri 7/14/17																						
55	2017-011	Conduct of IMS	Mon 6/12/17	Fri 9/1/17																						
56		Audit Conduct	Mon 7/17/17	Fri 8/4/17																						
57	2017-009	Environmental Qualification	Mon 8/28/17	Fri 11/24/17	X	X		X		X																
58		Audit Conduct	Mon 10/9/17	Fri 10/27/17																						
59	2017-012	Pressure Boundary	Tue 9/5/17	Fri 11/24/17	X	X	X	X	X	X	X															
60		Audit Conduct	Mon 10/9/17	Fri 10/27/17																						
61		PLANNED OUTAGE - P1761	Thu 8/31/17	Wed 12/6/17																						
62	2017-006	Business Planning	Mon 11/6/17	Fri 12/22/17	X	X	X	X	X	X	X															
63		Audit Conduct	Mon 11/20/17	Fri 12/1/17																						

Blue Bars: Ops, Mtce & Cross Functional Programs. Team Senior Manager Leonard Erb  
Red Bars: Engineering Programs Team Senior Manager Herminia Román

**Board Staff Interrogatory #73**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-11, Attachment 3

In her report, Dr. Galloway refers to numerous documents that she reviewed but which are not included as part of the application evidence. Therefore, please provide copies of the following, which are referred to on the indicated page of the reference:

- a) Integrated Reporting Plan (pages 10 and 68)
- b) Project Oversight Standard (pages 36 and 42)
- c) Project Management Standard (page 42)
- d) Records of Interviews (numerous references)
- e) Program specific policies and procedures (page 43)
- f) Planning and Controls Program Management Plan (page 56)
- g) Risk Register (page 63)
- h) Nuclear Projects Risk Management manual (page 65)
- i) Readiness to Execute Plan (page 71)

**Response**

The following response has been prepared by Pegasus-Global Holdings:

As requested, the following documents for each reference are attached. Attachments 1 through 9 correspond to parts a) through i) of the interrogatory, respectively:

Attachment 1: Integrated Reporting Plan (May 11, 2016)

Attachment 2: Project Oversight Standard (N-STD-AS-0030 R001A)

Attachment 3: Project Management Standard (N-STD-AS-0028 R002)

Attachment 4: Please see L-4.3-1 SEC-22

Attachment 5: Darlington Refurbishment Program Structure (NK38-NR-PLAN-09701-10001)

Darlington Refurbishment Charter (D-PCH-09701-10000)

Witness Panel: Darlington Refurbishment Program



1 Nuclear Refurbishment Earned Value Management (N-MAN-00120-10001)

2  
3  
4 Nuclear Refurbishment - Cost Management and Reporting  
5 (N-MAN-00120-10001-PC-13 R000)

6  
7 Nuclear Refurbishment - Program Change Management  
8 (N-MAN-00120-10001-PC-12 R000)

9  
10 Darlington Nuclear Refurbishment Program - Scope Control  
11 (NK38-INS-09701-10001-R006)

12  
13 Nuclear Refurbishment – Milestone Definition Framework  
14 (N-MAN-00120-10001-SCH-06-R003)

15  
16 Darlington Refurbishment Program Milestone & Integrated Master Schedule  
17 (NK38-PLAN-00300-10000-R003)

18  
19 Darlington Refurbishment: Schedule Management Plan for Integrated Level  
20 3 Execution (N-MAN-00120-10001-SCH-11-R000)

21  
22 Nuclear Refurbishment Cost Estimate (N-MAN-00120-10001-EST-01-R001)

23  
24 Darlington Nuclear Refurbishment Program-Scope Control (NK38-INS-  
25 09701-10001-R006)

26  
27 Nuclear Refurbishment - Program Change Management  
28 (N-MAN-00120-10001-PC-12-R001)

29  
30 Darlington Refurbishment Program Quality Surveillance Guide (NK38-GUID-  
31 09701-10038-R000)

32  
33 Darlington Refurbishment Program Quality Plan  
34 (NK38-NR-PLAN-09701-10001-0023-R000)

35  
36 Retube Feeder Replacement Project Contractor/Owner Interface  
37 Requirements (NK38-DAI-09701-10008)

38  
39 Attachment 6: Darlington Refurbishment Planning and Controls Program Management  
40 Plan (NK38-NR-PLAN-09701-10001-0002-R001)

41  
42 Attachment 7: RQE Contingency Development Report (NK38-REP-09701-10304)  
43 Risk Report by Project with Associated Actions

44  
45 Attachment 8: Nuclear Projects Risk Management (N-MAN-00120-10001-RISK-R002)

46  
Witness Panel: Darlington Refurbishment Program

1 Attachment 9: Refurbishment Readiness for Execution (April 26, 2016)  
2  
3 Readiness to Execute Plan (Rev. 2)  
4

# Darlington Refurbishment Program

Reporting  
May 11, 2016

## BEHAVIOURS

- Say It, Do It
- Simplify It
- Think Top and Bottom Line
- Integrate and Collaborate
- Tell It As It Is



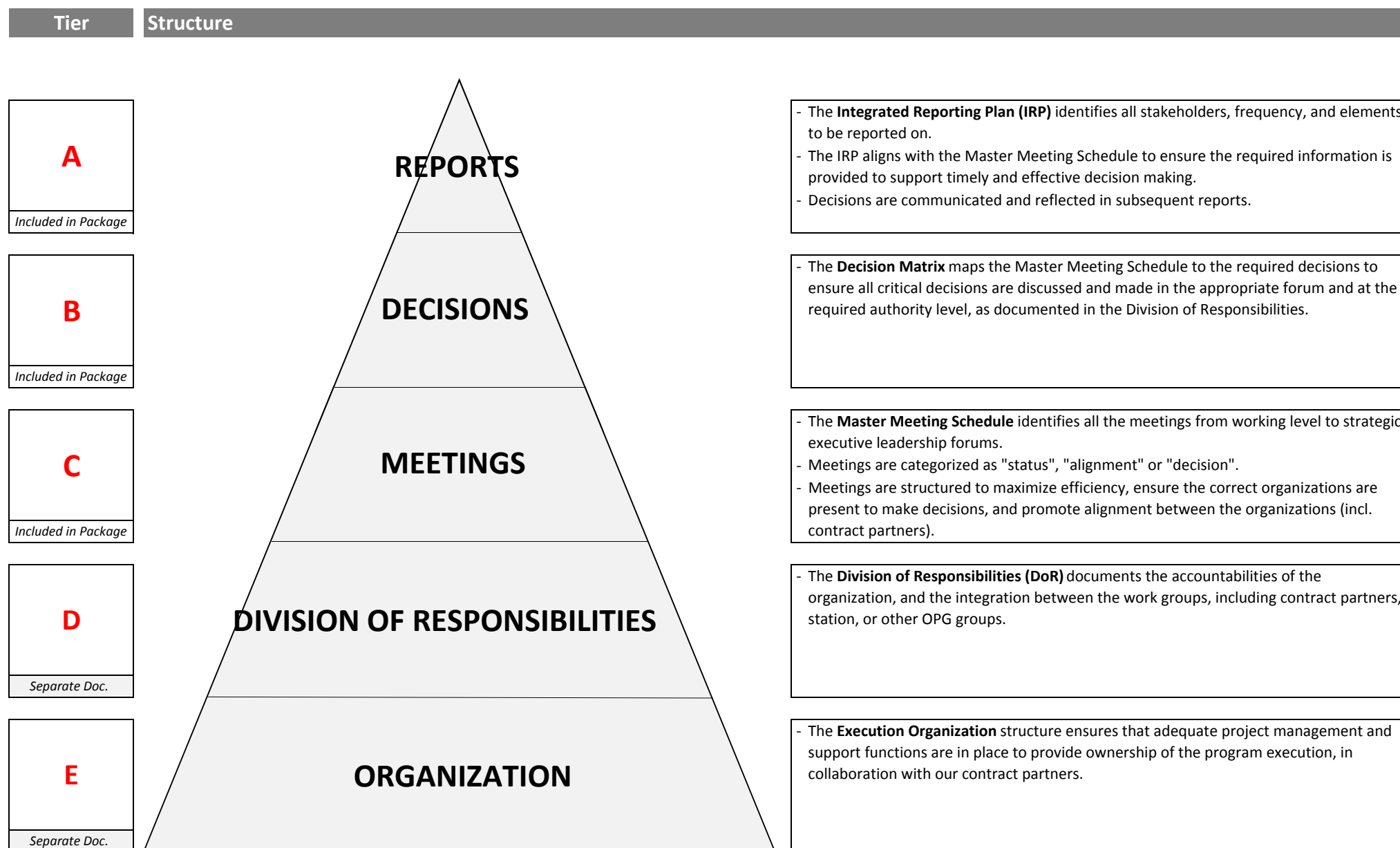
**VALUES** ▪ SAFETY ▪ INTEGRITY ▪ EXCELLENCE ▪ PEOPLE & CITIZENSHIP ▪



## SECTION 1: INTEGRATED REPORTING PLAN







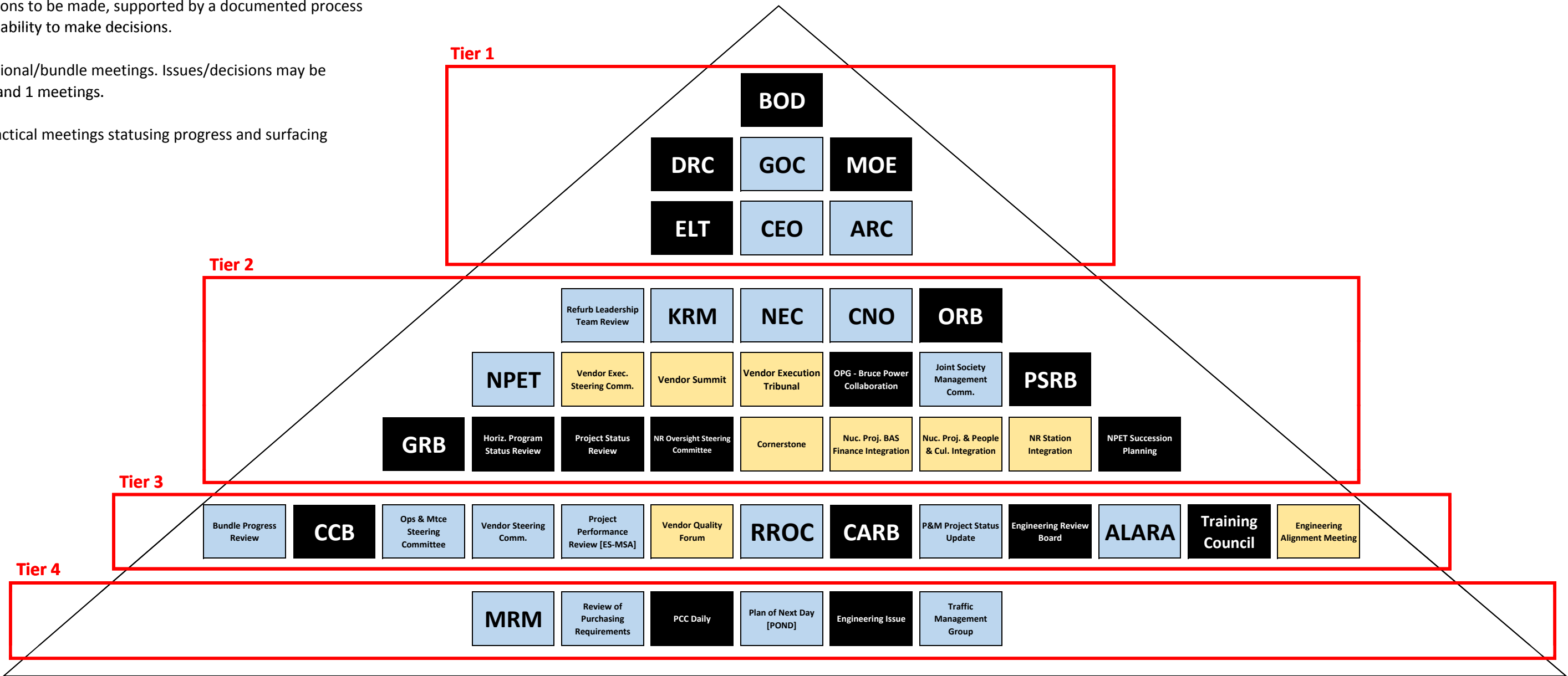
The Master Meeting Structure Tiers:

**Tier 1** - Strategically driven - focuses on strategic direction/decision making, major project risks and significant barriers impacting the safety, quality, cost and schedule objective.

**Tier 2** - Process Driven - An information/communication forum with the potential for decisions to be made, supported by a documented process that facilitates the ability to make decisions.

**Tier 3** - Cross functional/bundle meetings. Issues/decisions may be elevated to Tier 2 and 1 meetings.

**Tier 4** - Working/tactical meetings statusing progress and surfacing issues.



Text	Blue: Meeting is to provide information on the status of NR Program.
Text	Gold: Meeting is to ensure alignment between work groups, including contract partners, station, or other OPG groups.
Text	Black: Core meetings required to facilitate decision making.

**Note: The following meetings have not been included but are occurring: Face to Face Meetings, Pre-Req Working Meeting, Direct Report Meetings, Vendor Project Review Meetings and Field Walk Downs, SCR Screening Meetings**

Tier	Priority Meetings *	Key Reports	Actions / Decisions resulting from Report/Meeting	Decision Makers
1	<div>BOD</div> <div>Board of Directors</div>	<div>- Darlington Refurbishment Committee Report</div> <div>- Audit and Risk Committee Report</div>	<div>- Acceptance of DRC Committee Report</div> <div>- Approval of Board Motions as presented by DRC, i.e. Funding Requests</div>	Board of Directors
	<div>DRC</div> <div>Darlington Refurb Comm.</div>	<div>- DRP Status Memo</div> <div>- DRP Construction Review Board Report</div> <div>- DRP Assurance Reports</div> <div>- DRP External Oversight Report</div> <div>- DRP Requests for Funding</div> <div>- Bruce Collaboration Report</div>	<div>- Recommendation for Approval of Program Funding - Motion to Board</div> <div>- Acceptance of DRP Status Memo, Assurance Reports, Oversight Reports, and Management Direction as Required</div>	Members of the DRC
	<div>MOE</div> <div>Ministry of Energy</div>	<div>- Minister Stakeholder Report</div> <div>- External Oversight Report [MOE]</div>	<div>- Concurrence of BOD Decisions, when Required</div> <div>- Management Direction as Required, or Requests for Information</div> <div>- Continued support of the DRP</div>	Members of the Ministry of Energy
	<div>GOC</div> <div>Generation Oversight Committee</div>	<div>- Nuclear Safety Review Board Report</div>	<div>- Acceptance of NSRB Report and Management Direction as Required</div>	Members of the GOC
	<div>ARC</div> <div>Audit and Risk Committee</div>	<div>- Internal Audit Quarterly Report</div> <div>- Quarterly Enterprise Risk Management Report</div>	<div>- Acceptance of Reports and Management Direction as Required</div>	Members of the ARC
	<div>CEO</div> <div>President &amp; Chief Executive Officer</div>	<div>- Information Reports per Agenda</div>	<div>- CEO Review and Follow-up Actions as Required</div>	CEO
	<div>ELT</div> <div>Exec. Leadership Team DRP Review</div>	<div>- DRP Status Report [to ELT]</div> <div>- DRP Project Summary Reports</div> <div>- Company Support Reports</div> <div>- DRP Status Memo [to DRC]</div> <div>- Additional Information Reports</div>	<div>- Acceptance of Reports and Management Direction as Required</div>	Members of the ELT
2	<div>KRM</div> <div>Key Results Meeting</div>	<div>- KRM Report</div> <div>- Corporate Scorecard</div>	<div>- Acceptance of Reports and Management Direction as Required</div>	Members of the ELT
	<div>NEC</div> <div>Nuclear Exec. Comm.</div>	<div>- DRP Status Report [to NEC]</div>	<div>- Acceptance of Reports and Management Direction as Required</div>	Members of the NEC
	<div>CNO</div> <div>Chief Nuc. Officer Call</div>	<div>- CNO Weekly DRP Status Report</div> <div>- Key Project Performance Reports</div>	<div>- CNO Review and Follow-up Actions as Required</div>	CNO
	<div>NPET</div>	<div>- Periodic Status Reports</div> <div>- Communication of Strategic Initiatives</div>	<div>- Acceptance of Reports and Actions as Required</div> <div>- Feedback on Strategic Initiatives and Further Communication to Management Teams</div>	Members of the NPET
	<div>Vendor Exec. Steering Comm.</div>	<div>- Vendor Exec. Steering Committee Report</div>	<div>- Review of Status Reports, initiation of recovery plans when required</div> <div>- Removal of barriers, and resolution of high level issues between OPG and the contract partner</div>	Members of the NPET Executive Contract Partners
	<div>Vendor Summit</div>	<div>- Information Reports per Agenda</div>	<div>- Removal of barriers, and resolution of high level issues and opportunities between OPG and the contract partners</div>	Project Managers Contact Partners Management Team
	<div>Vendor Execution Tribunal</div>	<div>- Information Reports per Agenda</div>	<div>- Removal of barriers, and resolution of high level issues and opportunities affecting the Refurbishment Program (OPG and the contract partners)</div>	Members of the NPET Executive Contract Partners
	<div>OPG - Bruce Power Collaboration</div>	<div>- Information Reports per Agenda</div> <div>- OPG-Bruce Power Collaboration Report</div>	<div>- Review and Accept Collaboration Report</div> <div>- Removal of integration issues between OPG and Bruce Power. Sets direction of collaboration efforts</div>	CNO OPG and Bruce Power Members of the NPET Members of Bruce Power
	<div>Joint Society Management Comm.</div>	<div>- Information Reports per Agenda</div>	<div>- Discuss and resolve high level issues between DRP Management and The Society</div>	Members of the Joint Society Management Comm.
	<div>Refurb Leadership Team Review</div>	<div>- Information Reports per Agenda</div>	<div>- Strategic level review of the cited programs to prevent issues and early action to correct trends</div>	Execution VPs Project Directors
	<div>PSRB</div> <div>Prog. Scope Review Board</div>	<div>- Program Scope Review Package</div>	<div>- Approval of scope changes</div> <div>- Approval/recommendation on how scope will be funded</div>	Members of the PSRB
	<div>GRB</div> <div>Gate Review Board</div>	<div>- Gate Review Board Package</div>	<div>- Acceptance of Gate Package including scope, execution plans, risk &amp; mitigation plans and change analysis</div> <div>- Approval of funding release to next gate</div>	Members of the GRB
	<div>ORB</div> <div>Options Review Board</div>	<div>- Proposals per Agenda</div>	<div>- Review/discuss alternatives to complete scope, efficiency or contain cost</div> <div>- Endorse or reject proposals</div>	Members of the NPET Project Directors
	<div>Horiz. Program Status Review</div>	<div>- Horizontal Program Status Report</div>	<div>- Acceptance of Horizontal Program Status Report</div> <div>- Management Direction as Required</div>	Members of the NPET Project Directors
	<div>Project Status Review</div>	<div>- Project Status Report</div>	<div>- Acceptance of Project Status Report</div> <div>- Management Direction as Required</div>	Members of the NPET
	<div>NR Oversight Steering Committee</div>	<div>- NR Oversight Steering Committee Report</div>	<div>- Removal of issues impacting the planning, execution, documentation and communication of Nuclear Refurbishment Oversight performed by all groups in Refurbishment</div>	Members of the NR Oversight Steering Comm.
	<div>Cornerstone</div>	<div>- Information Reports per Agenda</div>	<div>- Alignment of NR management team</div>	Nuclear Refurbishment Leaders [MP6 and above]
	<div>Nuc. Proj. BAS Finance Integration</div>	<div>- Information Reports per Agenda</div>	<div>- Resolution of any issues affecting Nuc. Proj, BAS and Finance integration</div>	Senior Leaders of NP, BAS and Finance
	<div>Nuc. Proj. &amp; People &amp; Cul. Integration</div>	<div>- Information Reports per Agenda</div>	<div>- Resolution of any issues affecting NP and People and Culture, including communications and training</div>	Members of the NPET and People & Culture
	<div>NR Station Integration</div>	<div>- Information Reports per Agenda</div>	<div>- Removal of issues impacting integration of Refurbishment activities with station activities; initiate corrective actions as required</div>	Members of NR and Station Senior Leadership Team
	<div>NPET Succession Planning</div>	<div>- NR Succession Plan Reports</div>	<div>- Review and assess succession plans, determine roles requiring a succession plan, assess successors, and adjust as required</div>	Members of the NPET and People and Culture

\* Meeting List not intended to be all-inclusive

- Text

Blue: Meeting is provides information on the status of NR Program.
- Text

Gold: Meeting is to ensure alignment between the work groups, including contract partners, station, or other OPG groups.
- Text

Black: Core meetings required to facilitate decision making.

DRP = Darlington Refurbishment Program  
NR = Nuclear Refurbishment

Tier	Priority Meetings *	Key Reports	Actions / Decisions resulting from Report/Meeting	Decision Makers
3	<div>CCB</div> <div>Change Control Board</div>	<div><div></div><div><div>- Change Control Summary List</div><div>- Change Control Form's</div><div>- Change Control Trends and Drawdown Summary</div></div></div>	<div><div>- Assess and challenge nature of change</div><div>- Approval of any change from plan within the CCB's authority</div><div>- Assess overall trends and initiate corrective action when required</div></div>	Members of the Change Control Board
	<div>Ops &amp; Mtce Steering Committee</div>	<div><div></div><div><div>- Discussion items as required</div></div></div>	<div><div>- Review of current status and future readiness for both the NR and site O&amp;M .</div><div>Resolution of integration issues</div></div>	CNO and Members of the NR O&M and Station O&M
	<div>Vendor Steering Comm.</div>	<div><div></div><div><div>- Vendor Performance Reports</div></div></div>	<div><div>- Assess status of performance and initiate recovery plans when required.</div></div>	Members of the NPET and Project Teams
	<div>Bundle Progress Review</div>	<div><div></div><div><div>- Bundle Progress Reports</div></div></div>	<div><div>- Assess status of performance and initiate recovery plans when required.</div></div>	Project Dir, Vendor Lead & Execution Senior Leadership
	<div>Project Performance Review [ES-MSA]</div>	<div><div></div><div><div>- Vendor Performance Reports/Scorecard</div></div></div>	<div><div>- Assess status of performance and initiate recovery plans when required.</div></div>	Members of the NPET and Project Teams
	<div>P&amp;M Project Status Update</div>	<div><div></div><div><div>- Project Progress Reports</div></div></div>	<div><div>- Assess status of performance and initiate recovery plans when required.</div></div>	Members of the NPET and Project Teams
	<div>Vendor Quality Forum</div>	<div><div></div><div><div>- Vendor Quality Forum Package</div></div></div>	<div><div>- Assess Quality issues and initiate plans to address, follow-up on status.</div></div>	OPG Quality Management and Contract Partners
	<div>RROC</div> <div>Refurb Risk Oversight Comm.</div>	<div><div></div><div><div>- Refurb Risk Oversight Report</div></div></div>	<div><div>- Decisions on Key Risk Areas that require executive level oversight. These form the basis for upwards and external risk reporting</div></div>	Members of RROC
	<div>CARB</div> <div>Corrective Actions Review Board</div>	<div><div></div><div><div>- Review of A and B Level Root Cause Evaluations</div><div>- Review of OPEX and Trend Reports</div><div>- Corrective Action Plan Statistics</div></div></div>	<div><div>- Acceptance of Corrective Action Plans</div><div>- Agree on initiatives to resolve unfavourable Trends and apply OPEX</div><div>- Approve A and B Level Root Cause Evaluations</div></div>	Members of CARB
	<div>Engineering Alignment Meeting</div>	<div><div></div><div><div>- Discussion Items as Required</div></div></div>	<div><div>- Alignment of Nuc. Proj. Engineering staff</div></div>	Nuc. Proj. Engineering
	<div>Engineering Review Board</div>	<div><div></div><div><div>- Engineering Review Board Package</div></div></div>	<div><div>- Correction of adverse trends related to engineering</div><div>- Resolution of engineering issues</div></div>	Members of the ERB
	<div>ALARA</div> <div>As Low As Reasonably Achievable</div>	<div><div></div><div><div>- ALARA or DOSE Reports</div></div></div>	<div><div>- Assess DOSE reports and initiate action as required.</div><div>- Review ALARA plans and opportunities to reduce DOSE assess doability, cost, and provide direction.</div></div>	ALARA Committee
	<div>Training Council</div>	<div><div></div><div><div>- Training Statistics Report</div><div>- Training Qualification Reports</div></div></div>	<div><div>- Review and discuss Training Indicators, assess overall trends and initiate corrective actions as required</div><div>- Review and approval of new training programs qualification requirements</div></div>	Training Council Quorum Members
4	<div>PCC Daily</div> <div>Project Control Centre</div>	<div><div></div><div><div>- PCC Package</div><div>- Action Log</div></div></div>	<div><div>- Review the plan of the day, and assess readiness</div><div>- Resolution of issues/conflicts</div></div>	Project Teams Functional Teams Contract Partners
	<div>Traffic Management Group</div>	<div><div></div><div><div>- <i>under development</i></div></div></div>	<div><div>- MTO, Clarington, Darlington work scope around DNGS</div></div>	Execution Team
	<div>Plan of Next Day [POND]</div>	<div><div></div><div><div>- POND Package</div></div></div>	<div><div>- Review the plan of the next day, and asses readiness</div><div>- Resolution of issues/conflicts</div></div>	Project Teams Functional Teams Contract Partners
	<div>Review of Purchasing Requirements</div>	<div><div></div><div><div>- Procurement Priority Sheet</div></div></div>	<div><div>- Resolution of issues/conflicts/constraints to Execution Procurement</div></div>	Project Teams Nuc. Proj. Suply Chain Leadership
	<div>Engineering Issue</div>	<div><div></div><div><div>- Engineering Issue Log</div></div></div>	<div><div>- Review and resolve engineering issues</div></div>	Nuc. Proj. Engineering
	<div>MRM</div> <div>Management Review Meeting</div>	<div><div></div><div><div>- Station Condition Record MRM Package</div></div></div>	<div><div>- Review and assess the resolution categories assigned to NR SCRs</div><div>- Assess SCRs for Operability and Reportability</div></div>	Project Teams Functional Teams

\* Meeting List not intended to be all-inclusive

- Text

Blue: Meeting is provides information on the status of NR Program.
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External Stakeholders															Shareholder															Internal Stakeholders														
Public		INPO WANO	COG	Unions	CNSC	MOE	BOD	DRC	GOC	ARC	ELT	NEC	CNO	CNE	NPET		NP Senior Leadership		OPG Staff	Bundle Project Directors & PM's	OPG Functional Depart.																							
		World Assoc. Nuclear Operators	Candu Owners Group	PWU, Society	Canadian Nuclear Safety Commission	Minister of Energy	OPG Board of Directors	Darlington Refurb Committee	Generation Oversight Committee	Audit and Risk Committee	Executive Leadership Team	Nuclear Executive Committee	Chief Nuclear Officer	OPG Corporate "Fleet View"	Nuclear Projects Executive Team		Nuclear Projects Senior Leadership Team																											
Annual	Public Performance Report	Annual INPO/WANO Report	Annual COG Report		Annual CNSC Report		X ←	Refurb Program Review Board Report	Nuclear Safety Review Board Report																																			
	Bruce Collaboration Report																																											
Semi- Annual	Public Performance Report																																											
Quarterly	MD&A			Quarterly Report to Unions		Ind. External Assessment Report	X ←	DRP Assurance Report		Internal Audit Quarterly Report	X ←	DRP Status Report				Quarterly Vendor Executive Steering Committee Report																												
							X ←	DRP Constrction Review Board Report															DRP Project Summary Reports																					
							X ←	Ind. External Assessment Report																Company Support Reports																				
						X ←	DRP Requests for Funding	DRP Status Memo		Succession Planning Report																																		
						X ←	DRP Status Memo									Quarterly Enterprise Risk Management Report	Additional Information Reports																											
						X ←	OPG-Bruce Power Collaboration Report																																					
Ad-Hoc																Program Scope Review Board [PSRB] Packages	Gate Review Board [GRB] Packages	Options Review Board [ORB] Packages																										
Bi-Monthly																Refurb Risk Oversight Committee [RROC] Report																												
Monthly											Key Results Meeting & Corporate Scorecard	DRP Status Report [to NEC]			Vendor Execution Tribunal Package	Vendor STEECO Reports (by Bundle)	NR Oversight Steering Committee Report	Cornerstone Package			Engineering Review Board Report																							
															Horiz. Program Status Report	Nuc. Proj. BAS Finance Integration Package	Ops & Mtce Steering Committee Report	Corrective Action Review Board Report																										
															Project Status Reports (By Bundle)		Nuc. Proj. & HR Integration	Vendor Quality Forum Package																										
Twice a Month																Project Performance Review (ES FOX/B&M Vendor) Package					Work Management Integration Report	MRM																						
															NR Station Integration Report	Change Control Board [CCB] Report																												
Weekly													CNO Weekly Prog. Status Report	X ←	Key Progress Report				Weekly Flyer	Vendor Weekly Performance Reports (by Project)																								
															Key Project Performance Report																													
Daily																				PCC Daily Package	Engineering Issues Report																							
																				Plan of Next Day [POND] Package																								

Text	Green: Prepared by others i.e. OPG Corporate, or external 3rd Parties
Text	Black: Core Reports/detailed data used to manage projects

Text Grey: Oversight / Stakeholder Management Reports & Summary Level

Text Gold: Prepared by Vendors



Internal Use Only		
Document Number:	Revision	
N-STD-AS-0030	R001A	
Usage Classification:	Sheet Number:	Page:
Information	N/A	1 of 8

# Nuclear Standard

## TITLE

**PROJECT OVERSIGHT STANDARD**

## AUTHORIZATION

SINGLE POINT OF CONTACT:

~~D. Popovic~~ D. Stiers

Director, ~~Projects and Modifications~~ Management Systems Oversight, Nuclear Projects

DOCUMENT OWNER:

~~A. Robb~~ M. Timberg

VP, ~~Projects and Modifications~~ Project Assurance & Contract Management, Nuclear Projects

## DOCUMENT RELATIONSHIP

Applicability:

All of Nuclear

Receives Authority from:

N-PROG-AS-0007, Project Management Program

Document is Related to Pressure Boundary ☐

Document Requires CNSC Notification ☐

## PURPOSE

This standard provides the criteria and behavioral requirements for Project Oversight and the key elements for oversight of projects executed in Ontario Power Generation – Nuclear (OPG-N). Project oversight is an important aspect of project management which is used to ensure project deliverables and objectives are achieved.

## DATES (YYYY-MM-DD)

PDF Creation Date:

2016-04-26

Compliance Date:

Immediate

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**Nuclear Standard**

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Usage Classification: Information	Sheet Number: N/A	Page: 2 of 8

Title:  
**PROJECT OVERSIGHT STANDARD**

**EXCEPTIONS**

None

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## Nuclear Standard

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N-STD-AS-0030	R001A	
Usage Classification:	Sheet Number:	Page:
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### Title: PROJECT OVERSIGHT STANDARD

## 1.0 DIRECTION

This standard provides the Project Oversight principles and requirements to be applied to projects initiated and/or executed within OPG-N. Oversight is the independent assessment necessary to ensure OPG and project objectives are achieved. It is distinct from the in-line and normal quality assurance and control process. Oversight is applicable but not limited to:

- Safety
- Quality
- Cost and schedule performance
- Solution effectiveness
- Value for money
- Regulatory and environmental compliance
- Human performance
- Project planning
- Engineering
- Procurement, suppliers and contractors
- Installation and construction activities

Oversight is based on a proactive and graded, risk based approach. The means by which the different executing organizations implement this standard may vary based on business requirements and taking into consideration the risk profile and complexity considerations of the particular project being undertaken.

### 1.1 Key Oversight Elements

- (a) Oversight shall be performed throughout the project lifecycle.
- (b) The extent and frequency of oversight shall be applied strategically using a graded approach based on project complexity, risks, and performance. The level of oversight shall be modified to reflect the current project performance and changes in the risk profile. Examples where increased levels of oversight may be required include:
  - Project areas that include new processes or technology
  - Activities of high consequence to safety, quality, cost or schedule
  - Critical evolutions or changes



## Nuclear Standard

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- Where suppliers are new or have performed less than expected on current and previous projects
  - Fabrication by sub-contractors
  - Where nuclear safety or operation may be impacted
  - Project areas with evidence of negative trends, e.g. cost, schedule, safety or quality performance.
- (c) Oversight shall be applied proactively in a manner that allows for early detection of potential issues and effective implementation of corrective actions. Methods of proactive oversight may include:
- Communicating and establishing expectations and targets
  - Conducting regular status meetings
  - Look ahead planning and strategizing
  - Conducting challenge and preparedness meetings
  - Performing direct observation, surveillance and assessments
  - Using trend analysis and performance metrics
  - Tracking and resolving issue
  - Prompt escalation of issues
- (d) Oversight shall be applied in a manner that respects contract terms and conditions. It does not direct the work of suppliers who are performing under their own approved management system. Oversight results shall be communicated to stakeholders through the pre-approved designated authority for the oversight.
- (e) Oversight shall be applied to the portfolio or program of projects as well as to individual projects. The portfolio or program oversight shall be conducted in a manner that ensures:
- communication, coordination and integration between projects in order to establish and understand the interrelationships
  - overall portfolio safety, quality, cost and schedule performance
  - a higher degree of oversight for large projects and programs that include multiple projects.
- (f) The oversight strategy, roles and responsibilities shall be documented in a project oversight plan. The oversight plan shall be reviewed and updated when required to meet the project objectives in alignment with project and supplier performance.

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- (g) The Project Manager should develop the oversight plan with stakeholder input and shall:
  - (1) Direct and execute the overall project oversight.
  - (2) Obtain the necessary resources to execute the oversight.
- (h) Oversight results that include corrective actions shall be documented and communicated to the appropriate project stakeholders.
- (i) Lessons learned are used for continuous improvement.

## 1.2 Project Oversight Process

Detailed process instructions, guides, work aids and good practices for all key elements of project oversight in OPG-N are provided in various documents which have been independently developed and implemented.

The following instructions have been -written to assist Project Managers and contract owners implement the requirements of N-STD-AS-0030 Project Oversight Standard (governance), N-STD-AS-0032 Oversight of Supplemental Personnel (governance), and the guidelines presented within the following documents:

N-MAN-09701-10002, Nuclear Refurbishment Project Oversight.

N-INS-09701-10007, Project Oversight Planning and Implementation

N-INS-00120-10026, Supplemental Personnel oversight

N-GUID-01920-10000, Guideline for Engineering Oversight

N-GUID-09701-10022, Supply Chain Oversight

N-GUID-09701-10120, Guideline for Construction Oversight

[N-GUID-00120-10008, Contractor Management Process](#)

N-INS-09701-10007, Project Oversight Planning and Implementation is primarily intended to assist with the development of the Project Oversight Plan (POP) particularly for obtaining consistency on format and content. This is essential when recognizing that there are various groups executing projects across OPG Nuclear. It is imperative that consistency in format and minimum content is required specifically because of, the variation in project cost, complexity, duration and risk, and user groups such as Inspection and Maintenance Services (IMS), Station Engineering and Project & Modifications(P&M).

[N-GUID-00120-10008, Contractor Management Process, identifies the minimum process requirements for monitoring a contractor during the field execution of contracted work at Ontario Power Generation Nuclear \(OPGN\).](#)

In addition, oversight departments charged with ensuring that adequate oversight is being applied on projects require consistency and some minimum standard for POP's in order to

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measure application of governance and foster continuous improvement through the analysis of oversight results.

The Oversight process documents are available on the OPG intranet through "PowerSearch" or as an E-Manual under the Nuclear Projects webpage.

## 2.0 ROLES AND ACCOUNTABILITIES

### Vice President - Nuclear Projects Oversight

The Vice-President - Nuclear Projects Oversight, acts as the Program Owner for oversight and sets direction, monitors compliance, and assesses effectiveness in accordance with N-STD-AS-0030 Project Oversight Standard,. This is also described in the Nuclear Refurbishment Project Oversight Guide, N-MAN-09701-10002. Nuclear Projects Oversight supports the project teams in the development of their Project Oversight Plans (POPs) and the associated tools, including training, as required.

### Project Manager

The Project Manager is accountable for the following:

- Ensure adequate oversight is planned and implemented for the project.
- Develop and implement the Project Oversight Plan (POP)
- Engage and utilize the support of the functional groups in the development and implementation of the POP.
- Determine and resource the project oversight team (functional & support group representation) and how they will function.
- Document the expectations around communicating (internal and with vendor) and on the importance of sharing critical oversight results in an expeditious manner.
- Communicate expectations around oversight effort (full time, part time, twice a week, etc).
- Hold recurring meetings with the project team to review oversight results and revise the POP as required.

### Functional Support Organization Managers:

The functional organizations, in accordance with approved RACI (Responsibility, Accountability, Consultation, Information) documentation, are accountable to identify the oversight to consider for inclusion in the POP. They are also accountable to provide additional and or specialized resources to execute the plan when requested by the Project Manager.

## 3.0 DEFINITIONS AND ACRONYMS

### 3.1 Definitions

None

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## 3.2 Abbreviations and Acronyms

None

## 4.0 BASES, RECORDS AND REFERENCES

### 4.1 Bases

None

### 4.2 Records

4.2.1 Any controlled documents which may be produced as a result of this document should be managed in accordance with OPG-PROC-0178, Controlled Document Management.

4.2.2 Any records which may be produced as a result of this document should be managed in accordance with OPG-PROC-0019 Records and Document Management, and N-MAN-00120-10001-RDM Nuclear Projects Records and Document Management.

### 4.3 References

#### 4.3.1 Performance References

[N-GUID-00120-10008, Contractor Management Process](#)

-N-GUID-01920-10000, Guideline for Engineering Oversight

N-GUID-09701-10022, Supply Chain Oversight

N-GUID-09701-10120, Guideline for Construction Oversight

N-INS-09701-10007, Project Oversight Planning and Implementation

N-INS-00120-10026, Supplemental Personnel oversight

N-MAN-09701-10002, Nuclear Refurbishment Project Oversight

#### 4.3.2 Developmental References

N-PROG-AS-0007, Project Management

N-STD-AS-0028, Project Management Standard

N-STD-AS-0029, Contract Management Standard

N-STD-AS-0031, Field Engineering Standard

N-STD-AS-0032 Oversight of Supplemental Personnel

## 5.0 REVISION SUMMARY

[For Revision R001A](#)

[This is a non-intent revision.](#)

- [Cover Page updated to show revisions to SPOC and Document Owner based on updated Governing document ownership list](#)
- [Section 1.2 updated to include N-GUID-00120-10008, Contractor Management Process](#)

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- Section 4.3.1 updated to add N-GUID-00120-10008, Contractor Management Process to performance references

For R001: This is a **non-intent** revision.

- Document Authority updated
- Purpose statement updated
- Sec 1.0 Direction: The last sentence added to the last paragraph.
- Sec. 1.2 Project Oversight Process: entire section updated
- The following DCRs have been incorporated:

DCR# 0000116240

DCR# 0000120901

DCR# 0000122318

DCR# 0000123330

DCR# 0000124055

DCR# 0000127902



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## TITLE

**PROJECT MANAGEMENT STANDARD**

## AUTHORIZATION

SINGLE POINT OF CONTACT:      Riyaz Habib  
Director, Projects and Modifications

DOCUMENT OWNER:                 Art Rob  
VP, Projects and Modifications

## DOCUMENT RELATIONSHIP

Applicability:	All of Nuclear
Receives Authority from:	N-PROG-AS-0007, Project Management Program

Document is Related to Pressure Boundary      ☐      Document Requires CNSC Notification      ☐

## PURPOSE

This standard provides the criteria, expected behaviours and output requirements for the successful and timely execution of all projects in Ontario Power Generation – Nuclear (OPG-N). It describes the Project Management attributes and methodology required to manage projects throughout the project life cycle.

## DATES (YYYY-MM-DD)

PDF Creation Date:	2015-11-26
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## EXCEPTIONS

None

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### 1.0 DIRECTION

This standard provides the criteria, expected behaviours and output requirements for the successful and timely execution of all projects in Ontario Power Generation – Nuclear (OPG-N). It describes the Project Management attributes and methodology required to manage projects throughout the project life cycle.

The requirements for effective management of a project are dependent on the level of risk inherent to the project. Projects are managed using a graded, risk based approach.

Portfolio or Program Management is the management of a set of projects coordinated to achieve strategic level objectives and benefits. Projects executed as part of a Portfolio or Program should implement additional levels of integration and oversight within the context of this standard.

Projects are initiated, funded, and executed by many different groups and organizations within OPG-N

All staff within OPG-N that work on projects will apply the criteria, methodology and good practices described in this standard for all project management activities.

Detailed process instructions, guides, work aids and good practices for all key elements of project management in OPG-N are stored in the controlled documents module of Asset Suite and can also be accessed via N-MAN-00120-10001 which is available on the OPG intranet through “PowerSearch” or as an E-Manual under the Nuclear Projects webpage.

### 1.1 Project Management

Project Management is the discipline of planning, organizing, securing, and managing resources to bring about the successful completion of specific project goals and objectives. It is the application of a methodical and iterative approach for guiding a project from start to finish. It incorporates tools and processes to plan, execute, monitor, control and close-out project activities to ensure all project requirements are met.

Managing a project typically includes:

- (a) Identifying and documenting project requirements and deliverables to satisfy the project needs and objectives including key constraints, risks and assumptions.
- (b) Providing graded, risk based oversight of the project team, supporting departments, contractors, and suppliers.
- (c) Addressing the various needs, concerns, and expectations of stakeholders.
- (d) Developing project plans, estimates and schedules.

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- (e) Developing funding and contracting strategies.
- (f) Monitoring, reporting, communicating, and controlling project performance.
- (g) Documenting and managing project risks, identifying mitigating actions to eliminate or reduce the risk and implementing corrective measures.
- (h) Planning, managing and directing the project execution.
- (i) Managing and controlling project changes and priorities.
- (j) Incorporating operating experience and lessons learned.
- (k) Balancing competing project constraints including the following:
  - Scope
  - Schedule
  - Cost/Budget
  - Resources
  - Risks
  - Value for money.

1.1.1 The Project Manager has the overall accountability for the project and project management and shall use a graded, risk based approach when selecting the type and detail for Project Management processes and tools. The required level of Project Management and controls are a function of the project risk, complexity, duration, expected cost and project phase.

1.1.2 All work performed during a project shall:

- (a) Maintain safety and quality as the overriding priority.
- (b) Be executed by staff who are competent for the type of work.
- (c) Be executed in phases. Progression from one phase to the next is approved at a *Decision Gate* where project progress and performance is reviewed by management and validated to ensure project requirements and objectives are being satisfied.
- (d) Use as required the guides, instructions, forms and good practices for the specific project management area that are provided in the project management manual N-MAN-00120-10001 and further described in the project management e-manual available on the Project Management Intranet web page.

## 1.2 Project Phases and Decision Gates

Consistent with industry best practices, project development, execution and close-out is broken into Project Phases separated by *Decision Gates*. The gated concept provides points in the development and execution of the project for management decision to stop, rework or

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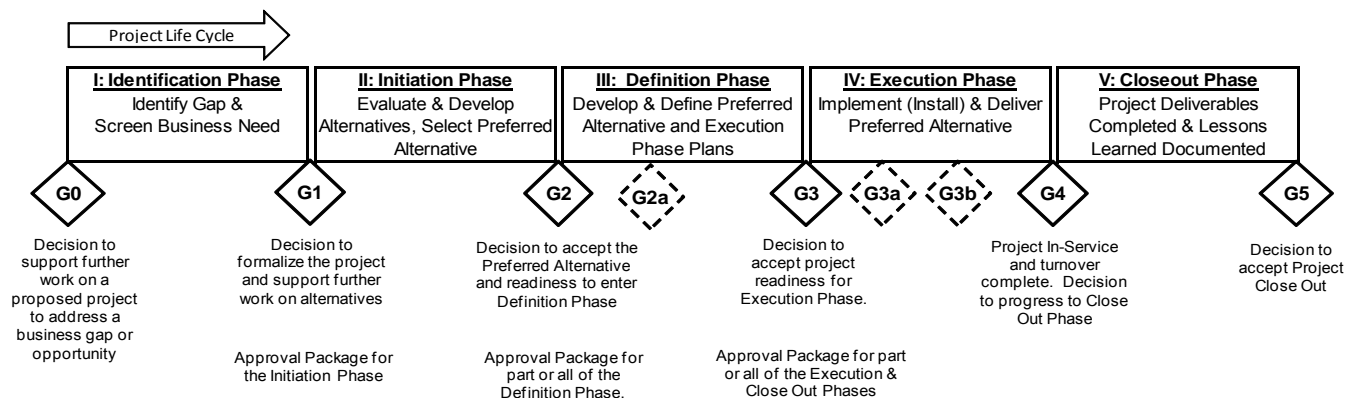
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proceed. It controls progression approvals and shall be used to manage the project through the project life cycle. This process requires that projects meet a consistent expectation of quality and performance. At each *Decision Gate*, the current phase deliverables and project performance are reviewed together with the plan and deliverables for the next phase(s).

1.2.1 The project life cycle typically consists of the following five phases:

- Identification phase
- Initiation phase
- Definition phase
- Execution phase
- Close Out phase.

Figure 1, Project Phases and Associated Decision Gates, illustrates the typical project phase and *decision gate* relationship.



**Figure 1: Project Phases and Associated Decision Gates**

**Note:** There may be additional *Decision Gates* (e.g. G2a, G3b) within a project phase depending on project risk, funding release and execution strategy, and organization's process. *Decision Gates* may be revisited when priorities or strategies change. In specific instances some projects will not be required to go through certain Gates. These projects will document why certain Gates are not applicable to their project.

A project proposal begins at *Decision Gate 0*. During the period prior to Gate 0, a business gap, need or opportunity has been identified by the initiating organization. The Gate 0 decision is primarily focused on confirming strategic alignment and intended benefits with the initiating organization and OPG-N business objectives.

## 1.3 Identification Phase

The Identification Phase begins after Gate 0 and ends at Gate 1. The objective of the Identification Phase is to build the initial business case for the project. The Identification

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Phase includes assessment of the business need, gap or opportunity and preparation of Gate 1 supporting documents to support further work on proposed solutions.

1.3.1 The Identification Phase deliverables typically include:

- (a) Preliminary project scope, objectives, Sponsor, stakeholders and accepting organization identified.
- (b) Initial project assumptions & constraints documented.
- (c) Project Charter or equivalent created.
- (d) Executing organization and Project Manager identified.
- (e) Work for the next phase(s) defined and planned, complete with an estimate and schedule.
- (f) Applicable Gate 1 *Approval Package* to support the initiation of the project.

## 1.4 Initiation Phase

The project Initiation Phase begins after Gate 1 and ends at Gate 2. The objective of the Initiation Phase is to evaluate viable alternatives and develop the scope of the preferred alternative to a point where there is confidence that all major elements of scope are accounted for. The Gate 2 supporting documents are prepared to summarize the alternatives analysis and rationale for recommending the preferred alternative so that an informed decision to continue or cancel the project can be made.

1.4.1 The Initiation Phase deliverables typically include:

- (a) Alternative options evaluated and a preferred alternative recommended.
- (b) Initial scope description and requirements
- (c) Identification of engineered equipment and services
- (d) Initial project contracting strategy.
- (e) Preliminary Risk Assessment and mitigating plans.
- (f) Initial total project cost estimate and schedule for the preferred alternative.
- (g) Work for the next phase(s) defined and planned, complete with a detailed estimate and schedule.
- (h) Project management plans and supporting documents.

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- (i) Applicable Gate 2 *Approval Package* to support the definition of the project.

### 1.5 Definition Phase

The Definition Phase starts at Gate 2 and ends at Gate 3. The objective of the Definition Phase is to define the project and demonstrate readiness for execution. This includes actions to further define the scope of the preferred alternative, including the completion of preliminary engineering or modification planning and Execution Phase planning. This phase may also include the completion of detailed engineering, and preparations for construction/installation field work.

#### 1.5.1 Definition Phase deliverables typically include:

- (a) Final scope description and requirements.
- (b) Preliminary engineering complete.
- (c) Sufficient detailed engineering to determine quantities of bulk materials required
- (d) Risk Assessment and mitigating plans
- (e) Regulatory Approvals identified and received or pending.
- (f) Refined total project cost estimate and schedule.
- (g) Work for next phase(s) defined and planned.
- (h) Applicable Gate *Approval Package* with updated project plans to support the next phase(s) including Gate 3 approval to begin the Execution Phase.

### 1.6 Execution Phase

The project Execution Phase includes the main construction/installation and commissioning work. It may also include completion of detailed engineering and procurement.

#### 1.6.1 Execution Phase deliverables typically include:

- (a) Pre-installation and commissioning readiness.
- (b) Quality Plan.
- (c) Safety Plan.
- (d) Regular reporting on project safety, quality, schedule and budget.
- (e) Installation and Commissioning Work Plans (if applicable).

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- (f) Installation and Commissioning Execution Packages.
- (g) Installation/construction, inspection/testing and commissioning complete.
- (h) Project Close Out phase planned.
- (i) Operations and Maintenance documentation updated.
- (j) Next *Approval Package* with updated plans and schedule, if applicable, for a multi-unit/phase project.
- (k) Available for Service (AFS) or Operations Acceptance approved (Gate 4).
- (l) Gate 4 approval to begin Close Out Phase.

## 1.7 Close Out Phase

The Close Out Phase is the last phase in the project life cycle and includes the final actions to complete all activities and formally finish and close out the project. This phase should be completed as quickly as possible after final AFS in order to minimize project costs.

### 1.7.1 Close Out Phase deliverables typically include:

- (a) Completion of any outstanding actions/deficiencies from final AFS and Gate 4.
- (b) Project financials finalized and closed.
- (c) Remaining project materials dispositioned as spares, surplus or obsolete.
- (d) New and affected drawings updated, approved and issued.
- (e) Records and documents filed.
- (f) Information Managed Systems updated.
- (g) Lessons Learned captured and documented.
- (h) Regulatory actions dispositioned and/or completed as needed.
- (i) Action tracking assignments completed and closed.
- (j) Completion and approval of project close out report (Gate 5).

## 1.8 Key Project Management Elements

Each executing organization shall have graded, risk based processes to incorporate the key Project Management elements.

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The key Project Management elements include the following items:

- Safety
- Scoping
- Estimating
- Resource planning
- Risk management
- Scheduling
- Cost management
- Procurement and contract management
- Communication
- Quality management
- Project oversight
- Project controls.

The ability to influence the outcome and success of a project is greatest at the front end of the project lifecycle. The key Project Management elements shall be applied in a manner that minimizes the likelihood of encountering issues during the execution of the work. As the project progresses and matures, the planning products should be further developed and refined to reflect the latest project information.

The products of the key Project Management elements are summarized in a Project Management Plan. Any other elements unique to a particular project should also be specified in the plan.

#### 1.8.1 Safety

Safety, including nuclear safety, radiological safety, environmental safety and conventional safety, is an overarching element in project management. Safety impacts people, quality, costs and schedule.

Each project shall consider safety in the planning, managing, controlling and execution of project deliverables.

#### 1.8.2 Scoping

Project scoping involves defining the project objectives and deliverables based on business requirements, assumptions, constraints and value for money.

- (a) Each project shall have a well defined project scope in order to produce an accurate estimate and schedule.
- (b) The inputs to determining the project scope should include but are not limited to:
  - Project Charter or equivalent

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- Project stakeholders
- Station/System Health Reports
- Station Engineering (system engineer)
- Design Basis and Design Requirements
- Facilitated workshops and Value Engineering
- Regulatory requirements
- Field Walk Downs
- Lessons Learned (internal and external)
- OPEX and SCRs
- Governance
- Challenge and COMS meetings
- Risk mitigating plans.

- (c) There shall be a process and plan to deal with scope changes. Project scope changes shall be managed and strictly controlled, with the impacts thoroughly understood, as they have the potential to affect the project risks, cost, schedule and stakeholders. Project scope changes require approval from the project sponsor or the applicable authorization authority appropriate for the project. If changes are significant the project may need to be re-evaluated.

#### 1.8.3 Estimating

Estimating is the process of quantifying the funding and resources required to complete the relevant project activities to achieve project objectives. An accurate cost estimate leads to a more precise project schedule and budget which forms the basis for project decisions, value and performance. Each project shall have a cost estimate and:

- Each project should create a cost estimate which includes the documentation of assumptions, constraints, class of the estimate along with the cost range, deliverables, and other relevant information that the estimate is based on.
- Estimating should be repeated for each project phase and should become more refined and accurate as the project scope and details mature.
- Estimating should be performed to determine the cost of changes including the addition of project scope.
- The estimate for the next immediate project phase should be of sufficient detail and accuracy to ensure thorough resource planning and cost control.

#### 1.8.4 Resource Planning

Resource planning includes identifying the quantity and type of resources required for the successful completion of project deliverables.



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- (a) The Project Manager shall ensure that qualified personnel, equipment and material are available at each stage of the project, in order to meet the oversight, schedule, quality and technical requirements.
- (b) Resource planning shall be graded and risk based and should be used as an input to develop the contracting and procurement strategies, and project schedule.

#### 1.8.5 Risk Management

Risk Management is the process used to identify, manage and control project risks throughout the project lifecycle.

- (a) The Project Manager shall ensure that project risk management is executed thoroughly to decrease the likelihood of unexpected issues occurring and adversely impacting the project and stakeholders.
- (b) Risk Management includes:
  - Identification and analysis of project risks
  - Mitigation and/or avoidance of risks through preventive action planning and execution
  - Determining the budget and schedule contingency required for residual risks
  - Developing risk contingency plans to deal with residual risks that may materialize
  - Monitoring and controlling risks throughout the project lifecycle.

#### 1.8.6 Cost Management

Cost management includes the processes related to assessing and managing the actual cost of deliverables against the budget baseline. The budget or cost baseline is based on the resource loaded project schedule. Cost management includes:

- (a) Establishment of the budget or cost baseline.
- (b) Monitoring the status and trend of cost performance.
- (c) Implementing corrective actions as required.
- (d) Managing the use of contingency funding required to manage project risks.
- (e) Forecasting future budget requirements.
- (f) Managing required budget changes.

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### 1.8.7 Scheduling

The project schedule outlines the deliverables and activities, their interrelationship and execution sequence. It is the main planning and monitoring tool used to communicate the execution of project deliverables.

Scheduling includes:

- (a) Identification of key activities including their start and finish date, duration and resources.
- (b) Activities that are deliverable based and communicate what needs to be done.
- (c) The sequence and logical interrelationship of activities and milestones.
- (d) Identification and optimization of the critical path.
- (e) Regular monitoring and updating to track performance and initiate corrective action for schedule threats.
- (f) Look ahead planning and strategizing to identify and manage priorities, opportunities, and threats.
- (g) The inclusion and management of float in the schedule.

### 1.8.8 Procurement and Contract Management

Projects shall manage contracts and suppliers in accordance with N-STD-AS-0029, Contract Management Standard.

### 1.8.9 Communication

The project manager shall ensure that proper and effective communication practices are used throughout the project life cycle. This is to ensure that all project team members, stakeholders, contractors and suppliers understand the deliverables and are working with the required and most recent information.

The communication requirements include:

- (a) Maintaining alignment between team members and stakeholders.
- (b) Timely distribution and control of information, documentation and changes.
- (c) Communicating targets and expectations.
- (d) Regular project team planning and progress meetings.
- (e) Informing stakeholders of project progress, risks and changes.

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- (f) Expediting support and issue resolution.
- (g) Reporting on project performance.

### 1.8.10 Quality Management

Quality management processes are required to control human performance, engineering, work planning, materials, and field work, in order to meet the requirements of the project.

- (a) Each project shall define what quality program is to be used in the project's quality plan.
- (b) The quality plan includes the methods that will be used to measure the project actual performance against the defined quality requirements.
- (c) The project quality plan should demonstrate the following elements where applicable:
  - (1) Quality planning to determine the type and frequency of internal and external quality standards and monitoring required for project success.
  - (2) Quality Assurance to plan a systematic pattern of means and actions designed to provide confidence that items or services will meet specified requirements and perform satisfactorily in service. These include quality systems, instruction, training, qualification and checklists.
  - (3) Quality Control processes to ensure that specified requirements are met through monitoring, inspections, testing, examinations or verifications. This includes the documentation of non-conformances and corrective actions.

Refer to N-STD-AS-0031, Field Engineering Standard, for projects using OPG-N's quality program.

### 1.8.11 Project Oversight

Projects using a contractor's or vendor's quality management system shall implement oversight in accordance with N-STD-AS-0030, Project Oversight Standard.

### 1.8.12 Management of Supplemental Personnel

Supplemental personnel are vital to the success of Nuclear Projects and OPG-N. They fill an important gap created by insufficient resources or skills of OPG-N employees.

N-STD-AS-0032, Oversight of Supplemental Personnel provides the oversight principles and requirements to be applied to work packages initiated and/or executed within OPG by supplemental personnel.

## Nuclear Standard

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Usage Classification:	Information	Page:
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### Title: PROJECT MANAGEMENT STANDARD

#### 1.8.13 Project Controls

- (a) Projects shall have control processes established to support key project management elements including but not limited to:
  - (1) Planning support.
  - (2) Monitoring of key project performance indicators (i.e. metrics).
  - (3) Schedule and cost variance and indicator analysis.
  - (4) Forecasting of project costs and schedule.
  - (5) Risk management.
  - (6) Project reporting to communicate project health and facilitating oversight.
  - (7) Contingency development and control.
  - (8) Safety and quality monitoring and reporting.
  - (9) Change management.
  - (10) Document control and records management.
- (b) Project performance shall be measured, on a regular basis, in comparison to the baseline deliverables and milestones approved in the applicable project gate *Approval Package*.
- (c) The monitoring and reporting of key performance indicators shall allow for the detection of at risk deliverables and support the direction of any corrective actions needed to recover performance. Analysis and corrective action shall support consideration of both project performance and business planning.
- (d) Changes to scope, cost, and schedule shall be managed and controlled through the applicable executing organization process.

## 2.0 ROLES AND ACCOUNTABILITIES

### Project Manager

The project manager is accountable for the following for all assigned projects:

- Initiating, planning, executing, controlling, and closing project management processes
- Setting and managing the project team priorities and ensuring that the assigned projects are supported and executed per the approved Business Case Summaries and Project Management Plans.
- Ensuring that all project activities are carried out safely, integrated into site work planning, and executed in accordance with the standards and processes established under the Nuclear Projects program in the areas of scope management, schedule management, cost management, quality management, resource management,

## Nuclear Standard

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### Title: PROJECT MANAGEMENT STANDARD

communications management, risk management, procedures/contract management, and project oversight

- the establishment of project reporting metrics and effective processes to reliably collect information ensuring that project reports are produced in a timely and accurate manner to support project management requirements and project information is communicated to all stakeholders

## 3.0 DEFINITIONS AND ACRONYMS

### 3.1 Definitions

**Approval Package** is a general term for a prescribed assembly of documentation prepared by the Project Manager and submitted for approval at a *Decision Gate*. The *Approval Package* forms the basis for authorizing authority consideration and subsequent approval for the project to proceed to the next phase. The content, structure, and rigor of the *Approval Package* will vary at each *Decision Gate* depending on a number of factors including organizational process, scope and complexity of the project and project stage.

**Decision Gate** is a management hold and review point in the Project Life Cycle where project attributes such as readiness, quality, value, risks and funding requests may be reviewed prior to approval of project advancement to the next phase or stage.

**Engineered Equipment** is equipment requiring application-specific technical specifications to meet the performance requirements for the project.

### 3.2 Abbreviations and Acronyms

<b>AFS</b>	Available For Service
<b>COMS</b>	Construction Operations Maintenance Safety stakeholder review process
<b>OPEX</b>	Operating Experience
<b>OPG</b>	Ontario Power Generation
<b>OPG-N</b>	Ontario Power Generation - Nuclear
<b>SCR</b>	Station Condition Record

## 4.0 BASES, RECORDS AND REFERENCES

### 4.1 Bases

None

## Nuclear Standard

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## PROJECT MANAGEMENT STANDARD

### 4.2 Records

- 4.2.1 Any controlled documents which may be produced as a result of this document should be managed in accordance with OPG-PROC-0178, Controlled Document Management.
- 4.2.2 Any records which may be produced as a result of this document should be managed in accordance with OPG-PROC-0019 Records and Document Management, and N-MAN-00120-10001-RDM Nuclear Projects Records and Document Management.

### 4.3 References

#### 4.3.1 Performance References

N-STD-AS-0029, Contract Management Standard  
N-STD-AS-0030, Project Oversight Standard  
N-STD-AS-0031, Field Engineering Standard  
N-STD-AS-0032, Oversight of Supplemental Personnel  
N-GUID-00120-10011, Collaborative Front End Planning Process  
N-MAN-00120-10001, Project Management Manual

#### 4.3.2 Developmental References

A Guide to the Project Management Body of Knowledge (PMBOK Guide) 5<sup>th</sup> Edition  
Association for Advancement of Cost Engineering (AACE)  
INPO 09-002, Excellence in Nuclear Project Management  
N-PROC-MP-0083, Constructability, Operability, Maintainability, and Safety  
N-PROC-MP-0090, Modification Process  
OPG-PROC-0056, Post Implementation Review  
OPG-PROC-AS-0006, Records and Document Control  
N-PROC-AS-0007, Project Management

## 5.0 REVISION SUMMARY

This is an **intent** revision.

- Compliance date and Exceptions revised.
- General revisions to the entire document to update and be consistent with N-PROC-AS-0007.
- Extensive revisions to section 1.0 Direction
- Bullet (g) modified in section 1.1
- Added bullet (d) to section 1.1.2
- Corrections to section 1.8.10 clarify between plan and program.

**ATTACHMENT 4**

**See Ex. L-4.3-15 SEC-022**



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**DARLINGTON REFURBISHMENT PROGRAM STRUCTURE**

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## **Darlington Refurbishment Program Structure**

**NK38-NR-PLAN-09701-10001-0001-R001**  
2015-09-08

Order Number: N/A  
Other Reference Number:

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Management System Oversight



Plan

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### Revision Summary

Revision Number	Date	Comments
R001	2015-09-08	Revised program framework. Updated Table 1 for latest PgMPs. Section 2.1, revised NR framework. Section 3.1, added accountabilities of VP, NR oversight. Section 4.1, added definitions.
R000	2014-01-31	This document supersedes NK38-PLAN-09701-10067 Sheet 0001. The changes between NK38-PLAN-09701-10067 Sheet 0001 and this document are as follows: <ul style="list-style-type: none"> <li>The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001,</li> <li>The security classification has been removed so that the document can be submitted to the CNSC, and</li> <li>Figure 1 and Table 1 have been updated to reflect the current list of Program Management Plans.</li> <li>References have been updated.</li> </ul>

**Plan**

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## **DARLINGTON REFURBISHMENT PROGRAM STRUCTURE**

### **1.0 PURPOSE**

The purpose of this document is to set the framework for the Darlington Refurbishment Program Management Plans (PgMPs) which describe how the Darlington Refurbishment Program meets the intent of OPG's Nuclear Management System while establishing program-specific requirements.

Darlington Refurbishment Program Management Plans are designed to provide assurance that all aspects of the Program (e.g. engineering, procurement, construction, turnover, and program life cycle phases) will be conducted in accordance with the requirements of:

- Canadian Standards Association Standard N286-05, Management System Requirements for Nuclear Power Plants;
- Canadian Nuclear Safety Commission's Regulatory Document RD-360, Life Extension of Nuclear Power Plants;
- N-CHAR-AS-0002, Nuclear Management System; and
- OPG Corporate and Nuclear governance.

Darlington Refurbishment Program Management Plans integrate requirements from other Management System standards for health, safety, environment, security, economics and quality and is defined to meet the principle that safety is the paramount consideration guiding all decisions and actions.

### **2.0 DIRECTION**

Owners of Darlington Refurbishment PgMPs are to follow the minimum structure and content requirements specified in this document to ensure consistency across the entire suite of Darlington Refurbishment PgMPs.

#### **2.1 Darlington Refurbishment Program Management Plans**

Darlington Refurbishment Program Management Plans are accessible to all staff that have access to OPG's Information Management System through Asset Suite. They can also be accessed through PowerSearch or on the Darlington Refurbishment SharePoint Team Site which are both linked to Asset Suite.

##### **2.1.1 Darlington Refurbishment Program Framework**

The hierarchy of Darlington Refurbishment Program documents is shown in Figure 1 below.



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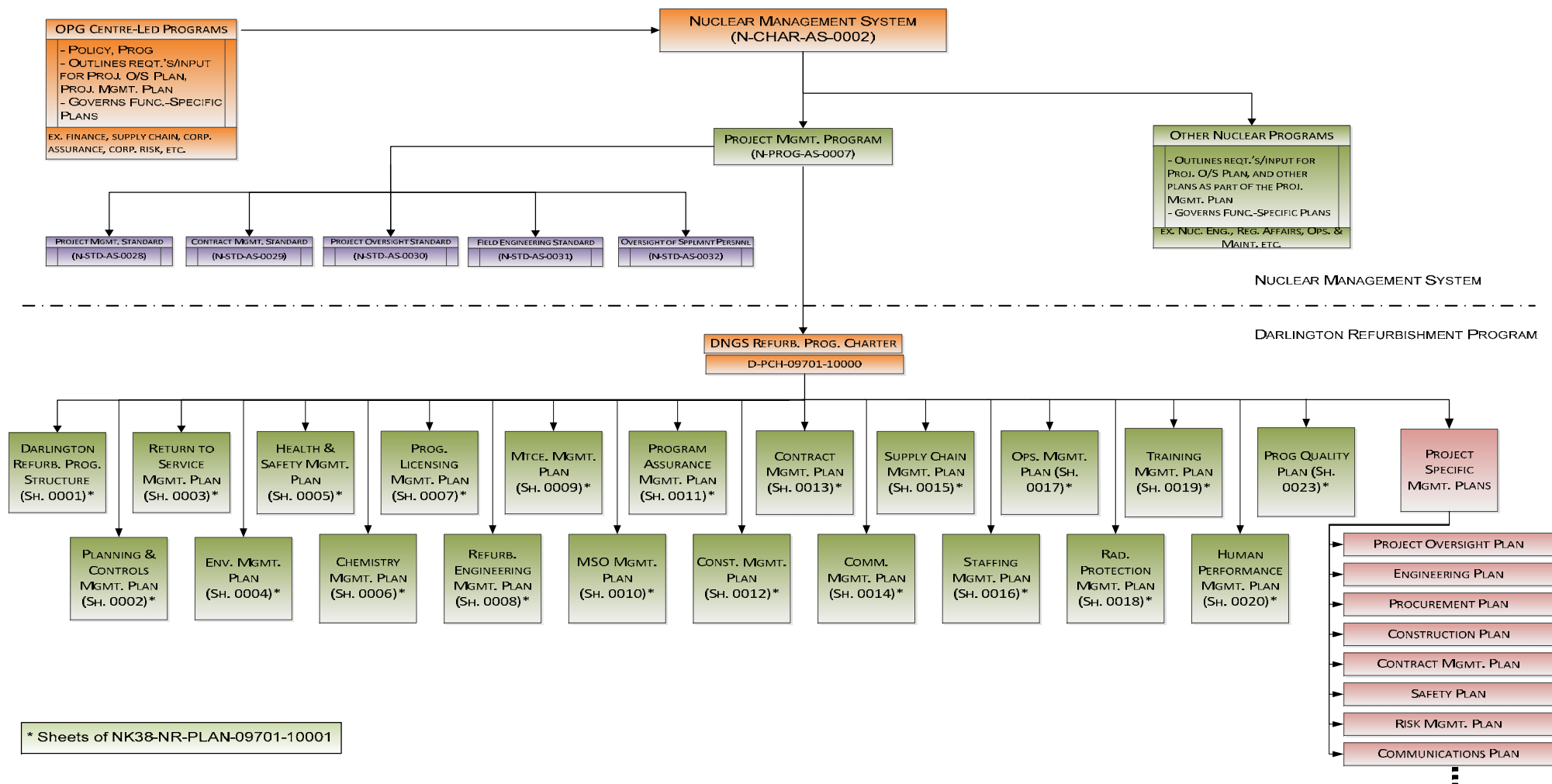


Figure 1: Darlington Refurbishment Program Framework



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As shown in the above figure, the top tier document of the Darlington Refurbishment Program is D-PCH-09701-10000, Darlington Refurbishment Project Charter. The 2<sup>nd</sup> tier documents consist of this document and the remaining PgMPs in the form of sheets to NK38-NR-PLAN-09701-10001. The 3<sup>rd</sup> tier documents (not shown in the framework) include documents such as Manuals, Guides, Instructions, Plans, Contractor/Owner Interface Requirements and Forms which are considered "Process Support Controlled Documents" as defined in NK38-MAN-09701-10006, "Nuclear Refurbishment - Requirements For Process Support Controlled Documents".

The Darlington Refurbishment Program also makes extensive use of Corporate and Nuclear Line of Business management system documents where applicable.

### **2.1.2 Program Management Plans**

The Darlington Refurbishment PgMPs stipulate function-specific requirements and processes for Darlington Refurbishment project execution.

The PgMPs are meant to convey how employees working within the Darlington Refurbishment Program will do their work while meeting the intent of the existing OPG Management System.

The structure and minimum content requirements for PgMPs are as follows:

#### Section 1.0, Purpose

- A clear and concise description of the fundamental intent or focus of the Program Management Plan.
- Limit rationale, background and process details.

#### Section 2.0, Program Requirements

This section is the most important section of the PgMP and should be considered a "roadmap" which conveys how employees working within the Darlington Refurbishment Program will meet the Program's requirements.

- Identify and briefly describe any Nuclear, Corporate, or other business unit governance, governance support and non-governance documents that provide implementing details for requirements, activities and processes described by the PgMP.
- State requirements which have been mandated by Darlington Refurbishment Functions for Darlington Refurbishment Projects to follow as part of contract development and project execution.
- Include a figure illustrating the entire PgMP framework, including implementing and interfacing documents.
- Specify the performance indicators or monitoring activities that are necessary to ensure the overall PgMP requirements are met.

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### **DARLINGTON REFURBISHMENT PROGRAM STRUCTURE**

#### Section 3.0, Roles & Accountabilities

- Identify and provide a high-level summary of accountabilities for Manager level (Stratum IV) or higher positions or roles concerning the accomplishment of activities related to the implementation of the document.
- Do not:
  - Duplicate actions, activities or tasks already covered by Section 2.0 of the PgMP.
  - Use personal names.

#### Section 4.0, Definitions & Acronyms

##### **Definitions**

- If there are no definitions, state "None".
- Limit each definition to one or two sentences.
- Place definitions in alphabetical order.
- Do not define:
  - Generic terms if the dictionary definition conveys the meaning of a term.
  - Terms commonly used within the applicable business area.
  - Organizational positions or roles.

##### **Acronyms**

- If there are no acronyms, state "None".
- List acronyms used within the document along with their expanded forms.
- Place acronyms in alphabetical order.

#### Section 5.0, References

- Only list those documents the user **needs** to use in conjunction with the PgMP.
- Identify each reference document number and title in alpha-numeric order. Do not include revision numbers.

### **2.1.3 Project Management Plans**

Project Management Plans (PMPs) describe how a specific project will develop its scope and execute the work. When Darlington Refurbishment Project Teams are developing or revising their PMPs they will reference relevant sections from applicable PgMPs.

### **2.2 Darlington Refurbishment PgMPs and Owners**

The following table summarizes the various Darlington Refurbishment PgMPs and their owners.



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### **DARLINGTON REFURBISHMENT PROGRAM STRUCTURE**

Sheet	Title	Owner
0001	Darlington Refurbishment Program Structure	Director, Refurbishment MSO
0002	Planning And Controls PgMP	Director, Planning & Controls
0003	Return to Service PgMP	Director, Operations & Maintenance
0004	Environmental PgMP	Director, Operations & Maintenance
0005	Health and Safety PgMP	Director, Operations & Maintenance
0006	Chemistry PgMP	Director, Operations & Maintenance
0007	Licensing PgMP	Manager, Refurbishment Licensing Support
0008	Engineering PgMP	VP, Refurbishment Engineering
0009	Maintenance PgMP	Director, Operations & Maintenance
0010	Management System Oversight PgMP	Director, Management System Oversight
0011	Program Assurance PgMP	Director, Management System Oversight
0012	Construction PgMP	VP, Refurbishment Execution
0013	Contract Management PgMP	Director, Contract Management
0014	Communications PgMP	Director, Corporate Relations and Communications
0015	Supply Chain PgMP	Director, Supply Chain
0016	Staffing PgMP	Manager, Human Resources Nuclear Refurbishment
0017	Operations PgMP	Director, Operations & Maintenance
0018	Radiation Protection PgMP	Director, Operations & Maintenance
0019	Training PgMP	Director, Operations & Maintenance
0020	Human Performance PgMP	Director, Operations & Maintenance
0023	Quality PgMP	VP, Refurbishment Execution

**Table 1: Darlington Refurbishment PgMPs (NK38-NR-PLAN-09701-10001)**

## **3.0 ROLES AND ACCOUNTABILITIES**

### **3.1 Director, Refurbishment Management System Oversight**

Is the document owner and is accountable for its definition and implementation.

### **3.2 Darlington Refurbishment Function Teams**

Are accountable for ensuring that PgMPs and subtier documents owned by the Function Team are in compliance with existing Management Systems and that any gaps are resolved to meet the needs of the Darlington Refurbishment Program.

### **3.3 Darlington Refurbishment Project Teams**

Are accountable for the development and maintenance of project-specific Project Management Plans.

Are accountable for executing projects to PgMP requirements and for providing input to PgMP owners if any gaps or incompatibilities exist.

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## DARLINGTON REFURBISHMENT PROGRAM STRUCTURE

### 4.0 DEFINITIONS AND ACRONYMS

#### 4.1 Definitions

***Program Management Plan*** The document that describes how function supports the Refurbishment Program with specific requirements that meet the intent of the Nuclear Management System.

***Project Management Plan*** The document that describes how the project in Darlington Refurbishment Program will be planned, executed, monitored and controlled, and closed.

***Function*** The matrix organization grouped by areas of specialization. The function is accountable for developing and maintaining functional excellence, setting standards, and providing required service to Darlington Refurbishment Program.

#### 4.2 Acronyms

**PgMP** - Program Management Plan  
**PMP** - Project Management Plan

### 5.0 REFERENCES

- [1] N-CHAR-AS-0002, Nuclear Management System
- [2] NK38-NR-PLAN-09701-10001 Sheets 1-23, Darlington Refurbishment Program Management Plans
- [3] NK38-MAN-09701-10006, Nuclear Refurbishment – Requirements for Process Support Controlled Documents



## Charter

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Title: <b>DARLINGTON REFURBISHMENT CHARTER</b>	

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## Darlington Refurbishment Charter

**D-PCH-09701-10000-R003**  
2016-01-026

Order Number: N/A  
Other Reference Number:

## Internal Use Only

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Reviewed By: D. Stiers  
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Management System Oversight

Approved By: D. Reiner  
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**Charter**

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**DARLINGTON REFURBISHMENT CHARTER**

**Revision Summary**

Revision Number	Date	Comments
R003	2016-01-26	Revised Governance Framework. Updated Org Structure. Incorporated DCR 0000132503000 Added Section 5.0, DRP Scope and Section 9.0 Contracting Strategy Revised Section 10.0 Schedule Minor other editorial changes throughout.
R002	2014-12-05	Contents of charter refreshed to reflect current status of program and to include a description of the Darlington Refurbishment Management System.  The Security Classification has also been reduced from "OPG Confidential" to "Internal Use Only".
R001	2009-06-02	Revision changing direction of document to contain complete project This document contains 4 physical pages
R000	2008-06-19	First issue

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### 1.0 PURPOSE

The Purpose of the Darlington Refurbishment Program (DRP) Charter is to establish and communicate the expectations of the Senior Vice President (SVP), Nuclear Projects regarding the management of the Darlington Refurbishment Program (DRP).

The expectations of the SVP, Nuclear Projects are aligned with and expand on the Nuclear Management System established and communicated under OPG-POL-0032, Safe Operations Policy; N-POL-0001, Nuclear Safety Policy; and N-CHAR-AS-0002, Nuclear Management System.

This document, in conjunction with the referenced policies, programs, standards and other controlled documents, establishes the overall Management framework of the DRP that assures that all aspects of DRP work and activities are of the required quality throughout all phases of the DRP.

### 2.0 BACKGROUND

OPG's nuclear facilities are ageing and there is a need to assess and make recommendations with respect to the feasibility of continuing to operate these stations beyond the current predicted end-of-service life dates. Current high confidence estimates, based on Darlington pressure tubes fitness for service, predict that the Darlington Nuclear Generating Station (DNGS) reactors will reach the end of their current operating lives between 2018 and 2020 (based on 210,000 Effective Full Power Hours).

The Fuel Life Channel Extension has evaluated the ability to extend the end-of-service life dates by an additional three years (to 235,000 Effective Full Power Hours) allowing OPG to unlap the first unit refurbishment and commence the final unit's refurbishment prior to the final unit reaching its extended end-of-service life.

The Plant Life Extension Project group was established in February 2006 to undertake feasibility studies for refurbishing and extending the life of the nuclear units at the Pickering and Darlington sites. The organization's name was changed to Nuclear Generation Development in December 2006 and to Nuclear Refurbishment in November 2008.

OPG Senior Management, with approval by the Board of Directors and Shareholder, has tasked Nuclear Refurbishment (NR) with assessing the feasibility of refurbishing DNGS to enable operations for an additional 30 years or more.

Due to the unique requirements associated with a refurbishment outage and the large scope of the project, it is recognized that additions and modifications to the normal Ontario Power Generation Nuclear (OPGN) processes are required to ensure that the refurbishment is completed in a safe, timely, economic manner and to the required quality expectations. NR will implement and follow appropriate processes to ensure successful completion of each phase of the project.



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### 3.0 SCOPE

This charter is applicable to all aspects of the NR business and includes the organizations and functions<sup>1</sup> involved in completing all program work associated with the refurbishment of the DNGS. The program management processes are applicable to all of the projects within the DRP and to all of the parties supporting and contributing to these projects. The process support documents<sup>2</sup> framework implemented within the Darlington Refurbishment Program is described in Appendix A, Darlington Refurbishment Program.

### 4.0 DIRECTION

#### SVP, Nuclear Projects – Expectations for the Darlington Refurbishment Program

As personnel within NR and organizations and functions<sup>1</sup> supporting the DRP, we have the responsibility to conduct ourselves in a manner which places safety, our core values, and effective business management at the forefront of our priorities. We clearly understand our roles and accountabilities and focus our efforts on providing results which meet or exceed expectations. Our strategic directions and business activities contribute to positioning our company to provide maximum value to the Province of Ontario while at the same time understanding that the safe, reliable, cost-effective generation of electricity must be the central focus of our operation.

Many of our responsibilities have a direct impact on the future of OPG's nuclear line-of-business. The decisions we make and the manner in which the DRP is executed will be done such that all available options are evaluated in a business-like manner ensuring risks are clearly understood and appropriate management systems are established to ensure execution according to plan. This charter is applicable to the organization and functions involved in DRP.

The DRP will perform work in accordance with the managed systems defined in OPG-POL-0032, Safe Operations Policy, N-POL-0001, Nuclear Safety Policy, N-CHAR-AS-0002, Nuclear Management System and this charter.

Our mission is the successful refurbishment of Darlington Nuclear: Safely, On time, On budget, with 100% of scope completed, and to the quality expected within a Nuclear station.

The Director, Management System Oversight is responsible for interpreting the requirements of this Charter and its sub-tier documents.

#### *SVP, Nuclear Projects*

<sup>1</sup> OPG has adopted a matrix organization design with centre-led functions supporting operating business units. The *centre-led functions* are generally accountable for developing and maintaining functional excellence, setting standards, and providing cross-company services. Please refer to OPG-POL-0033, OPG Business Model, which lists all the operating units and functions.

<sup>2</sup> For a definition of "process support documents" refer to NK38-MAN-09701-10006.

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### 4.1 Program Deliverables

The NR organization has been established with the responsibility of assessing and making recommendations with respect to the feasibility of refurbishment and continuing to operate the nuclear generating stations beyond the current predicted end of life and executing all activities associated with refurbishment.

For DNGS, NR will undertake the DRP, in phases as authorized by OPG Management, the OPG Board of Directors, and the Shareholders to:

- Assess the feasibility of refurbishing Darlington and operating it for an additional 30 years or more,
- Fully define refurbishment scope,
- Execute front-end planning including cost and schedule development and a full risk assessment,
- Manage the pre-outage planning and preparation activities for the refurbishment outage,
- Execute the refurbishment outage(s),
- Return the refurbished nuclear unit(s) to Nuclear Operations, and
- Manage refurbishment closeout.

### 4.2 DRP Objectives

The principal objective of the DRP is to:

- Confirm the business case for the refurbishment of DNGS,
- Obtain the approvals for the business case, and
- Plan and execute the refurbishment in order to enable continued operations of DNGS for an additional 30 years or more

Subsidiary objectives needed to ensure the principal objective is achieved are as follows:

- Obtain the necessary corporate, government and regulatory approvals (e.g., Environmental Assessments, Integrated Safety Review, and Integrated Improvement Plan) for refurbishment in a timely and cost effective manner.
- Establish regulatory certainty, to the degree possible, for the refurbishment program and subsequently bound the uncertainty prior to submitting the recommendation to the OPG Board.
- Complete timely and comprehensive technical studies and a plant condition assessment to determine the appropriate refurbishment scope.

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- Implement appropriate contract and procurement strategies to execute the work and obtain all required materials in advance of the refurbishment outage.
- Implement appropriate processes for each phase of work for the refurbishment program.
- Complete engineering and detailed refurbishment outage planning in order to finalize the refurbishment program scope, cost, and schedule.
- Form the DRP team that will manage the execution of the DNGS units' refurbishment.
- Execute the refurbishment outage in a managed and controlled fashion that results in meeting the safety, quality, cost and schedule projections.
- Provide adequate and accurate information to all OPG Management, the Board of Directors, and the Shareholder, in order to obtain the phased based funding for the refurbishment program.

## 5.0 DRP SCOPE

During the Refurbishment phase, major components in each reactor will be inspected, serviced, and replaced. The key refurbishment activities will include:

- Pressure tube, calandria tube, and feeder replacement
- Steam Generator inspection, maintenance, and cleaning
- Turbine Generator refurbishment including replacement of the control system
- Valve Rehabilitation/replacement
- Flux Detector and Adjuster Rod Replacement
- Auxiliary Shutdown Heat sink Upgrades
- Electrical System Rehabilitation
- Safety improvement upgrades including installation of an third Emergency Power Generator, a Containment Filtered Venting System, and a Powerhouse Steam venting system.
- Upgrades to existing site infrastructure to support the refurbishment activities.

A Program Scope Review Board with supporting governance was put in place to approve the scope of the DRP. The technical scope for the DRP was initially confirmed in May 2012. Since that time, as a result of engineering studies and analysis, results of planned inspections, and completion of regulatory submittals including the Integrated Safety Review (ISR) and the Environmental Assessment (EA), scope has been finalized.

A Change Control Board with supporting governance has been established to manage the cost, schedule, and scope changes. If there is significant new or changed scope, approval will be required through the PSRB.

The project scope includes four phases and is subdivided into five main execution bundles. The four phases includes lead in, removal, inspection & installation and lead out. The five bundles

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include Retube & Feeder Replacement, Steam Generators, Turbine Generators, Fuel Handling and Balance of Plant<sup>3</sup>. There are number of Facilities & Infrastructure and Safety Improvement Opportunity projects which are being executed as pre-requisites to the refurbishment scope.

## 6.0 DRP PROGRAM MANAGEMENT PROCESSES

As a Canadian nuclear operator, OPG is regulated by the Nuclear Safety and Control Act and Regulations through the Canadian Nuclear Safety Commission (CNSC) which issues OPG a Power Reactor Operating Licence (PROL). One of the conditions in the PROL is for OPG to meet the requirements of Canadian Standards Association (CSA) N286, Management System Requirements for Nuclear Power Plants, in managing all aspects of nuclear activities. The DRP will perform work in accordance with this charter which is developed following the principles of N-POL-0001, Nuclear Safety Policy and N-CHAR-AS-0002, Nuclear Management System, and meets the requirements of CSA N286.

N-PROG-AS-0007, Project Management, and its associated implementing standards, provide the principles and requirements for planning, organizing, executing, and controlling resources to ensure safe and effective execution and completion of projects. Safety and quality shall be the overriding priority and will not be compromised for cost or schedule.

The DRP also takes into consideration the CNSC's Regulatory Document, RD-360, Life Extension of Nuclear Power Plants, providing guidance on requirements for refurbishments and the need for the licensee to prepare a Project Execution Plan (PEP). Similarly, N-STD-AS-0028, Project Management Standard, also requires a Project Management Plan be prepared.

The DRP charter supporting processes to execute the refurbishment program activities for DNGS were developed utilizing the Project Management Institute's (PMI) Program Management format. This consists of a suite of Program Management Plans (PgMPs), as described in Section 5.1, and Project Management Plans (PMPs), as described in Section 5.2. This suite of PgMPs and PMPs are equivalent to the PEP.

The DRP charter supporting processes and their link to the N-CHAR-AS-0002, Nuclear Management System is shown in Appendix A.

### 6.1 Program Management Plans (PgMPs)

PgMPs describe the high-level processes that will deliver the program benefits (these are business level requirements including strategies for management, oversight, and execution, not technical design requirements) and they take their authority from this program charter.

The purpose of the PgMP is to:

<sup>3</sup> Balance of Plant is managed as 4 sub-bundles: Shutdown and Layup, Refurbishment Support Facilities, Unit Islanding, and Balance of Plant Refurbishment which includes valves, electrical upgrades, etc.

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- Ensure that all key issues relevant to the successful execution of the Program are identified, defined and understood at the earliest possible stage.
- Provide the DRP team members, end users, line authority and stakeholders with a common understanding of the program and the planned method of execution.
- Provide a reference to OPGN governance and refurbishment specific process support controlled documents for the DRP.

The level of detail in the PgMPs is consistent with each phase of the Project, based on the time frame. The documents will initially focus on the definition and preliminary planning phases and provide fewer details around the later phases. In addition to the items above, the PgMPs provide:

- Direction on project controls.
- Direction on managing risk.
- Direction on document management processes that are not included in governing documents.

PgMPs are intended to be living documents. They will be reviewed and updated as necessary during the definition and execution phases of the DRP, nominally every 12 months.

Each PgMP is assigned to a functional owner who is responsible for developing and maintaining their PgMP in consultation with the Director of Management System Oversight.

The PgMPs are all listed as individual sheets under NK38-NR-PLAN-09701-10001 and available through Asset Suite.

Additional PgMPs or related documents (e.g. commissioning plan), including those that may be required per the CNSC's Regulatory Document – RD360, may be added to the suite of documents at any time during program execution.

## 6.2 Project Management Plans (PMPs)

The PMPs describe how a specific project (or bundle) in the DRP will develop and execute its work scope and how it will operationalize the program processes to deliver a successful project (these are business level requirements, not technical design requirements).

**Note:** Where a project will follow a Program process exactly as written, it is sufficient to confirm and reference the Program document in the Project Management Plan.

The DRP has organized the identified and approved scope into projects or project bundles for the purposes of initiating the work and providing staff to execute the initial conceptual planning. As planning progressed, projects and/or project bundles were merged and/or shifted into different project bundles as per N-MAN-00120-10001-SCH-04, Nuclear Refurbishment Program Work Breakdown Structure Guide.

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Each project, within the ‘bundle’ will have a PMP developed as per N-MAN-00120-10001-GRB, Nuclear Projects - Gated Process.

### 7.0 DRP RESOURCING

The SVP, Nuclear Refurbishment with support from the SVP, Darlington Nuclear Generating Station will establish the organization and resources necessary for successful completion of the DRP. Internal resources, complemented by externally available expertise will be used to execute the scope of work.

### 8.0 DRP FUNDING

During the initiation phase of the DRP, the funding, which was from the OM&A stream, was obtained and managed through the OPG business planning process.

After successful completion of the initiation phase and following the OPG Board of Directors approval of the DRP, a capital project has been created and funding will be requested and released in phases based on successful completion of key work programs and program milestones in accordance with an approved release strategy that is documented in the DRP’s Business Case.

In the definition phase, OPG developed a detailed cost estimate (budget) for all of the work associated with Darlington’s refurbishment. This was approved by OPG’s Board of Directors in November 2015 and forms the overall control budget for which cost performance will be measured.

### 9.0 DRP CONTRACTING STRATEGY

The DRP is a multi-phase project made up of individual projects of various sizes. As part of the Definition Phase, OPG developed an overall commercial strategy (the “Commercial Strategy”) and separate contracting strategies for all major project work packages, taking into account factors such as the nature and scope of the work, the vendor marketplace, and any potential long term commercial arrangements. Each contracting strategy results in a recommendation on the most suitable sourcing approach, contract structure and pricing mechanism for that specific work package.

The Commercial Strategy sets out an overall commercial framework with guiding principles for establishing and maintaining commercial relationships with third parties to support the DRP. The Commercial Strategy is a multi-prime contractor model in which there is more than one prime contractor working on the DRP. The owner has a separate contract with each prime contractor. Each prime contractor is responsible for the completion of the work under its particular contract, but not for the entire DRP. The owner is the integrator between the prime contractors and is responsible for the entire DRP. Under this model OPG retains project management responsibility and design authority for the DRP.

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To execute the work, OPG retains a number of contractors who are responsible for major project work packages. To guide OPG in project oversight and contracting activities, OPG has engaged external technical and project management experts to assist with the overall project management. The benefits of this model are that OPG retains control over the entire DRP, including the deliverables, costs and schedule. Retaining control by OPG is important given the scale, technical complexity and integrated nature of the DRP. OPG will also be able to assign risks to the party that is best able to manage the risk and mitigate its impact on the DRP. This will provide OPG with a better balance between the transfer of risk and the costs of the contractor services.

## 10.0 DRP SCHEDULE

Refurbishment timing is developed as part of the DRP definition and front end planning process and based on the following elements:

- Risk/uncertainty in technical life limits for major components,
- Lead time for obtaining regulatory certainty and acquiring tooling and materials necessary for the refurbishment,
- Value of energy and capacity and impact on OPG's revenue, market share, and sustainability, and
- Industry capability to execute the refurbishment, given timing of other refurbishments or new nuclear projects and taking into consideration effective risk management strategies.

As part of Definition Phase, OPG has integrated all vendor schedules, determined the critical path for the project and created a schedule that covers all four units. OPG evaluated risks for each segment of the schedule, determined the amount of contingency required to deliver the project, and produced a high confidence schedule. The high confidence duration for each unit outage is 37 to 40 months. The schedule begins with the Darlington Unit 2 outage in October 2016. Unit 2 is expected to be substantially complete before the Unit 3 start to allow effective lessons learned implementation. It will take up to 113 months to complete refurbishment of all four reactors. Based on the current assumptions that each of the Darlington units will operate to 235,000 Effective Full Power Hours (EFPH), this schedule results in no idle time on operating units.

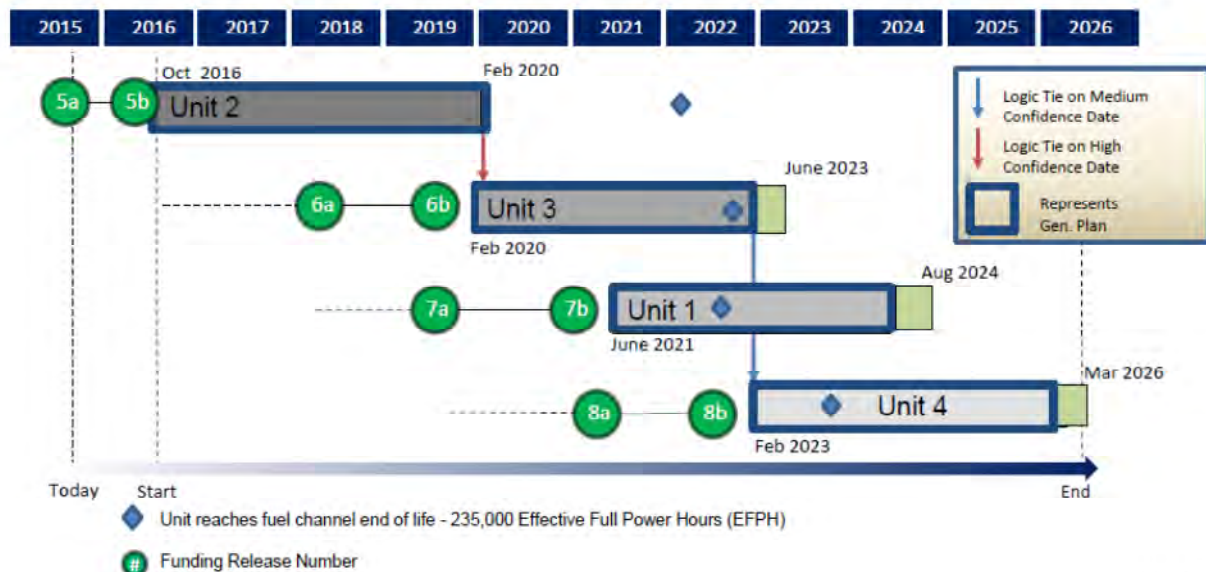
OPG has established a release strategy that provides opportunities to review project performance prior to allowing the project to proceed to the next phase. Funding will be released on a unit by unit basis in accordance with the release strategy shown, this is also aligned to the principles outlined in the December 2013 Ministry of Energy's Long Term Energy Plan (LTEP).

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This schedule was accepted by OPG's Board of Director's in November 2015 and the Execution phase of the project was formally launched in January 2016. This high confidence schedule, which includes contingency, assumes the first unit outage will commence in October 2016 with each unit lasting 37 to 40 months. The release strategy is also defined, with a unit specific release for assessing and readiness work followed by a request for full release of funds to execute the outage work. For Generation planning, OPG assumed the high confidence 40 month schedule for the first unit and the medium confidence schedule for the subsequent units.

## 11.0 DRP ASSUMPTIONS AND RISKS

A formal Risk Management process has been implemented for the DRP. Risks are actively identified and managed, and reported on a routine basis. All key assumptions are also managed in a central database and form the basis of planning as well as risk management.

Key risks within the program include:

**Cost and scheduling related Risks** - There is a risk to the costs and timelines for refurbishment due to other nuclear projects that may be occurring simultaneously i.e. other major CANDU projects in Canada.

**Resource Risk** – There is a risk is that labour may not be available at the time of the DRP due to the other potential nuclear programs taking place in the same time frame.

**Lessons Learned** – Operating Experience from other mega projects and lessons learned from the Pickering Refurbishment planning activities should be factored into the planning of the DRP.



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## 12.0 ROLES AND ACCOUNTABILITIES

**SVP, Nuclear Projects** approves this Refurbishment Program Charter and acts as the DRP Sponsor at the corporate level. The SVP, Nuclear Projects and the associated leadership team is responsible for developing the program scope, obtaining regulatory certainty, developing the program estimates and obtaining program approval and phase based releases of funds, and establishing the refurbishment program organization to plan and execute the DRP.

**SVP, Refurbishment Execution** is accountable for the execution of the refurbishment outages in accordance with this Charter.

**SVP, Darlington Nuclear Generating Station** is responsible for the life cycle of the facility and is, therefore, a vital partner for the input and confirmation of the adequacy of the proposed refurbishment program. The SVP, Darlington Nuclear Generating Station, is responsible for planning the scope and schedule for shutdown or continued operation of the Darlington units.

**The Chief Nuclear Engineer** is responsible for the life cycle of the Steam Generators, Feeders, Fuel Channels, and Reactor Components and determines the Predicted End of Service Life dates. This is the critical input for confirming the adequacy of the refurbishment program and continued operation scope and schedule for these components.

### Design Authority

- Design Authority for the Refurbishment Program resides with the Director, Refurbishment Engineering in accordance with N-STD-MP-0024, Engineering and Design Authority.
- Design Authority for the Darlington Waste Management Facility, where waste from refurbishment may be stored as well as on-going dry storage of used fuel, resides with the Manager, Nuclear Waste Engineering and Design Authority, Nuclear Waste Management Division in accordance with N-STD-MP-0024, Engineering and Design Authority.

### Nuclear Refurbishment - Organization Structure

See Appendix B for the current NR organizational structure. This organizational chart provides a high level overview of the NR organization and also identifies the key functions and roles that provide direct service or support to the Refurbishment Program. All associated role documents are documented in the series N-MAN-08131-10000.

## 13.0 GLOSSARY OF TERMS

<b>CNSC</b>	Canadian Nuclear Safety Commission
<b>DNGS</b>	Darlington Nuclear Generating Station
<b>DRP</b>	Darlington Refurbishment Program
<b>EA</b>	Environmental Assessment
<b>ISR</b>	Integrated Safety Review

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## **DARLINGTON REFURBISHMENT CHARTER**

<b>NR</b>	Nuclear Refurbishment
<b>OPG</b>	Ontario Power Generation
<b>OPGN</b>	Ontario Power Generation Nuclear
<b>PgMP</b>	Program Management Plan
<b>PMP</b>	Project Management Plan
<b>PSRB</b>	Program Scope Review Board
<b>SVP</b>	Senior Vice President

## **14.0 DEFINITIONS**

**Program:** The Darlington Refurbishment activities are being managed, consistent with Project Management Institute (PMI) practices, as a program. A program is a group of related projects and program activities that are managed in a coordinated way to obtain program level benefits not achievable individually; i.e. for Refurbishment to be successful, all of the related projects must be successful.

**Project:** A project refers to a set of scope(s) of work or temporary endeavour being performed within the overall Darlington Refurbishment Program. The Project, also referred to as a Project Bundle, may include multiple EPC contracts plus OPG Oversight and Integration Work in order to achieve DRP results or to deliver the required service. Examples include the Re-tube and Feeder Replacement Project and the Steam Generator Refurbishment Project.



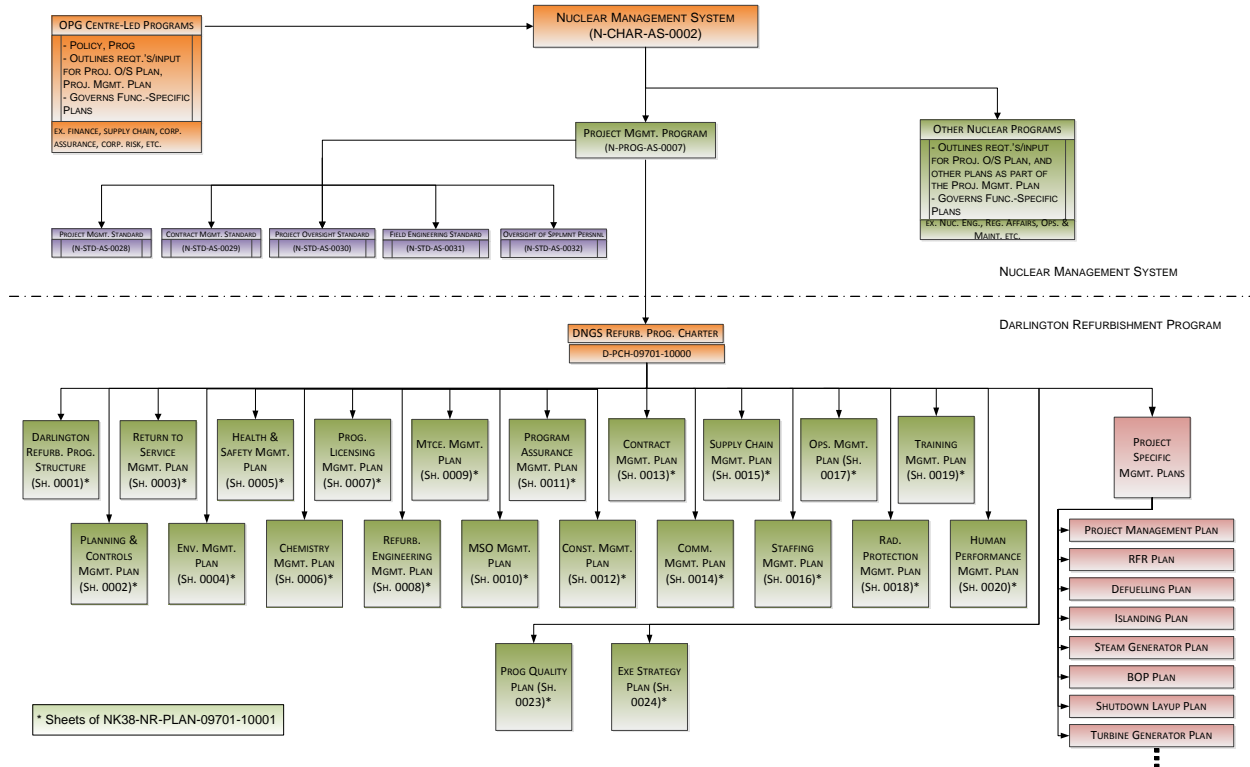
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## Appendix A: Darlington Refurbishment Program Framework



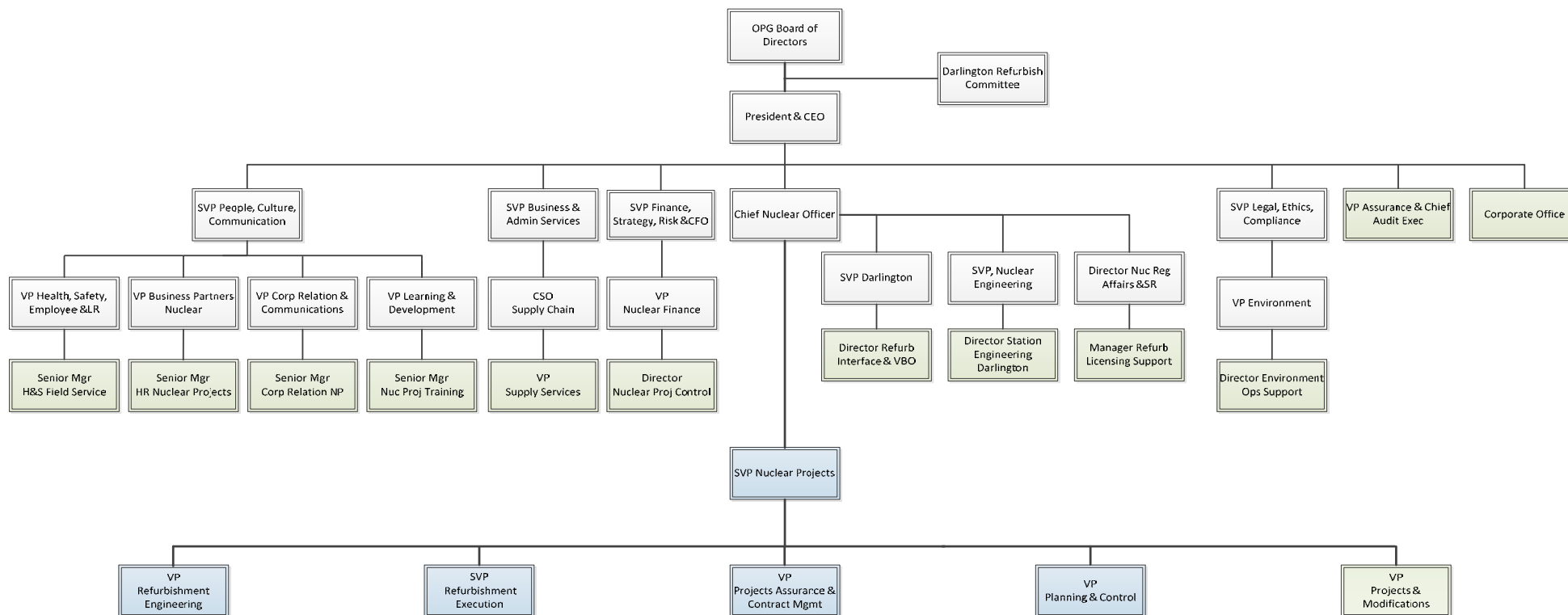


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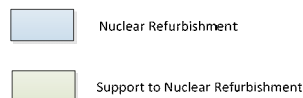
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## Appendix B: Nuclear Refurbishment Organizational Structure



### Legend:



This chart provides a high level overview of the Refurbishment organizations and key functions and roles that provide direct service/support to the NR Program. Please refer to OPG Org chart for the latest information.

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## NUCLEAR REFURBISHMENT EARNED VALUE MANAGEMENT

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## Nuclear Refurbishment Earned Value Management

**N-MAN-00120-10001-SCH-07-R002**

2015-02-04

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Revision Summary

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R000	2013-03-15	Initial issue
R001	2014-07-07	Added Engineering Earned Value Process
R002	2015-02-04	Overall update, EV Management Processes Updated, Earning Rules Added



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## 1.0 INTRODUCTION

### 1.1 Objective

This document establishes the Earned Value Management (EVM) methodology for Nuclear Refurbishment (NR) as a management tool for program and project planning and control.

The intended audience of this manual is all staff involved in NR work, including OPG, direct work contractors and their major sub-contractors.

### 1.2 Guidance

Earned Value Management is a standard project management technique for quantifying and measurement of project progress performance. It not only provides comparison of actual costs against that budgeted, but also allows continual analysis of progress achieved against that planned throughout the project timeline and across individual tasks at the Control Account/Work Package level.

In other words, the project (or a Control Account/Work Package) “earns” progress as work steps are completed thus allowing management to implement strategies should the project (or a Control Account/Work Package) track “off-plan”.

EVM provides necessary incentive mechanisms to project teams and contractors; it also provides effective approaches to assess program/project progress and cost status, and is the basis for a more precise forecast for time and cost control during schedule implementation.

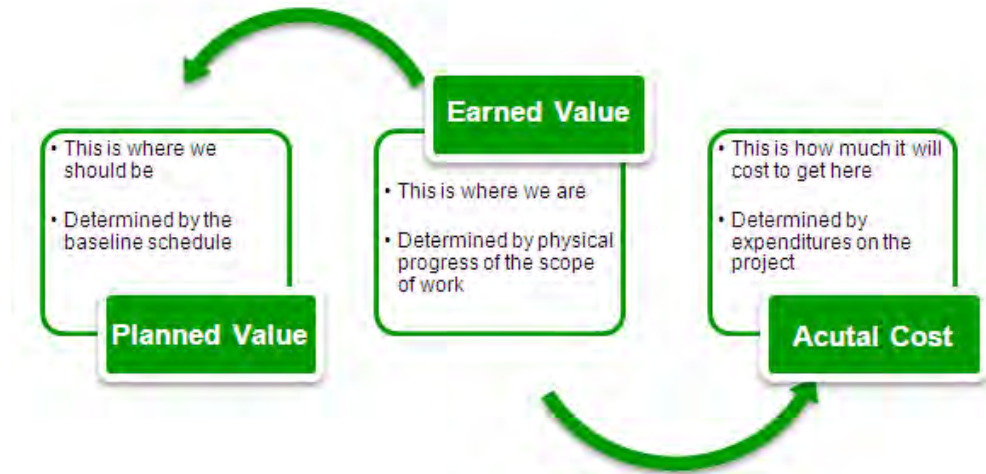
In order to conduct Earned Value Analysis, three components are needed; Planned Value to be earned, Earned Value (physical progress percent complete against budgeted value) and Actual Costs (from finance/ accounting or contractor invoices and accruals). Earned Value Process Summary is described below:

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### 1.3 Purpose

Earned Value Management benefits are well identified by major industry key players, such as:

- EVM provides a sound basis for problem identification, corrective actions and management re-planning as may be required. It provides for early identification of performance trends and variances from the management plan and allows management decision making while there is adequate time to implement effective corrective actions (ANSI/EIA-748-B Earned Value Management Systems).
- Earned Value is a commonly used method of performance measurement. It integrates project scope, cost and schedule measures to help the project management team assess and measure project performance and progress (PMI – A Guide to the Project Management Body of Knowledge).

Utilizing Earned Value Management methodologies and tools allow:

- The integration of scope, schedule and cost.
- Assessment of past and current performance.
- Comparison of progress against plan.
- Assessment of trends over time.
- Early identification of issues and allow the development of mitigation or recovery plans.
- Project teams to provide improved forecasts of future performance.

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## 2.0 DEFINITIONS

Refer to Project Controls Definitions for definitions used in the development of and within the Darlington Nuclear Generation Refurbishment Program Project Controls governance documents and manuals.

Additionally, a comprehensive list of P&C definitions is maintained by the NR Project Controls to provide program-wide read access, which is amended on a more frequent basis.

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### 3.0 PROCESS

The EVM process can be summarized under three major phases as below:

- EVM Planning
- EVM Monitoring
- Change Management

#### 3.1 EVM PLANNING

3.1.1. **Scope Definition** – OPG projects define scope, Refer to Scope Manual N-MAN-00120-10001/ SCOPE and NK38-INS-09701-10001

3.1.2. **Prepare WBS and Define Control Accounts/Work Packages:** The WBS will represent all of the work to be completed. It will form the basis for developing project schedule, resource estimation, performance measurement, management control and reporting. As the program progresses from one phase to another, WBS will be reassessed. If the program requirement changes, the WBS will evolve with the program. Establishing WBS Standard structure and guideline is first deliverable under this subject:

WBS Standard Structure/Guideline	
Responsible Organization	Manager – PMO – Scheduling
Key Output	WBS Guideline

Project and Functional managers are accountable for preparing standard WBS structure for use in all bundles.

Detailed WBS Defining All Work Packages	
Responsible Organization	Project Managers Functional Managers
Key Output	Detailed WBS define all work packages

Detailed WBS preparation includes:

- Preparing detailed WBS following WBS Guidelines to break the work to the lowest possible work packages (WP) based on defined scope
- Establish WP Numbering system (refer to NR standard WBS)

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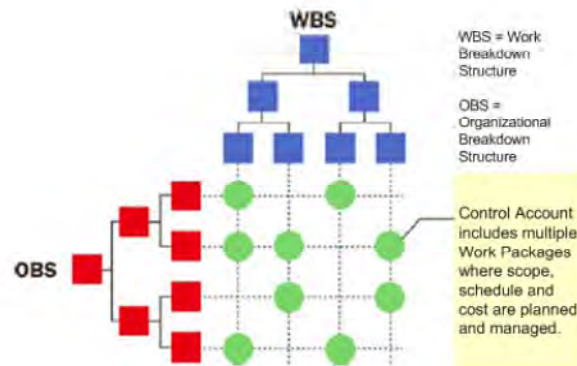
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- Issue Rev 0 of WBS

Define Control Account: Control Account can be understood as a group of related Work Packages that can be completed by a unique organization in a continuous time window. Refer to WBS Guideline N-MAN-00120-10001/SCH-05



- 3.1.3. **Prepare CBS:** NR Program is utilizing Activity Based Cost (ABC) and practically defined Work Breakdown structure is considered as Cost Breakdown Structure (CBS).
- 3.1.4. **Prepare Estimate by WP:** Based on WBS/CBS, prepare resources cost for every work package for Project Manager Approval.

Prepare Estimate by WP	
Responsible Organization	Estimating Group Project Managers Functional Managers
Key Output	Prepare estimate for every Work Package

- 3.1.5. **Prepare WBS Dictionary and get Manager's Approval:** The WBS dictionary defines the work scope represented in each element of WBS.

Prepare WBS Dictionary and get Manager's Approval	
Responsible Organization	Project Managers Functional Managers
Key Output	WBS Dictionary for all associated work packages

WBS Dictionary mainly contains the following:

- Summary scope description
- Deliverables

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- Estimate data resources/dollars
- Assumptions/Constraints
- Baseline schedule for the CA/WP
- Earning Rules

3.1.6. **Establish Rules of Credit:** In order to establish the Earned Value, the achieved progress must be assessed for each scheduled element and entered into the Cost Management System (this can be thought of as the “earned value”).

Establish Rules of Earning	
Responsible Organization	Project/Functional Manager
Key Output	Rules of earning guideline

- There are 3 basic methods for determining schedule progress (percent complete) and they should be selected and recorded in the WBS Dictionary for each Work Package (Level 3 activities progress contribution into their associated Work Package and Work Packages progress contribution into their associated control account should also be defined under Rules of Credit):
  - Discrete Effort – Discrete tasks are those tasks which are quantifiable to individual work products or predetermined tangible measurement. Techniques utilized for discrete efforts are:
    - Fixed Formula – 0/100, 50/50, 25/75 etc. With this method, x% of work is credited as complete for the measurement period in which the work begins, regardless of how much work has actually been accomplished. Remaining % is credited when the work is completed. Fixed formula techniques are most effectively used on small, short-duration task (typically less than two reporting periods)
    - Units Complete (Physical % Complete) – physical quantity count converted into a percent. Hours are often used for labour tasks such as engineering deliverables or

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installation Work Packages, (For example, for a total fuel channels of 480 if we complete the removal of 48 then the physical % complete would be 10% for the fuel channel removal Work Package).

- Valued Milestone (Steps) – It involves predetermined percent complete based on internal milestones within the Work Package. That value is earned as the milestones are completed (generally applicable to Fixed Price or Procurement Work Packages). This method is sometimes called weighted milestones.
- Level 3 activities progress contribution into their associated Work Package and Work Packages progress contribution into their associated control account should also be defined under Rules of Credit.
- Apportioned Effort – Apportioned effort is work for which the planning and progress are tied to other efforts. The budget for the apportioned account will be time-phased in relation to the resource plans for the base account(s). Status and the taking of earned value are driven by the status on the base account(s). If the base account(s) are on schedule, the apportioned account will be on schedule and an appropriate amount of value will be earned.
  - For example, Non-Manual Construction Support could be evaluated at 90% of the composite percent complete of all direct construction Work Packages. The final 10% would be earned when the paperwork closeout at the end of the project is complete (which is generally after the craft is gone).
- Level of Effort (LOE) – LOE is work scope of a general or supportive nature for which performance cannot be measured or is impracticable to measure. Resource requirements are represented by a time-phased budget scheduled in accordance with the time that the support will likely be needed. The earned

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value is earned by the passage of time and is equal to the budget scheduled in each time period. The performance data provided is simply a comparison of budget to actual cost. For LOE  $SPI = 1$ ;  $EV = PV$  and  $CPI = EV/AC$ .

- 3.1.7. **Baseline Schedules:** Please refer to the Program Schedule Management Procedure, NK38-PLAN-09701-10067-0004, for the definition of Baseline Schedules. Responsibilities and deliverables are as follow:

Level 3 Baseline Schedules Preparation	
Responsible Party	Project Managers Function Managers
Key Output	Baseline schedules

- Gate Submission Baseline, the Level 3 baseline schedules will be finalized with resource loaded (labour/quantity) and approved by management.
- In order to set up the project and its work package in planned values the Cost Control group must be provided with the following:
  - Work Package number
  - Work Package title
  - Work Package owner
  - Work Package baseline early start date
  - Work Package baseline early finish date
  - Work Package monthly resources distribution

Baseline Schedule Approval	
Responsible Party	Manager – PMO – Scheduling
Key Output	Review and approve L3 Schedule Baseline for use Ensure alignment with guidelines and procedures



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- 3.1.8. **Establish Planned Value (PV):** Planned Values per each work package under projects will be calculated and stored. This information will be utilized as basis for earned value and performance calculation.

Generate BCWS for all Work Packages and Generate Various Reports	
Responsible Party	PMO – Reporting
Key Output	Various cost reports original budget/BCWS

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### 3.2 EVM Monitoring

3.2.1. Calculating Earned Value, collecting Actual Costs, Schedule Performance Index (SPI) and Cost Performance Index (CPI), Cost and Schedule Variances by Work Package are supposed to be performed under monitoring phase.

3.2.2. **Progressing:** Level 3 Schedule activities would get progressed based on their physical progress (i.e. comparing physical quantity of complete work vs. physical quantity of scope), progress values from Level 3 activities contribute into their associate Work Package progress as per defined and documented earning rules.

Progressing	
Responsible Party	Contractors/Project Managers
Key Output	Percent Progress for every WP

- Every WP is represented by many activities in the Level 3 Schedule to cover the scope of work/resource loaded to an agreed level of RBS and based on the established rules of earning
- Physical % complete will be calculated by Level 3 activities rolled into the WP level
- In some cases progress may be calculated in a dedicated progress measurement/monitoring system and then input into the Level 3 activities (This assumption should be document as part of Earning Rules).

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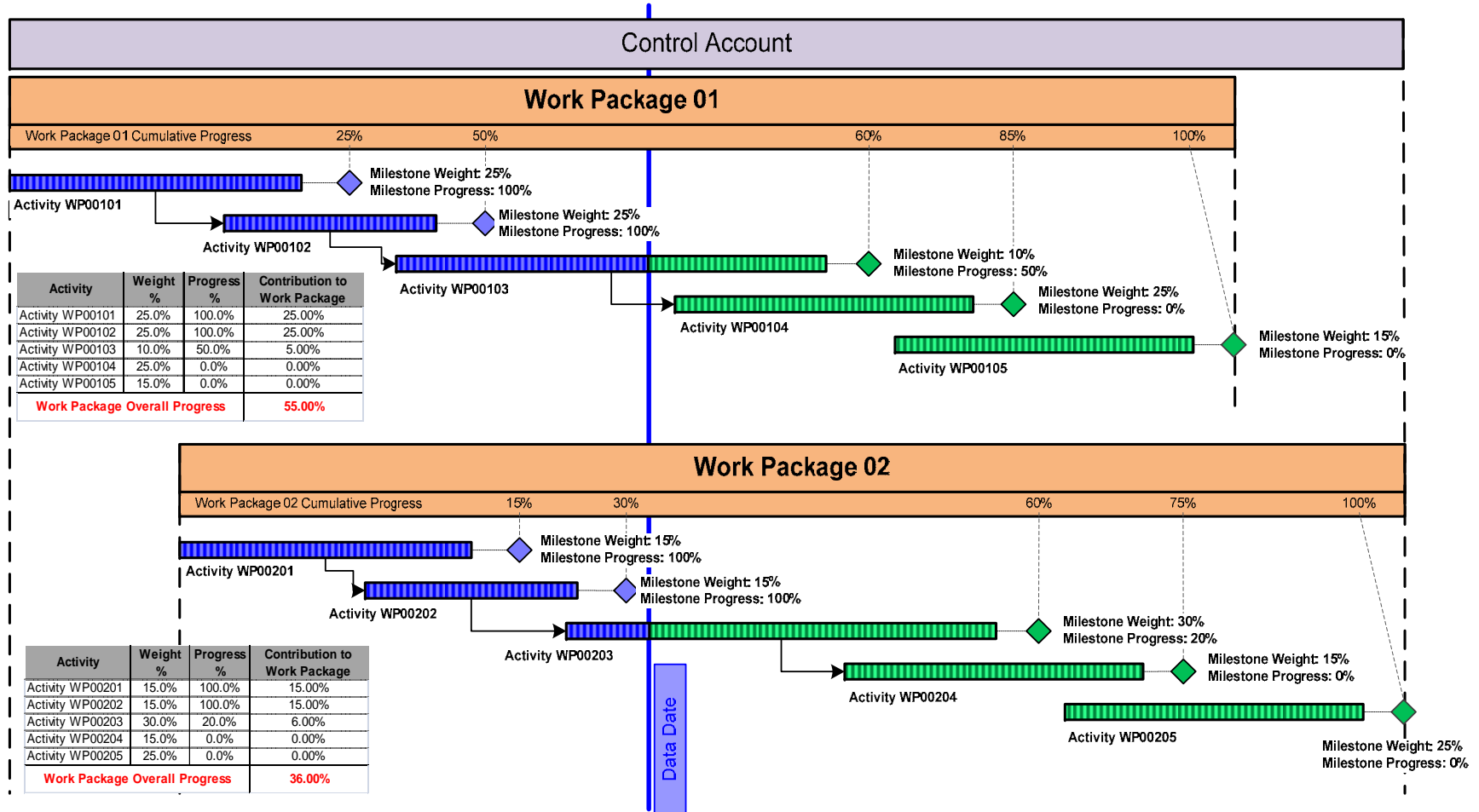
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- For example, activities from Level 3 are contributing into their associated work package progress and work packages are contributing into Control account. Weighted milestones are basis for rolling up percent progresses.



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- 3.2.3. **Collecting Cost:** Collect Actual Cost by Work Package; Generate SPI/CPI; cost and schedule variance

Generate SPI/CPI cost and schedule variance	
Responsible Party	Manager – PMO – Reporting
Key Output	Calculate EV; collect AC Calculate SPI,CPI Calculate cost and schedule variance

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### 3.3 Change Management

3.3.1. Refer to Change Management Section of this Document

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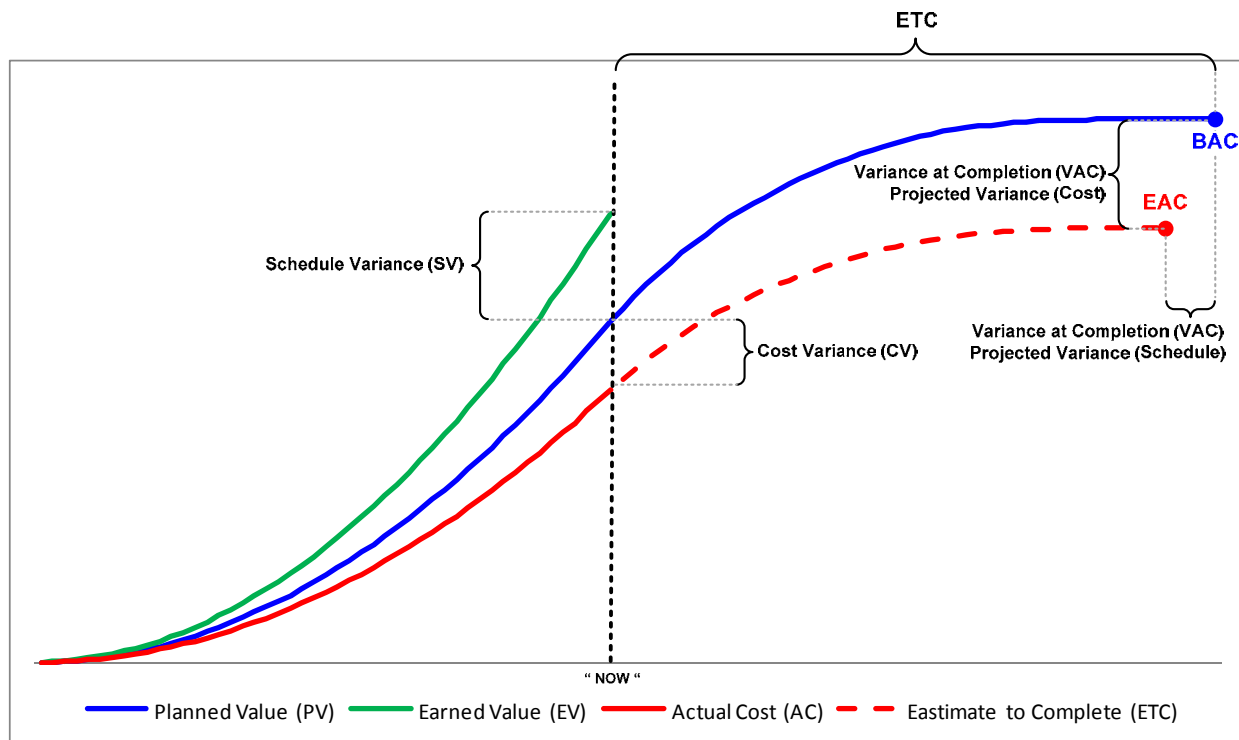
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## REFURBISHMENT EARNED VALUE MANAGEMENT

### 4.0 GRAPHS, FORMULAS, AND DEFINITIONS



**AC (or ACWP):** Actual cost of work performed to date; the actual costs charged against the activities

**PV (or BCWS):** Budgeted cost of work scheduled to date (planned value); the total baseline costs budgeted for the activities scheduled or planned

**EV (or BCWP):** Budgeted cost of work performed to date (earned value of accomplished work)

**BAC:** Budget at completion; BCWS at end of project, or original budget + changes

**ETC:** Estimate to Complete

**EAC:** Estimate at Completion

$$EAC = AC + ETC$$

**CV:** Cost Variance

$$CV = AC - EV$$

**CPI:** Cost Performance Index  
=  $EV / AC$

**SV:** Schedule Variance  
=  $EV - PV$

**SPI:** Schedule Performance Index  
=  $EV / PV$

**VAC:** Variance at Completion (Projected Variance)  
=  $EAC - BAC$

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The distinction between **PV** and **EV** is that the former represents the budget of the activities that were planned to be completed and the latter represents the budget of the activities that actually were completed.

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### 5.0 ANALYSIS AND MEANINGS

The Earned Value analysis is conducted by creating the Planned Value, calculating Earned Value, collecting Actual Cost, calculating the CPI, SPI, Cost Variance (CV) and Schedule Variance (SV).

The following are quick indicators:

- $CPI > 1$  indicates that the project is progressing under budget
- $CPI < 1$  indicates that the project is progressing over budget
- $SPI > 1$  indicates that the project is progressing ahead of schedule
- $SPI < 1$  indicates that the project is progressing behind schedule



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### 6.0 CHANGE MANAGEMENT

The Performance Measurement Baseline will only be changed for Directed Changes. Directed Changes should be reflected in both Cost and Schedule at the same time if they affect both. Directed Changes may be issued to cover variances so great that they impact the ability to obtain a meaningful measure of performance. Approval process will follow the workflow as per the change management process.

Refer to the Project Controls Plan, N-MAN-00120-10001-PC.

- The Cost Control group will lead the Change Management Process; the Scheduling group will support running “what-if” scenarios and assess schedule impacts (Original Baselines should always be retained and new baseline should get populated).
- Once the change is approved, it will be implemented to both cost and schedule baselines.

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## 7.0 P6 – PROLIANCE INTERFACES

- Proliance is the software for managing Planned Values, Cost Control, Earned Values plus performing analysis on each work package and control account level.
- SPI/CPI shall be calculated at the Work Package level where Actual Cost is collected. Cost reports and earned value can be rolled to various levels according to the WBS/CBS.
- Percent complete shall be calculated for every work package using Level 3 schedule and earning rules.

### 7.1 Initial Setup of the Plan

- 7.1.1. Level 3 schedules shall represent every work package in the WBS contributing into Earned Value Management.
- 7.1.2. Level 3 schedules shall be resource loaded with labour and quantity according to the predefined resource library.
- 7.1.3. After completing baseline schedules; the following will be generated from by the Project Cost and Schedule Analysts:
  - 7.1.3.1. Early Start/Early Finish date for every work package in the WBS.
  - 7.1.3.2. Monthly labour distribution for Early Plan (Planned Values per Work Packages by units).
  - 7.1.3.3. Level 3 schedules shall not contain any cost values or cost calculation or cost related activities (such as escalation or interest).
  - 7.1.3.4. Planned Values (PV)/Budgeted Cost for Work Scheduled (BCWS) for every work package shall be calculated and transferred to Proliance according to WBS/CBS. This will ensure that Planned Values (PV)/Budgeted Cost for Work (BCWS) are available on units and equivalent cost and roll up to the overall project.

### 7.2 Monitoring and Calculating SPI/CPI

- 7.2.1. Level 3 schedules shall be updated under P6 and on agreed frequencies and lead to Earned Value calculations.

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- 7.2.2. Level 3 schedules shall be integrated and percent complete and status will be calculated for every work package.
- 7.2.3. Work packages percent progress, forecast early date, and forecast finish dates from Level 3 schedules shall be obtained and transferred to Proliance.
- 7.2.4. Actual Cost will collected through Nuclear Financial Reporting and Analytics (NFRA) and stored under Proliance.

### **7.3 P6 / Proliance Change Management**

- 7.3.1. Scope, Cost, and Schedule changes shall be recorded in Proliance (Budgets, Planned Values, earning Rules, etc.).
- 7.3.2. All changes except pure cost related changes shall be implemented in P6.

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## 8.0 EARNED VALUE MEASUREMENT GUIDELINES

In EVM, the progress of all work must be measured. Measuring project performance is a complex task involving many interrelated and progressive steps. The key to performance measurement is the objective assessment of work in progress. Measuring the amount of work scope completed is planned at the task level in conjunction with the performance measurement baseline. An EV technique is selected for each task based on temporal and physical quantities. Objective measurement of physical progress on tasks with tangible outcomes is superior to other all other measurements. Tasks that can be completed in one progress-reporting period require only one measurement and are preferred. Tasks that span several reporting periods should be measured objectively with milestones representing intermediate, tangible outcomes. Appendixes subsections provide the guidelines for measuring the project progress objectively.

### Earned Value Management Guidelines

Modification Design Request (MDR)  
Design  
Planning & Assessing  
OPG Procurement – Long Lead Items  
OPG Procurement – Non-Long Lead Items  
Vendor Procurment  
Construction  
RTS

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## 9.0 TOOLS

Earned Value will be managed by the following systems:

- Primavera P6 – Scheduling, Resourcing and Progress Updating
- Proliance – Planned Value, Actual Costs, Earned Values and Forecasts
- BI Tool –Reporting, CPI/SPI , Forecasting, Budget, Actual

### 9.1 Primavera P6

- 9.1.1. The original program baseline schedule will be developed by the respective teams based on the latest funding release, resource requirement, and timeline.
- 9.1.2. The project baseline schedule for each project will be developed by OPG at gate using the standard Work Package fragnets.
- 9.1.3. The above baseline may be revised on agreement of the contract schedule with the appropriate EPC contractor. The EPC contractor's schedule must roll up to the work packages included in the project baseline schedule.
- 9.1.4. Project teams shall update each of the work packages with the progress achieved based on the established Earning Rules.
- 9.1.5. A progress values will be developed on a cyclical basis to transfer work package attributes and progress information to Proliance.

### 9.2 Proliance

- 9.2.1. The Original Program Budget and Planned Value will be developed by the Program P&C Department, based on information developed by the projects in the development of the Original Program Schedule Baseline.
- 9.2.2. The Control Budget and Planned Value for each project will transferred to Proliance, developed by the respective projects for their scope of work which, will comprise:
  - 9.2.2.1. Work Packages for Work that has been approved under latest fund release.
  - 9.2.2.2. Work Packages for future Work at Control Account level.
  - 9.2.2.3. Work Packages schedule information and progress information will be uploaded from Primavera P6 on a cyclical basis.

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### 9.3 BI Tool

9.3.1. The BI Tool will use data from both Primavera and Proliance to develop required reports for:

9.3.1.1. Project Performance (CPI, SPI)

9.3.1.2. Cost and Schedule Planned and Actual Data

9.3.1.3. Forecasts

9.3.1.4. Risks

9.3.1.5. Other related information.

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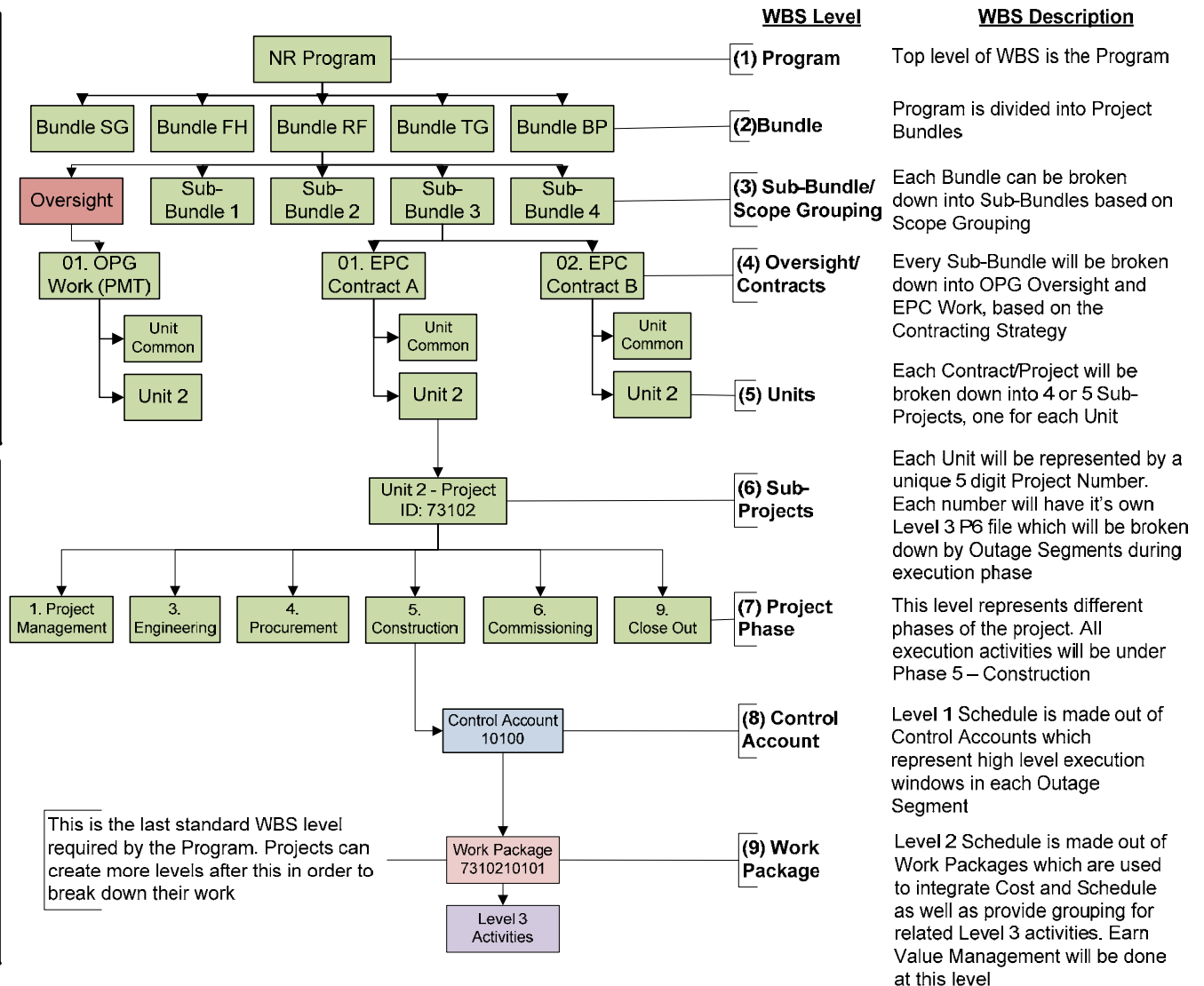
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## REFURBISHMENT EARNED VALUE MANAGEMENT

### Appendix A: Control Account/Work Packages

#### Program Breakdown Structure



#### Project WBS

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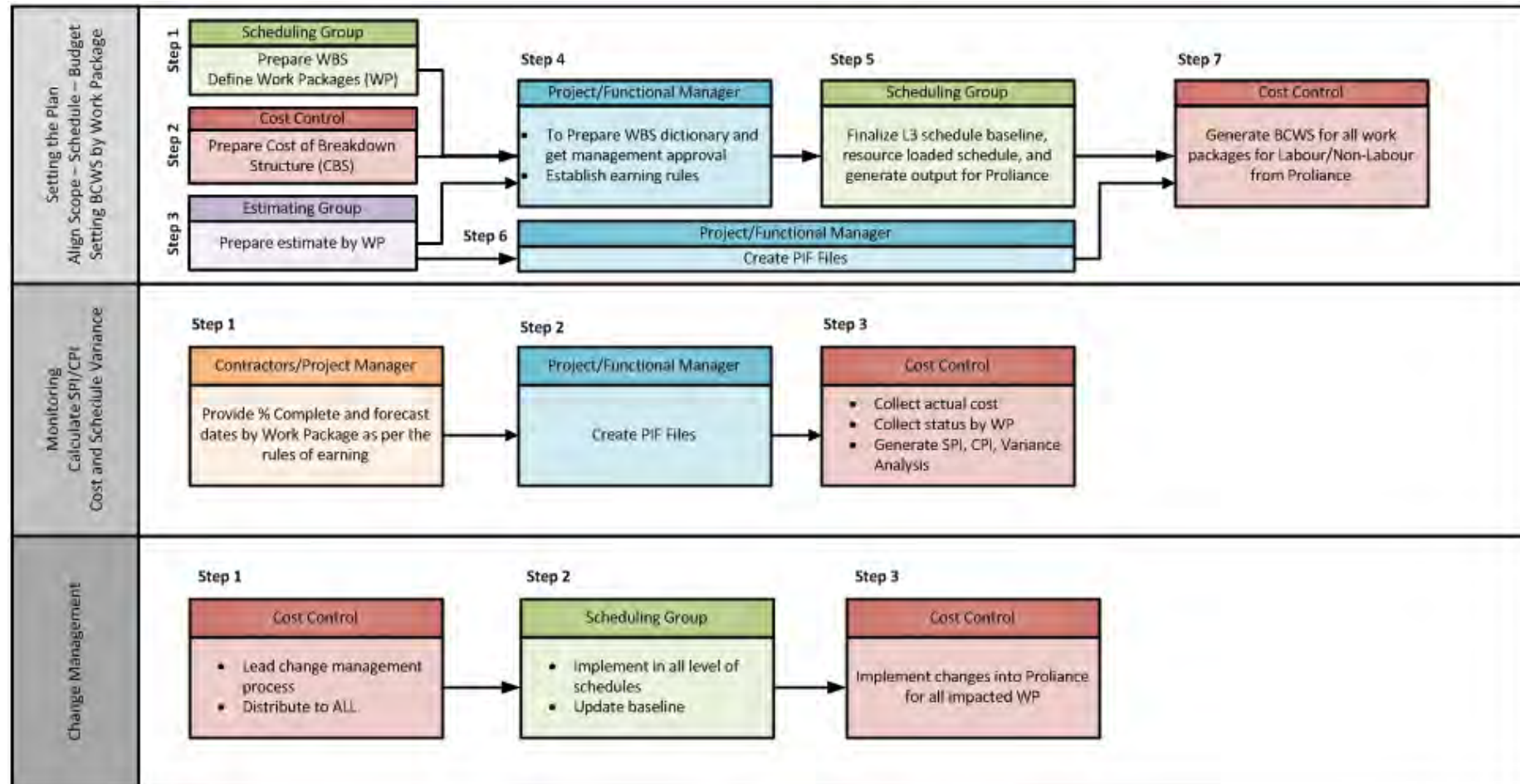
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**Appendix B: Earned Value (EV) Process**





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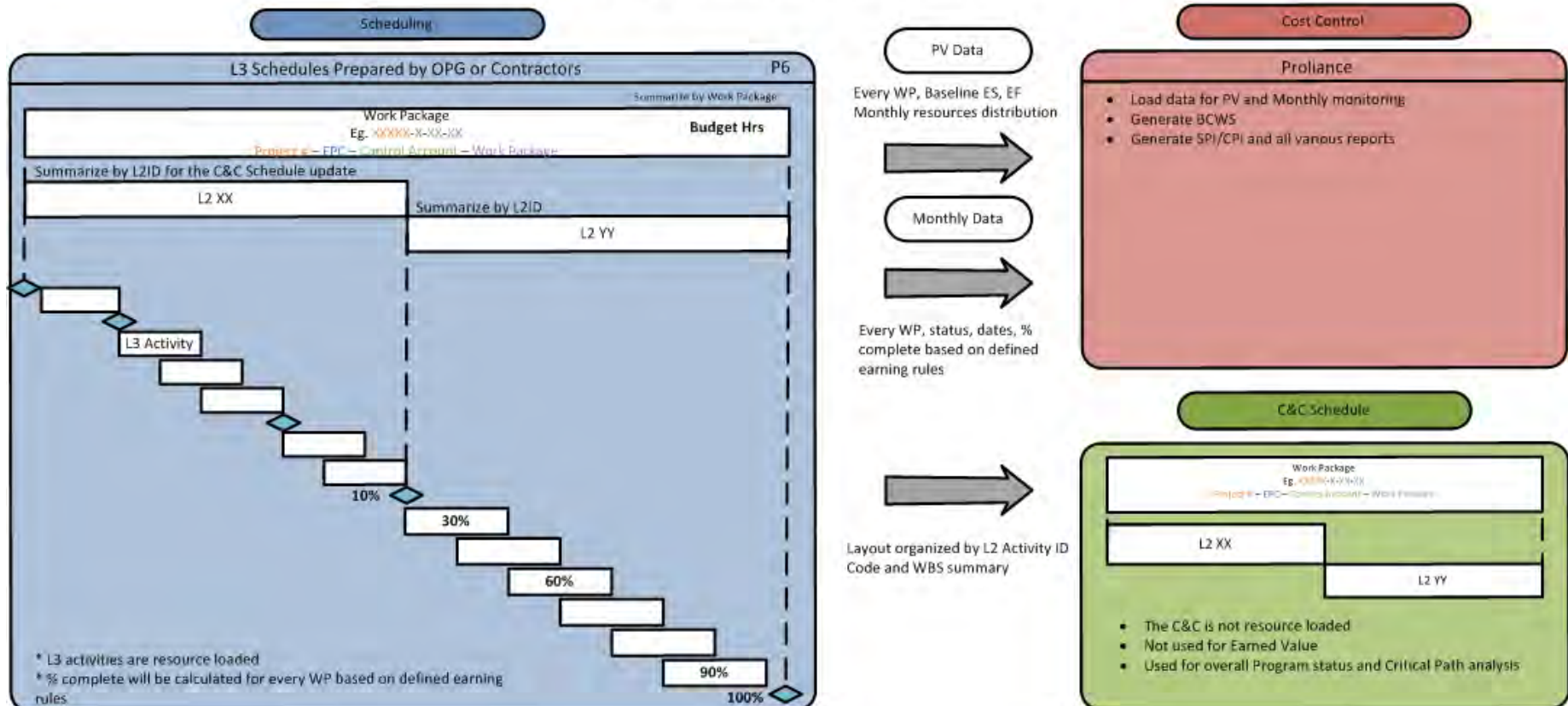
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## Appendix C: Primavera/Proliance Interfaces

### L3 Schedule/C&C Interfaces

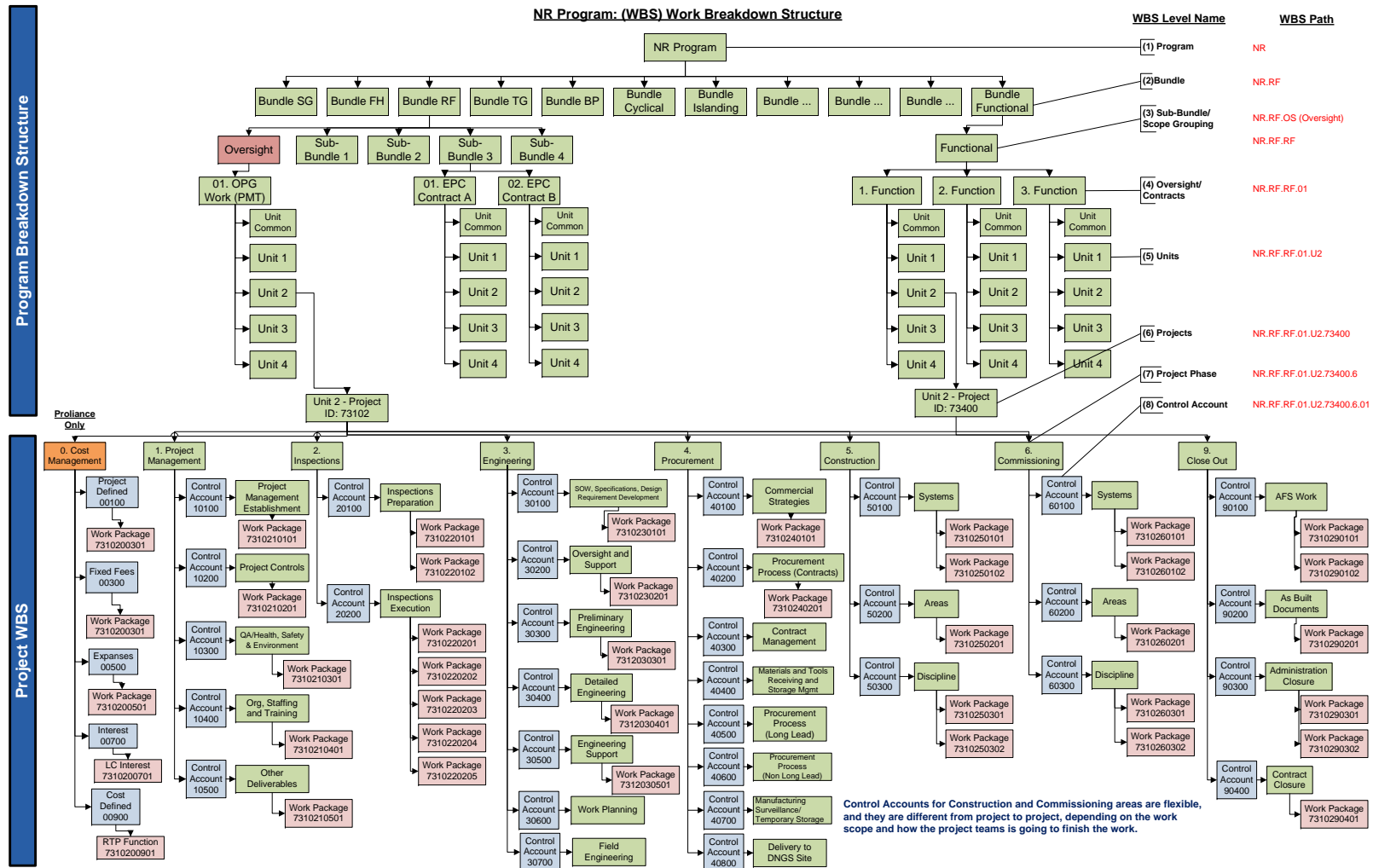


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## Title: NUCLEAR REFURBISHMENT EARNED VALUE MANAGEMENT

### Appendix D: Program and Project Work Breakdown Structure



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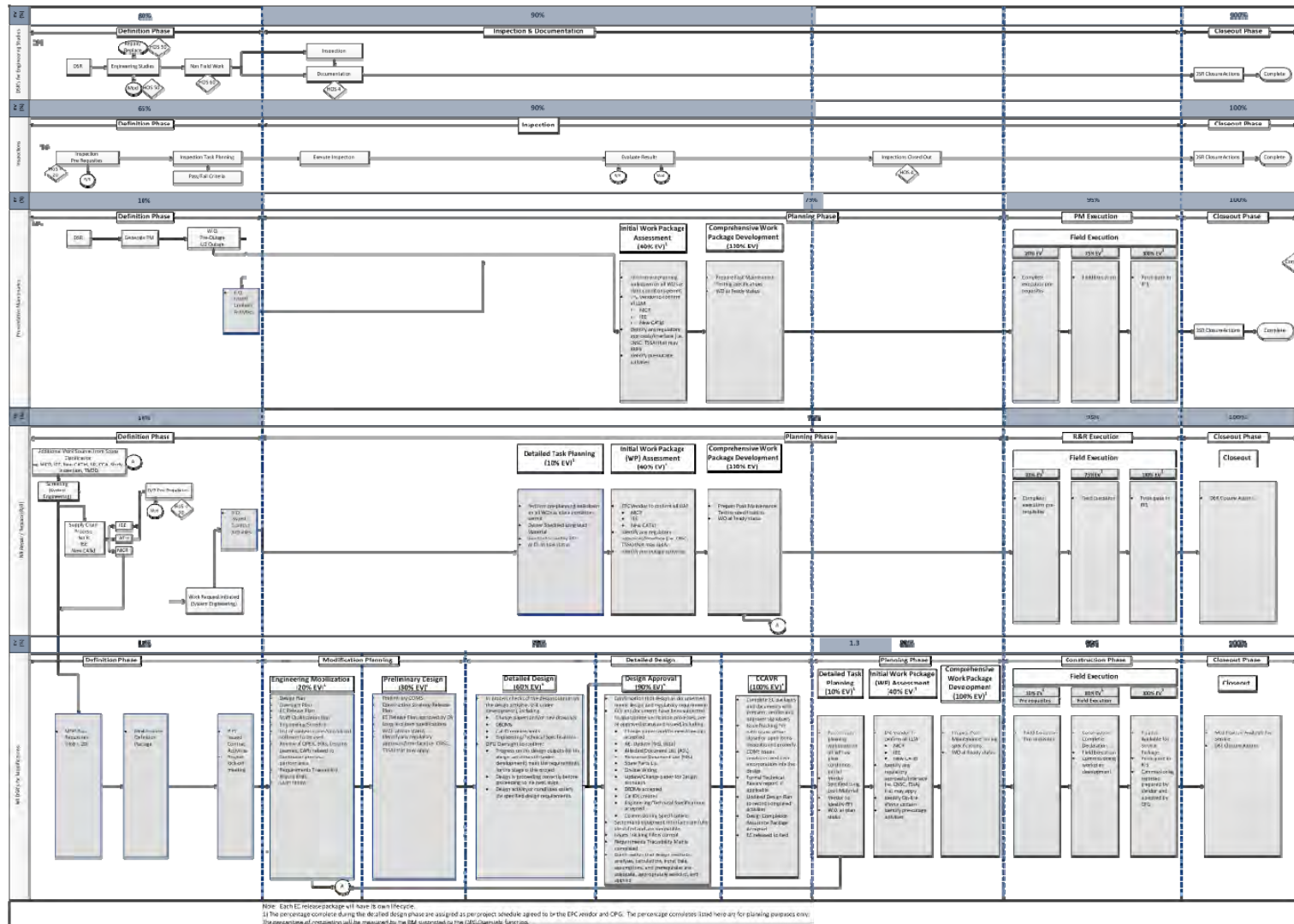
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## Appendix E: Engineering Major Work Streams

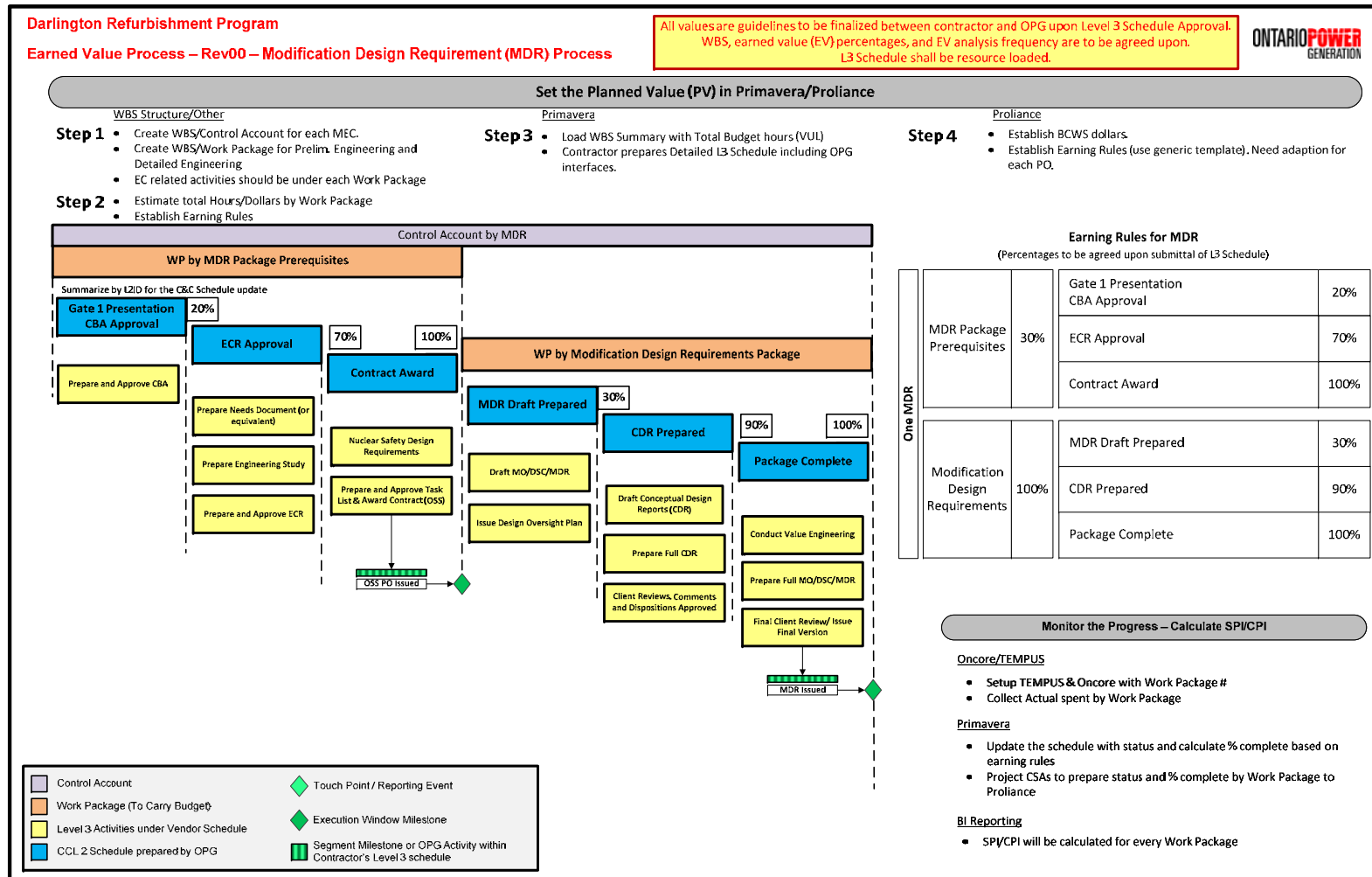


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## Appendix F: Earned Value Management / MDR Development

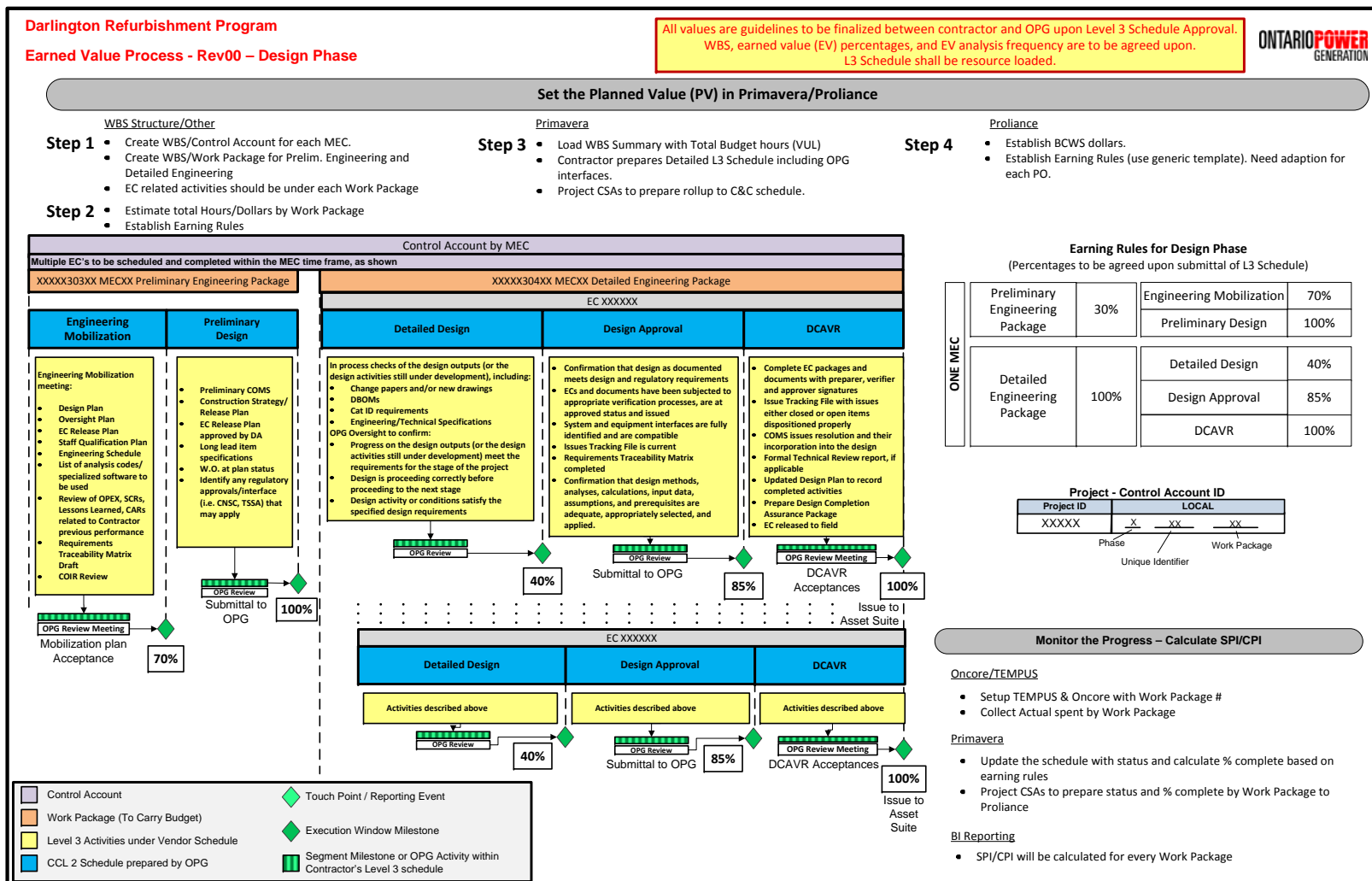


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## Appendix G: Earned Value Management / Design Phase



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## Appendix H: Earned Value Management / Planning Assessing

### Darlington Refurbishment Program

### Earned Value Process – Rev00 – Planning Assessing Phase

All values are guidelines to be finalized between contractor and OPG upon Level 3 Schedule Approval. WBS, earned value (EV) percentages, and EV analysis frequency are to be agreed upon. L3 Schedule shall be resource loaded.



#### Set the Planned Value (PV) in Primavera/Proliance

##### WBS Structure/Other

- Step 1**
- Create WBS/Control Account for each MEC.
  - Create WBS/Work Package for each MEC
  - EC related activities should be under each Work Package

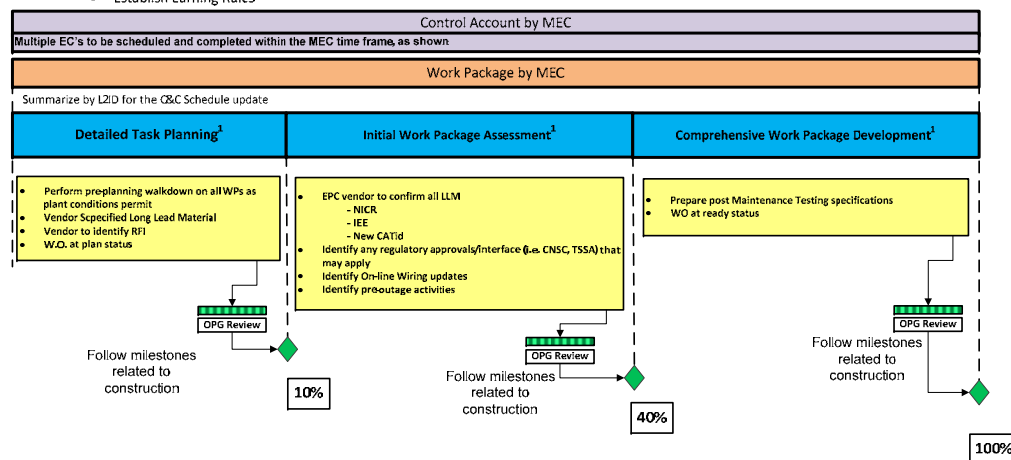
- Step 2**
- Estimate total Hours/Dollars by Work Package
  - Establish Earning Rules

##### Primavera

- Step 3**
- Load WBS Summary with Total Budget hours (VUL)
  - Contractor prepares Detailed L3 Schedule including OPG interfaces.

##### Proliance

- Step 4**
- Establish BCWS dollars.
  - Establish Earning Rules (use generic template). Need adaption for each PO.



#### Earning Rules for Planning Assessing

(Percentages to be agreed upon submittal of L3 Schedule)

ONE MEC	One WP per MEC	100%	Detailed Task Planning	
			Initial Work Package Assessment	40%
			Comprehensive Work Package Development	100%

#### Monitor the Progress – Calculate SPI/CPI

##### Oncore/TEMPUS

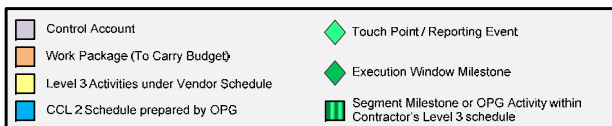
- Setup TEMPUS & Oncore with Work Package #
- Collect Actual spent by Work Package

##### Primavera

- Update the schedule with status and calculate % complete based on earning rules
- Project CSAs to prepare status and % complete by Work Package to Proliance

##### BI Reporting

- SPI/CPI will be calculated for every Work Package



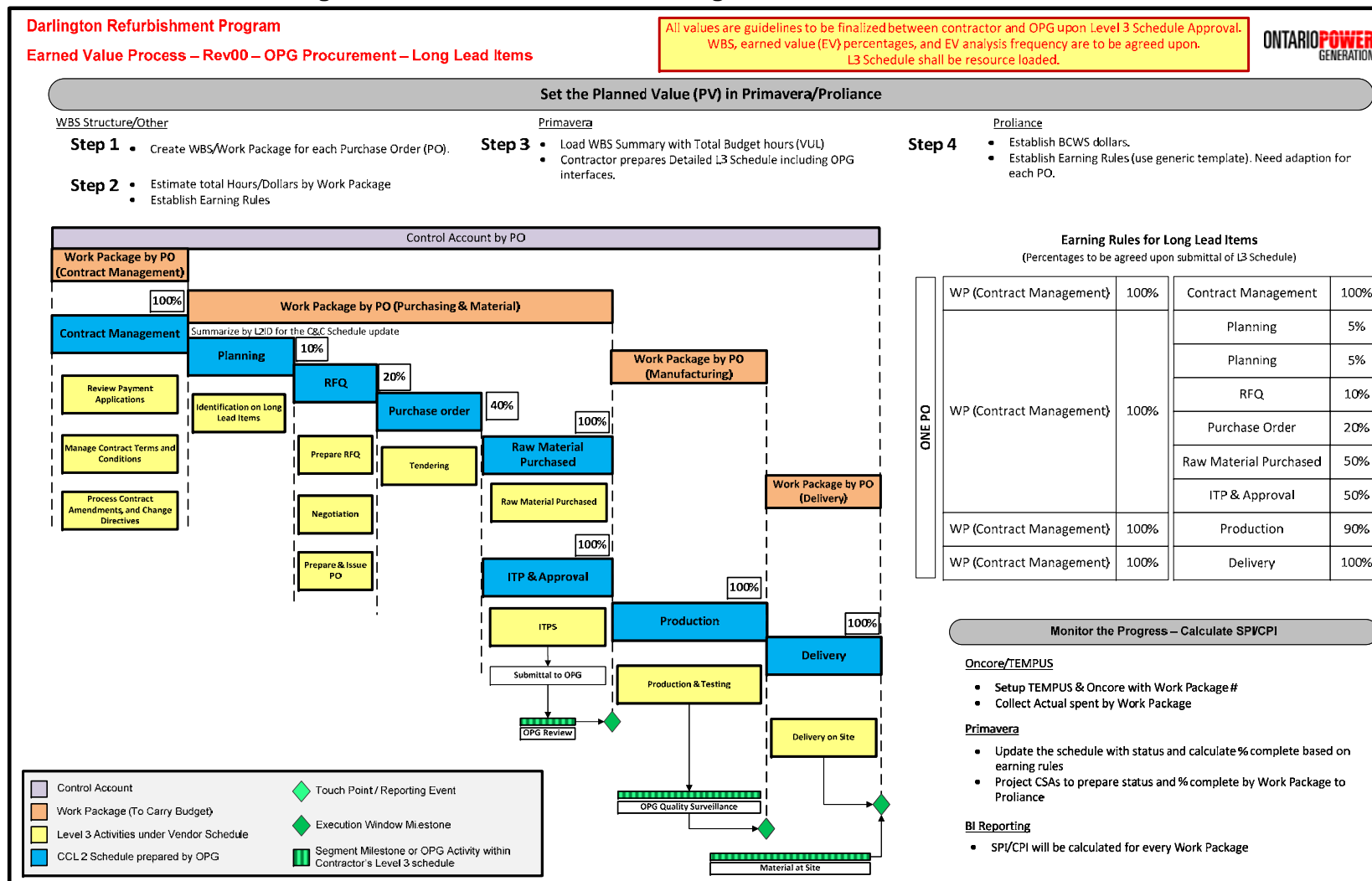


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### Appendix I: Earned Value Management / OPG Procurement – Long Lead Items



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## Appendix J: Earned Value Management / OPG Procurement – Non-Long Lead Items

### Darlington Refurbishment Program

### Earned Value Process – Rev00 – OPG Procurement – Non-Long Lead Items

All values are guidelines to be finalized between contractor and OPG upon Level 3 Schedule Approval. WBS, earned value (EV) percentages, and EV analysis frequency are to be agreed upon. L3 Schedule shall be resource loaded.



#### Set the Planned Value (PV) in Primavera/Prolance

##### WBS Structure/Other

**Step 1** • Create WBS/Work Package for each Purchase Order (PO).

**Step 2** • Estimate total Hours/Dollars by Work Package  
• Establish Earning Rules

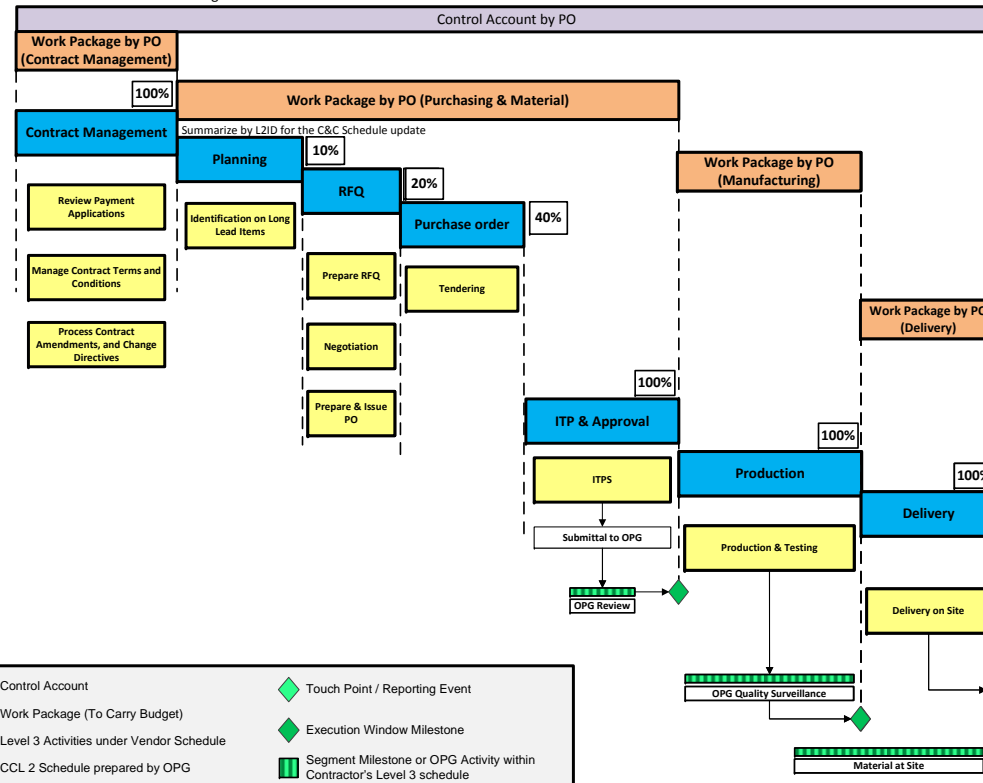
##### Primavera

**Step 3** • Load WBS Summary with Total Budget hours (VUL)  
• Contractor prepares Detailed L3 Schedule including OPG interfaces.

**Step 4**

##### Prolance

• Establish BCWS dollars.  
• Establish Earning Rules (use generic template). Need adaption for each PO.



#### Earning Rules for Non-Long Lead Items (Percentages to be agreed upon submittal of L3 Schedule)

WP (Contract Management)	100%	Contract Management	100%
		Planning	5%
		Planning	5%
		RFQ	10%
		Purchase Order	20%
		ITP & Approval	50%
		Production	90%
		Delivery	100%
WP (Contract Management)	100%		
WP (Contract Management)	100%		

#### Monitor the Progress – Calculate SPI/CPI

##### Oncore/TEMPUS

- Setup TEMPUS & Oncore with Work Package #
- Collect Actual spent by Work Package

##### Primavera

- Update the schedule with status and calculate % complete based on earning rules
- Project CSAs to prepare status and % complete by Work Package to Prolance

##### BI Reporting

- SPI/CPI will be calculated for every Work Package



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## Appendix K: Earned Value Management / Vendor Procurement

### Darlington Refurbishment Program

### Earned Value Process – Rev00 – Vendor Procurement

All values are guidelines to be finalized between contractor and OPG upon Level 3 Schedule Approval. WBS, earned value (EV) percentages, and EV analysis frequency are to be agreed upon. L3 Schedule shall be resource loaded.



#### Set the Planned Value (PV) in Primavera/Proliance

##### WBS Structure/Other

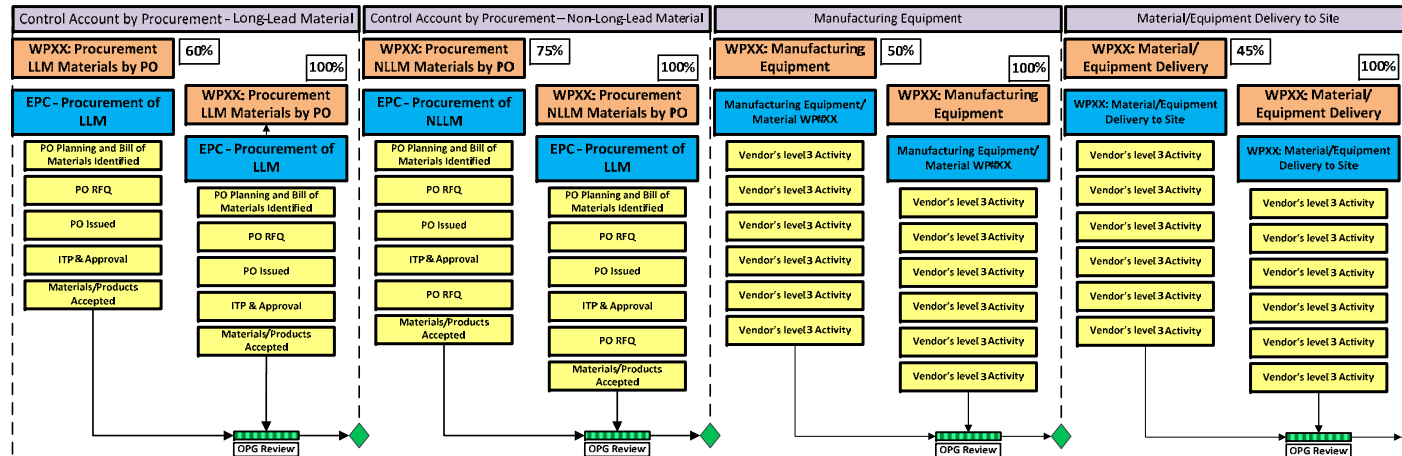
- Step 1**
- Create WBS/Work Package for each phases requirements and strategies.
- Step 2**
- Estimate total Hours/Dollars by Work Package
  - Establish Earning Rules

##### Primavera

- Step 3**
- Load WBS Summary with Total Budget hours (VUL)
  - Contractor prepares Detailed L3 Schedule including OPG interfaces.

##### Proliance

- Step 4**
- Establish BCWS dollars.
  - Establish Earning Rules (use generic template). Need adaption for each PO.



- Vendor's Manufacturing Work Packages will be defined as per its strategies and requirements.
- Vendor's Material Delivery Work Packages will be defined as per its strategies and requirements.

#### NOTE:

Material/Equipment Delivery to Site Milestone (from Vendor's Schedules) needs to be linked into all associated "Execution Windows" Readiness Milestones

Control Account	Touch Point / Reporting Event
Work Package (To Carry Budget)	Execution Window Milestone
Level 3 Activities under Vendor Schedule	Segment Milestone or OPG Activity within Contractor's Level 3 schedule
CCL 2 Schedule prepared by OPG	

#### Earning Rules for Vendor Procurement

(Percentages to be agreed upon submittal of L3 Schedule)

LLM Procurement	100%	WPXX: Procurement LLM Materials by PO	60%
		WPXX: Procurement LLM Materials by PO	100%
Non-LLM Procurement	100%	WPXX: Procurement Non-LLM Materials by PO	75%
		WPXX: Procurement Non-LLM Materials by PO	100%
Manufacturing Equipment	100%	WPXX: Manufacturing Equipment/Material	50%
		WPXX: Manufacturing Equipment/Material	100%
Material/Equipment Delivery to Site	100%	WPXX: Material/Equipment Delivery	45%
		WPXX: Material/Equipment Delivery	100%

#### Monitor the Progress – Calculate SPV/CPI

##### Oncore/TEMPUS

- Setup TEMPUS & Oncore with Work Package #
- Collect Actual spent by Work Package

##### Primavera

- Update the schedule with status and calculate % complete based on earning rules
- Project CSAs to prepare status and % complete by Work Package to Proliance

##### BI Reporting

- SPV/CPI will be calculated for every Work Package

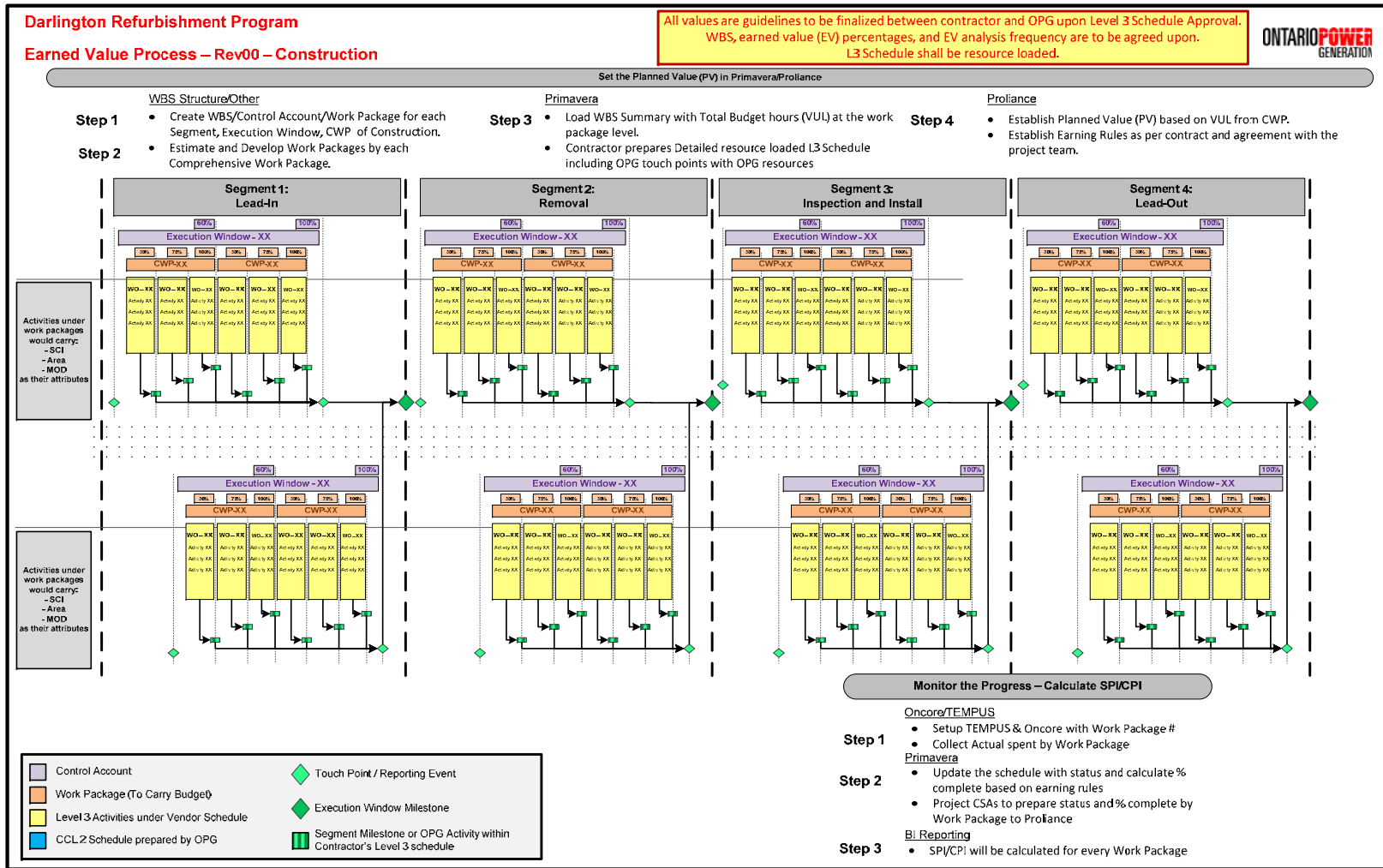
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## Appendix L: Earned Value Management / Construction



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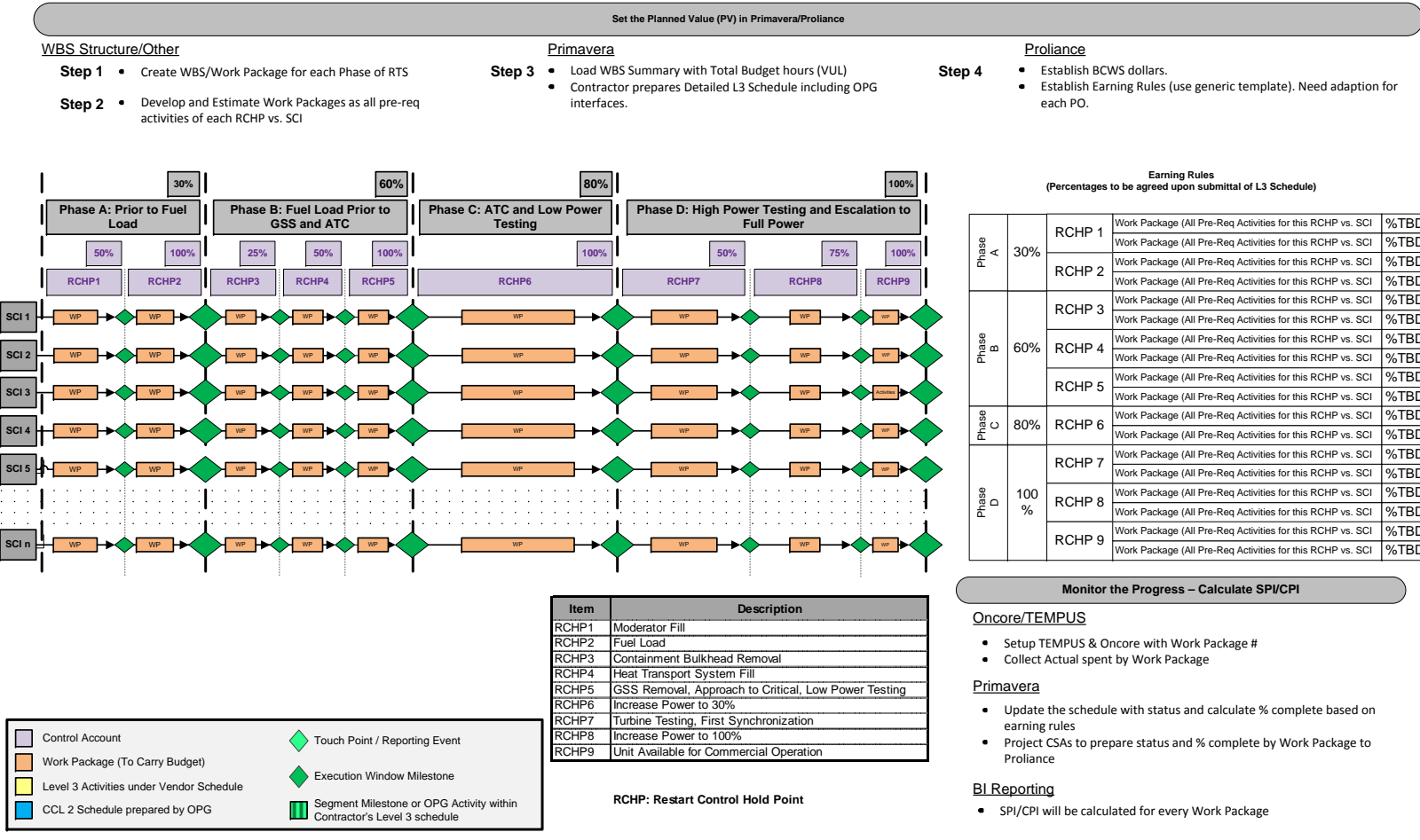
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## Appendix M: Earned Value Management / Return to Service

### Darlington Refurbishment Program

#### Earned Value Process – Rev00 – Return to Service

All values are guidelines to be finalized between contractor and OPG upon Level 3 Schedule Approval.  
WBS, earned value (EV) percentages, and EV analysis frequency are to be agreed upon.  
L3 Schedule shall be resource loaded.





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**NUCLEAR REFURBISHMENT - COST MANAGEMENT AND REPORTING**

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## **Nuclear Refurbishment - Cost Management and Reporting**

**N-MAN-00120-10001-PC-13 R000**  
2013-10-04

Order Number: N/A  
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Revision Summary

Revision Number	Date	Comments
R000		Initial issue.

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### 1.0 PURPOSE

This guide defines the processes, including the interface to approved tools and source systems, used to execute Cost Management within the Nuclear Refurbishment Program. This manual takes authority from N-MAN-00120-10001-PC, Project Controls.

Cost Management includes the processes required to enable projects to be completed within approved budgets. The purpose of this manual is to establish the requirements in undertaking those activities.

Cost management is comprised of the following processes:

- (a) Cost Management Planning – The process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.
- (b) Cost Estimating – The process of developing an approximation of the monetary resources needed to complete project activities.
- (c) Cost Budgeting – The process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.
- (d) Funding – The process of providing the financial resources to meet the time-phased cash needs of the project. Funding is an importance part of the cost budgeting process.
- (e) Cost Monitoring and Control – The process of monitoring the status of the project to update the project costs and manage changes to the cost baseline.
- (f) Forecasting – The process of estimating or predicting the project's future based on knowledge and information available at the time of the forecast. Forecasting is an important element of cost monitoring and control.
- (g) Cost Performance Reporting – The physical or electronic representation of cost performance information compiled in project/program documents, intended to generate decisions, actions, and awareness. This information is generated during the cost monitoring and control process.

### 2.0 COST MANAGEMENT PLANNING

Cost Management planning is the process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.

Detailed Cost Management planning shall be performed as part of the overall Project Management (PM) planning process.

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The Cost Management Plan will define how the team will estimate the project cost, prepare and present a project budget, control project costs, as well as document the review and approval requirements for the cost management processes.

Definitions of the terms used in cost management are contained in Section 6.1 of this document.

### 2.1 Organization, Roles and Responsibilities

The organization responsible for cost management activities as well as individual roles and responsibilities are contained in Appendix A.

### 2.2 Cost Management Planning Parameters

Cost Management planning shall establish and document the following as a minimum:

- (a) Control Thresholds – Variances between actual and/or forecast performance and the baseline plan in excess of 5% should be investigated to determine the cause and develop a corrective action plan.
- (b) Control Accounts – Control accounts shall be established for Work Breakdown Structure (WBS) elements at a level consistent with maintaining effective control of the project scope-budget-cost-schedule using Earned Value Management (EVM) techniques. in accordance with N-MAN-00120-10001-PC-09, Earned Value Management.
- (c) Work/Planning Packages and Activities - Each control account shall contain one or more work packages (WP). Each work package may contain a number of activities. Except for functional areas and Cost Only WP, no more than 15% of the total project value shall normally be comprised of Level of Effort (LOE) work packages.
- (d) Reporting Period – Reporting periods shall be monthly and shall be based on the OPG fiscal calendar. During high periods of activity such as during execution, more frequent reporting may be required.
- (e) Earned Value Management (EVM) – As a minimum, EVM shall be performed at the work package level. The EVM measurement techniques to be used for each work package shall be documented and in accordance with N-MAN-00120-10001-PC-09, Earned Value Management.
- (f) Escalation – Adjustments for escalation due to inflation shall be established in consultation with Finance. They shall be tracked and reported in separate Cost Only WPs. Cost Only WPs are not included in EVM.



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- (g) Interest – Adjustments for interest costs shall be established in consultation with Finance. They shall be tracked and reported in separate Cost Only WPs. Cost Only WPs are not included in EVM.

## 2.3 Cost Management Tools

Proliance is the project Cost Management System tool. Proliance is a web-based application, accessible in the office or on site and enabling real-time communication. Using Microsoft's .NET application framework, it integrates with other systems, including NFRA.

The relationship between Proliance and other OPG business systems is shown in Figure 1. The source systems for cost management data are shown in Table 1.

**Table 1. Source Systems for Cost Management Data**

Tools	Data
Proliance	Cost-Only Work Packages, Planned Value, Earned Value, and Forecast
Primavera 6	Work Packages, Schedules, Physical Percent Complete, WBS
NFRA	Actual Costs

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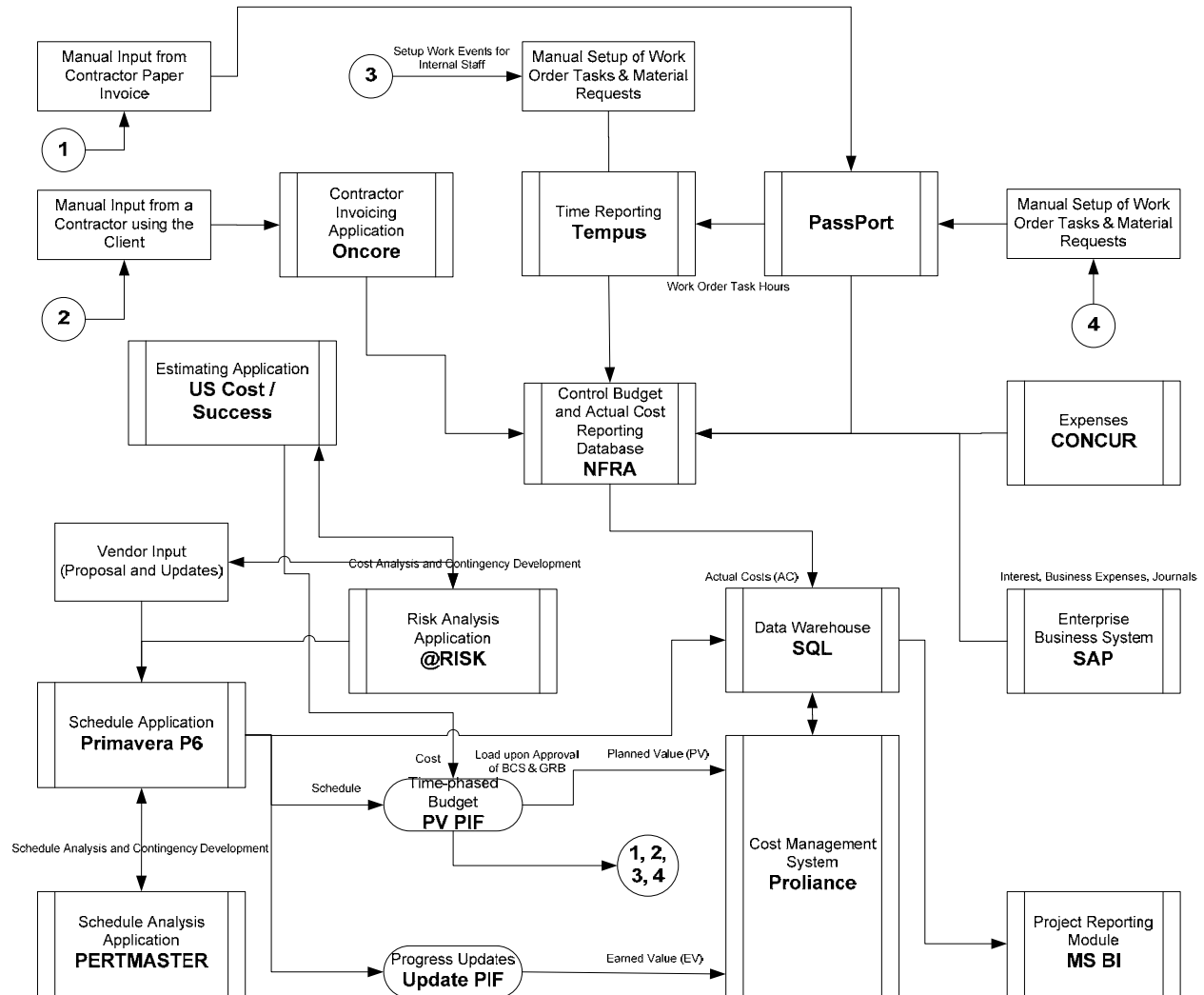
Primavera P6 is the source of all scheduling data. NFRA is the source of all actual costs (including data from Oncore, Tempus, and PassPort). Proliance Import Files (PIF) are custom formatted Excel spreadsheets that are used to import data into Proliance. Scheduling data is exported from Primavera P6 into the PIF.

Microsoft BI has been selected as the Project/Program Reporting tool. It pulls data from Proliance via the data warehouse to generate the Project/Program cost reports.

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**Figure 1. OPG Business Systems Context**



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### 2.4 Cost Management Outputs

Information obtained through Cost Management shall be used for the following purposes:

- (a) Contingency management, in accordance with N-MAN-00120-10001-RISK-05, Risk Management.
- (b) Cost performance reporting, in accordance with Section 5.5, Cost Performance Reporting.
- (c) Schedule performance monitoring in accordance with N-MAN-00120-10001-SCH, Schedule Management.
- (d) Financial reporting, in accordance with FIN-PROC-PA-013.
- (e) Development of cost data for future use in estimating and business planning etc.

### 3.0 COST ESTIMATING

Cost estimating is the process used to determine the total cost of labour, materials, equipment, fees, and other resources, required for the execution of a project or part of a project. Estimates are also used to evaluate changes, alternatives, and what-if scenarios to assist in decision making. An accurate cost estimate leads to a more precise project schedule and budget which forms the basis for project planning decisions, value and performance monitoring and control.

The Basis of Estimate (BOE) documents the parameters and scope used in support of developing the estimate and also includes the complete estimate details and breakdown. The BOE breakdown shall follow the approved WBS to support the funding and budgeting processes.

All estimates shall be performed in accordance with N-MAN-00120-10001-EST, Cost Estimating.

### 4.0 COST BUDGETING

Cost Budgeting is the process of developing time-phased costs of individual activities or work packages to establish an authorized cost baseline.

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### 4.1 Funding

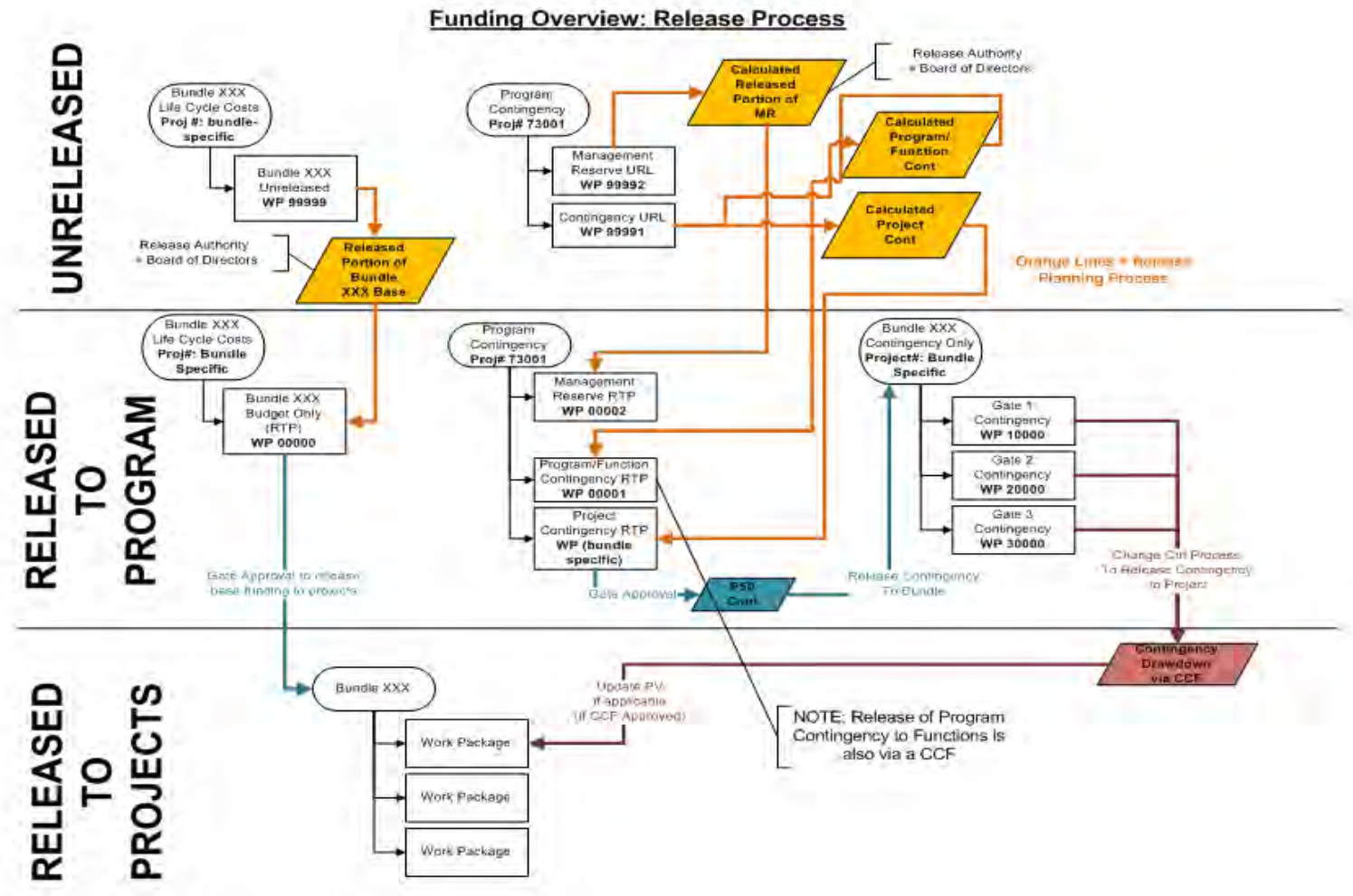
Funding provides the financial resources to finance a need, program, or project. Funding is approved by the OPG Board of Directors (BOD) in the form of Program Funding Releases.

An overview of the Funding Release Process is shown in Figure 2.

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Figure 2. Funding Release Process Overview



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The aggregated cost estimates form the basis of the Program Funding Release submission to the BOD and once approved become the Original Budget (OB). Original Budget funding for the release period will be allocated directly to functional groups upon release approval. Project funding will be allocated from the program via the Gated Process and the Gate Review Board in accordance with N-MAN-00120-10001-GRB. Estimated funding requirements for the program life cycle beyond the current release will be documented as unreleased funds at the Bundle and/or project and functional levels.

Program releases will also establish program level Contingency and Management Reserve funding. Project level Contingency funding may be allocated within the Definition and Execution phases via the Gated Process. Contingency funding at all levels is based on known risks. Management Reserve funding is set based on “unknown-unknowns” that could impact the viability of the program. NR guidance and strategies for managing Contingency and Management Reserve are defined in N-MAN-00120-10001-RISK-05, Nuclear Refurbishment – Contingency Development and Management. Release of Contingency and Management Reserve funding will be controlled via the change control process as described in N-MAN-00120-10001-PC-12.

### 4.2 Control Budget

Once funding is approved at the project and/or functional levels, budget information is loaded into the Proliance cost tool. Budget information is loaded at the Work Package level such that initially:

$$OB = CB = AF = FC$$

Where each of the above is a summary column in Proliance representing:  
OB = Original Budget, which serves as the original baseline and remains unchanged for the life of the project.

CB = Control Budget, representing the current baseline and Planned Value (PV) for the Work Package.

AF = Approved Funding, representing the current approved cost envelope for the Work Package.

FC = Forecast, representing the projected cost of the Work Package, including any pending changes yet to be approved.

## 5.0 COST MONITORING AND CONTROL

Cost Monitoring and Control is the process of gathering, accumulating, analysing, forecasting, reporting and managing the costs on an ongoing basis. Nuclear Refurbishment will utilize Proliance for the effective cost management of all programs and projects.

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### 5.1 Cost Control

Cost Control is the process of measuring progress and monitoring performance against plans; measuring variances from authorized budgets, and allows effective action to be taken to optimize costs.

Nuclear Refurbishment utilizes Earned Value Management (EVM) as the fundamental process for evaluating the overall health of schedule and cost. As such, Proliance, and the associated reports generated from the cost tool, are configured to provide all elements of an Earned Value Management System. These include:

- Planned Value (PV) is (in cost terms) the current Control Budget assigned to the work.
- Earned Value (EV) is the dollar value of work performed in terms of the approved budget assigned to the work.
- Actual Cost (AC) is the dollar amount actual cost incurred as recorded in the OPG financial source system (NFRA).
- Schedule Performance Index (SPI) is the ratio of EV to PV.
- Cost Performance Index (CPI) is the ratio of EV to AC.
- Cost Variance (CV) is the difference between EV and AC.
- Budget Variance (BV) is the difference between PV and AC.
- Schedule Variance (SV) is the difference between EV and PV.

It is incumbent upon the entire team to fully and diligently participate in cost control activities. These activities will be accomplished through the use of formal cost monitoring and reporting procedures. Cost Control is a line-owned function facilitated through the Planning and Controls team. The Cost Control functions described above shall be executed via the following activities:

(a) Measuring progress:

- (1) Measuring physical progress for earned value assessment.
- (2) Updating progress (i.e. percent complete) in the P6 schedules.
- (3) Updating progress in Proliance.
- (4) Ensuring actual costs are collected in the appropriate cost or control accounts.
- (5) Ensuring accruals are captured in the actual costs.



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- (6) Identifying incorrect, inappropriate, or unauthorized charges and implementing corrective actions to rectify.
- (b) Reviewing progress;
  - (1) Gathering all commitments and payments.
  - (2) Monitoring commitments against budgets.
  - (3) Identifying and analyzing variances.
  - (4) Identifying and analyzing trends.
  - (5) Identifying items requiring corrective action (i.e. unfavourable variances and trends).
- (c) Reporting progress: Prepare and distribute status data (e.g. PV, EV, AC, variances, forecasts, and trends) and corrective action plan status as detailed in Section 5.5 of this document.
- (d) Taking corrective action: Initiate any corrective action and recovery plans required to mitigate and resolve identified issues. If warranted, change requests shall be initiated as detailed in Section 5.4 of this document.

## 5.2 Forecasting

Forecasting is the process of estimating or predicting the project's future based on knowledge and information available at the time of the forecast.

Forecasting is performed by analyzing the work performed against the work planned, identifying trends, analysing remaining the work, and determining the impact of performance on the estimated cost and schedule going forward.

Forecasting cost shall take into consideration the committed costs, the actual execution efficiency of the work performed, and the planned efficiency for the remaining work.

The Project Manager is accountable for having the forecast updated as necessary to reflect the latest status and expected performance of the project. Effective forecasting can be achieved when experience and objective judgement are applied together with consideration of risks and the usage of quantitative forecasting techniques, such as Earned Value technique.

All forecasts shall be performed in accordance with N-MAN-00120-10001-PC-14, Nuclear Refurbishment - Forecasting.

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### 5.3 Change Control

Changes to functional and project Performance Measurement Baselines (PMB) will be managed via a formal control process as described in N-MAN-00120-10001-PC-12, Change Management.

### 5.4 Invoice Management

OPG-PROC-0051 specifies and documents the processes, principles and responsibilities for payment of vendor invoices.

FIN-PROC-AP-011 outlines the line responsibilities for invoice approval, defines accountabilities of Account Payment and Supply Chain in support of the line's accountabilities in this process.

FIN-PROC-AP-006 defines the processes, principles, responsibilities, and documents to be utilized in determining approvals required and supporting documents for progress payments. The Procedure establishes the general requirements including governing rules, supporting documentation, and condition to reject or revise a Progress Payment.

FIN-PROC-AP-010 defines the processes, principles, responsibilities, and documents to be utilized in determining approvals required and supporting documents for holdback payments.

### 5.5 Cost Performance Reporting

Cost Performance Reporting is the process of reporting the costs on an ongoing basis. OPG Nuclear Projects will utilize Microsoft Business Intelligence (BI) as the report generation tool for all programs and projects.

This section details the requirements for cost performance reporting. Overall reporting requirements are contained in N-MAN-00120-PC, Project Controls.

#### 5.5.1 Report Planning

The Director, Planning and Control, NR shall establish the cost reporting requirements structured according to WBS.

Cost reporting shall:

- (a) Encompass the entire program and project scope, including activities that are the responsibility of contracting companies.
- (b) Enable the following:

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- (1) Definition of the process for formally identifying the basis for cost, schedule, and performance reporting.
- (2) Specification of the expectations for documents required to establish cost and progress reporting.
- (3) Documentation of the need for a standard set of reports.

The cognizant PM shall provide the information necessary to establish status of the work (including the WBS), provide explanations of the causes of variance from the baseline plan, and propose changes to address the variance (typically for those > 5%).

### 5.5.2 Report Development

Following approval, Cost Management shall perform the following:

- (a) Establish a cost progress review and reporting process to provide a set of reports with the information necessary for the Project Managers, Project Management Office and contracting companies to understand the status of the work.
- (b) Update reporting of cost to show actual progress and performance achieved against the baseline, inclusive of approved or pending changes.

Definitions of the terms used in this section are contained in Section 6.1 of this document.

As a minimum, the following data shall be summarized and reported at the project and functional area level;

- Project/Functional Area WBS Code And Description
- For the Current Period (CP)
  - PV, EV, AC, CPI, SPI
  - Cost Variance (CV)
  - Budget Variance (BV)
- For Life to Date (LTD)
  - PV, EV, AC, CPI, SPI
  - CV, BV
- At Completion (Gate) and At Completion (Phase)

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- BAC, EAC, VAC

As a minimum, the following WP data shall be summarized at the project or function level and reported;

- LTD
  - PV, EV, AC, CPI, SPI
  - CV
- At Completion (Gate)
  - Original Budget (OB)
  - Directed Changes (DC)
  - Scope Transfers (ST)
  - Control Budget (CB) which is the BAC
  - Funding Variance (FV)
  - Approved Funding (AF)
  - Estimate At Completion (EAC)

Depending on the audience, the above information may be viewed for the Current Period, At Completion (Gate), At Completion (Release), At Completion (Life Cycle), or Life To Date.

### 5.5.3 Performance Reporting Process

The project team shall seek input from scope budget holders, Finance Department, Supply Chain, and contracting companies, to update the cost report based on observed progress, change approvals, and commitments. This information shall be received in a form that facilitates data entry into the cost management systems.

The project team shall use the information received to update the cost management systems and perform the following:

- (a) Assess the earned value of completed work.
- (b) Validate the actual costs of delivered work and services that have been imported into Proliance from NFRA.
- (c) Update the value of contractor invoices approved for payment, and calculate accrual balance.

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- (d) Identify the value of change orders not yet approved, and any future commitments that are forecast to be required.
- (e) Maintain the current budget through budget transfers and contingency drawdown.
- (f) Identify the variances between current budgets and forecasts.
- (g) Update the risk management system (including contingency drawdown) based on actual activity.
- (h) Update the cash-flow forecast to reflect actual spending to date.
- (i) Track the amount of committed cost, scope, and responsibilities.

### 5.5.4 Outputs from Cost Performance Reporting

Project Reporting shall issue reports monthly and provide NR Project Teams and Project Stakeholders with summarized and detailed information such that project performance and status may be determined and corrective action taken.

During the Project Execution phase, Project Reporting shall issue additional project reports weekly.

Reports shall enable an understanding of (at a minimum) the following:

- (a) Cost and schedule performance against the baseline plan.
- (b) Forecast performance, including EAC.
- (c) Cost and schedule variance explanations (typically for those > 5%).
- (d) Required actions from identified corrective action plans and mitigation strategies.

## 6.0 DEFINITIONS AND ACRONYMS

### 6.1 Definitions

**Accrual** is the value of work completed and eligible for payment but not yet included on an invoice.

**Actual Costs (AC)** is the realized costs incurred for the work performed during a specified time period.

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**Approved Funding (AF)** consists of the Control Budget (CB) plus all approved Funding Variances (FV).

**Budget at Completion (BAC)** is the sum of all budgets established for the work to be performed.

**Budget Variance (BV)** is the difference at a given point in time between the Actual Costs (AC) and Planned Value (PV) (i.e.  $BV = AC - PV$ ).

**Change** is a modification from the approved Performance Measurement Baseline (PMB).

**Committed Costs** is value of work purchased, but not yet paid for.

**Contingency** is an amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs. Some of the items, conditions, or events for which the state, occurrence, and/or effect is uncertain include, but are not limited to, planning and estimating errors and omissions, minor price fluctuations (other than general escalation), design developments, and changes within the scope, risk response, and variations in market and environmental conditions. It is typically estimated using statistical analysis or judgment based on past asset or project experience. Contingency **excludes**:

- (a) Major scope *changes* such as *changes* in end product specification, capacities, building sizes, and location of the asset or project.
- (b) Extraordinary events such as major strikes and natural disasters.
- (c) **Management Reserves.**
- (d) Escalation and currency effects.
- (e) Changes in scope or major social or natural events such as war, strikes, floods or earthquakes.

Contingency is generally included in most estimates, and is expected to be expended, see *Management Reserve*.

**Contingency Drawdown** is the method by which the contingency fund is used.

**Contracting Companies** are organizations external to Nuclear Refurbishment working on a Nuclear Refurbishment project under a contractual arrangement (includes Engineer-Procure-Construct Contracts at an agreed-to level of detail).

**Control Budget (CB)** consists of the OB plus the sum of all approved Directed Changes (DC) and Scope Transfers (ST) (i.e. PMB changes). It is also known as the Budget at Completion (BAC).

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**Cost Performance Index (CPI)** is a measure of the cost efficiency of budgeted resources expressed as the ratio of Earned Value (EV) to Actual Cost (AC).

**Cost Variance (CV)** is the difference at a given point in time between the Actual Costs (AC) and Earned Value (EV) (i.e.  $CV = AC - EV$ ). It should be noted that PMI defines this term as  $CV = EV - AC$  and hence the sign would be different.

**Deliverable** is any unique product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project.

**Directed Changes (DC)** constitutes re-baselining, and is generally caused by situations beyond the control of the budget/work program owner that renders the existing baseline obsolete. An approved DC will result in changes to the Control Budget (CB) of the appropriate function or project as well as equal and opposite changes to the appropriate contingency account CB.

**Earned Value (EV)** is the measure of work performed expressed in terms of the budget authorized for that work.

**Estimate at Completion (EAC)** is the expected total cost of completing all work expressed as the sum of the actual costs to date and the estimate to complete. It represents the responsible Project Manager's estimate of the cost at completion of the current release, gate, and the entire Project Lifecycle including all pending (i.e. unapproved) funding change requests plus the impact of undocumented funding impacts based on managerial judgment.

**Estimate to Complete (ETC)** is the expected cost to finish all remaining work.

**Forecast** is the project team's estimate of the most likely outcome for a given element of the project (e.g. cost forecast, schedule forecast etc.).

**Forecast Trends (FT)** are Budget Owner forecast estimates of future **anticipated** changes to Approved Funding levels. Such changes are documented for management forecasting and do not impact budgets. They are reflected in the Estimate at Completion (EAC) column of the cost management system.

**Funding Variance (FV)** is an approved change that does not meet the DC criteria but requires a change in funding requirements. A FV will result in changes to the Approved Funding (AF) of the appropriate function or project as well as equal and opposite changes to the appropriate contingency account AF.

**Management Reserve** is an amount added to an estimate to allow for discretionary management purposes outside the defined scope of the project, as otherwise estimated. Use of management reserve requires a change to the project scope and cost baseline. (Contrast with contingency funds that are used for items within the project's approved scope.)

**Original Budget (OB)** is the approved funding established by the release or Gated Process. Original Budgets cannot be altered for the period in which they apply.

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**Pending Changes (PC)** consists of all changes proposed changes but not yet approved.

**Performance** is the comparative ratio between the planned rate of progress and the actual rate of progress.

**Performance Measurement Baseline (PMB)** is the approved, integrated scope-schedule-cost plan for the work against which project execution is compared to measure and manage performance. The PMB includes contingency, but excludes management reserve.

**Planned Value (PV)** is the authorized budget assigned to scheduled work.

**Scope Transfer (ST)** is the reallocation of scope, and its associated budget, from one work package to another. The net variance is always zero.

**Schedule Performance Index (SPI)** is a measure of schedule efficiency expressed as the ratio of Earned Value (EV) to Planned Value (PV).

**Trend** is a non-random variance of actual performance from that which was planned. Analysis of performance measurements is required to determine if an observed performance variance is a trend (i.e. predictable), or a random outcome (i.e. unpredictable), and that determination will influence subsequent control actions and forecasts.

**Variance** is the nominal differential between earned, planned, actual, and forecast performance.

**Variance at Completion (VAC)** is the difference between the BAC and EAC.

**Work Breakdown Structure (WBS)** is the hierarchical decomposition of the work to be carried out to accomplish the objectives and create the required deliverables. It is a tool used to define and group a project's discrete work elements (or tasks) in a way that helps organize and define the total work scope of the project.

**Work Package (WP)** is the work defined at the lowest level of the Work Breakdown Structure (WBS) for which cost and duration can be estimated and managed.

## 6.2 Abbreviations and Acronyms

<b>BI</b>	Business Intelligence
<b>BOD</b>	Board of Directors
<b>BOE</b>	Basis of Estimate
<b>CAD</b>	Canadian Dollars



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<b>CP</b>	Current Period
<b>CSA</b>	Cost/Schedule Analyst
<b>DSR</b>	Darlington Scope Request
<b>EPC</b>	Engineer-Procure-Construct
<b>EPSCA</b>	Electrical Power System Construction Association
<b>EVM</b>	Earned Value Management
<b>FTE</b>	Full-Time Equivalent
<b>GRB</b>	Gate Review Board
<b>LTD</b>	Life to Date
<b>LOE</b>	Level of Effort
<b>NR</b>	Nuclear Refurbishment
<b>OPG</b>	Ontario Power Generation
<b>PC</b>	Pending Changes
<b>PIF</b>	Proliance Import File
<b>PM</b>	Project Management
<b>RAPID</b>	Recommend, Agree, Perform, Input, and Decide
<b>RFS</b>	Ready for Service
<b>SVP</b>	Senior Vice President
<b>UOM</b>	Unit of Measure
<b>WSIB</b>	Workplace Safety Insurance Board

## **7.0 RECORDS AND REFERENCES**

### **7.1 Records**

Any records which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0042, Quality Assurance Records.

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Any controlled documents which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0003, Controlled Document Management.

The following records may be generated by use of this document and shall be registered in an appropriate document management system in accordance with the following table.

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (PASSPORT Type/Sub-Type)
Program Status Report	N/A	N	Indexed in Passport Records Mgmt module as a report using the following document configuration:  N-REP-00120-XXXXXXX RRC – TBD
Deliverables Completion Declaration	D-FORM-10790	N	File locally by department

## 7.2 Governing Document

Nuclear Refurbishment's (NR's) approach to cost management is defined in N-STD-AS-0028, *Project Management Standard*. Cost management and control practices are further detailed in N-MAN-00120-10001-PC, *Project Controls*.

## 7.3 References

### 7.3.1 Performance References

- FIN-PROC-AP-006, Progress Payments Procedures
- FIN-PROC-AP-010, Holdback Payments Procedure
- FIN-PROC-AP-011, Payment Approval Process for Services Provided
- FIN-PROC-PA-013, Project Accounting and Reporting Procedure
- N-PROC-AS-0003, Controlled Document Management

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- N-PROC-AS-0042, Quality Assurance Records
- N-MAN-00120-10001-EST, Cost Estimating
- N-MAN-00120-1001-GRB, Gated Process
- N-MAN-00120-10001-PC, Project Controls.
- N-MAN-00120-10001-PC-09, Earned Value Management
- N-MAN-00120-10001-PC-12, Change Management
- N-MAN-00120-10001-PC-14, Forecasting
- N-MAN-00120-10001-SCH, Schedule Management
- N-MAN-00120-10001-RISK-05, Risk Management
- N-STD-AS-0028, Project Management Standard
- OPG-STD-0017, Organizational Authority Register
- OPG-PROC-0051, Payment

### 7.3.2 Developmental References

- HYDRO and EP documents for definitions
- NK054-PROC-0016, DNNP Project Controls
- A Guide to the Project Management Body of Knowledge, 5<sup>th</sup> Edition (PMBOK Guide)
- Total Cost Management Framework: An Integrated Approach to Portfolio, Program, and Project Management, 1<sup>st</sup> Edition, Revised (TCM)

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### Appendix A: Cost Management Roles and Responsibilities

The following accountability model has been selected and is in use on the Darlington Nuclear Refurbishment project. It details the responsibilities and accountabilities throughout the life cycle of a scope of work, from the Darlington Scope Request (DSR) to the declaration of Ready for Service (RFS).

- (a) The guiding philosophy behind the project revolves around the Project Manager having the ultimate accountability for delivering a successful project. That said, an accountability model showing the Project Manager accountable for each and every element of the project would do little to communicate the width and breadth of effort required to perform the complete scope of work.

The **RAPID** model (as shown in Figure A.1) is used to describe who in the organization has the primary role in making **Recommendations**, establishing **Agreement**, **Performing** the work once decided, providing **Input** to the decision, and being accountable to make that **Decision**.

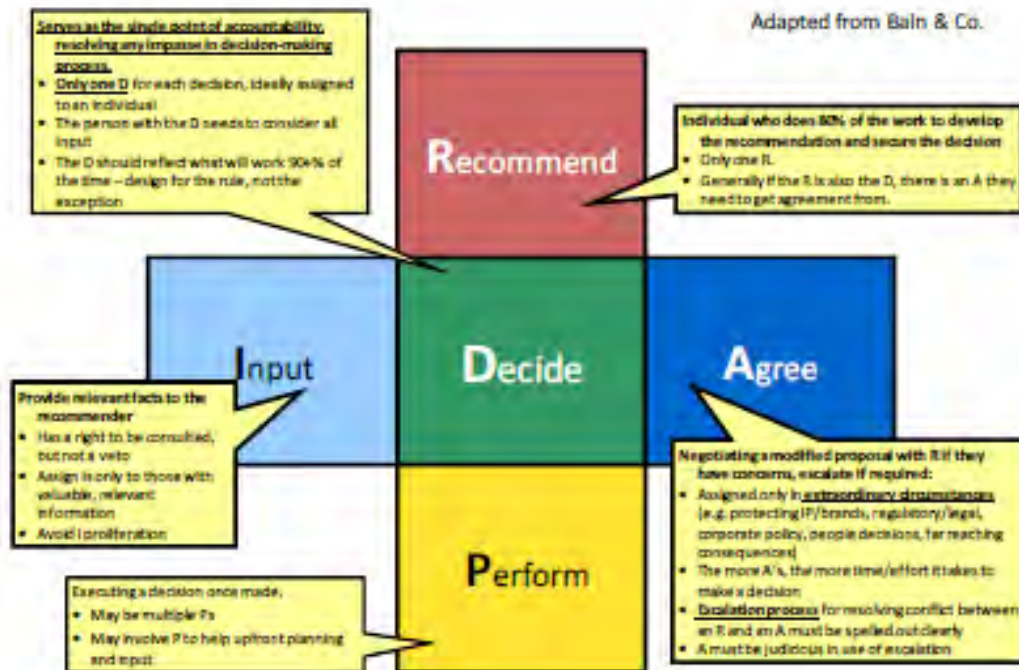
It is important to understand that with this model the Recommender is the role that is primarily responsible for the element of scope and that the primary accountability resides with the role of the Decider.

It is also important to note that this model is centred on each of the elements and their associated responsibilities and accountabilities. The model does not abdicate fundamental accountabilities as defined by the Internal Responsibility System, Chain of Command, Governance, and Delegated Authorities.

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**Figure A.1. RAPID Accountability Model**



- Input (I):** Provide relevant facts to the Recommender.
- Recommend (R):** Provide data and analysis based on research and stakeholder management.
- Agree (A):** Negotiate modified proposal with Recommender with ability to veto and escalate.
- Decide (D):** Single point of accountability; bringing decision to closure; implementing decision.
- Perform (P):** Executing the decision promptly and effectively.

### A.1.0 PRIMARY ROLES

#### A.1.1 Director, Planning and Controls, NR

Establishes and sets direction for cost management and project reporting activities for NR and support organizations to ensure activities, deliverables, and costs are controlled and appropriate information is reported.

#### A.1.2 Manager, Project Control and Reporting, NR

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Manage the operation of the cost management and project reporting systems to provide appropriate outputs.

Establish the processes, guides, and tools necessary to facilitate the successful implementation of the direction herein.

### A.1.3 NR Directors and Managers

Manage approved budgets for projects and functions and ensure costs are appropriately charged to the right budget item.

Provides updates to the cost management and reporting processes as required to meet project reporting cycles.

Review cost reports and take corrective action in accordance with established thresholds.

### A.2.0 COST MANAGEMENT RESPONSIBILITIES

Specific responsibilities for the cost management processes detailed in this document are contained in Table A.1.

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**Table A.1. Cost Management Responsibilities**

Activity	Responsibility												
	BOD	GRB	SVP, NR	Director, Planning & Controls, NR	Manager, Project Reporting	Estimating	Cost Management	Reporting	Project Scheduling	Planning & Controls Leads	Project Infrastructure	NR, Directors & Managers	Finance
Cost Management Planning				D	A	I	R	I	I	I	I	I, P	I
Cost Management Tools				D	A		I				R, P	I	
Cost Estimates				D	A	R, P						A, I	
Funding Requests - Program	D		R, P	A	I					I		I, P	A
Funding Requests - Projects		D	A	A	A	I	I		I	R		A, P	
Cost Budgeting - Program				D	R		P					I	A
Cost Budgeting - Projects					A	I	I		I	R		D	
Cost Monitoring and Control				D	A		R, P		I	R		I	I
Forecasting				A	A	I	I			R		D, P	

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Activity	Responsibility												
	BOD	GRB	SVP, NR	Director, Planning & Controls, NR Manager, Project Reporting	Estimating	Cost Management	Reporting	Project Scheduling	Planning & Controls Leads	Project Infrastructure	NR, Directors & Managers	Finance	
Cost Performance Reports - Program				D	A		I	R, P	I	I			I
Cost Performance Reports - Projects				A	A		I	P	I	R		D	I

- Input (I):** Provides relevant facts to the Recommender.
- Recommend (R):** Provides data and analysis based on research and stakeholder management.
- Agree (A):** Negotiates modified proposal with Recommender with ability to veto and escalate.
- Decide (D):** Single point of accountability; brings decision to closure; implements decision.
- Perform (P):** Executes the decision promptly and effectively.





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**NUCLEAR REFURBISHMENT - PROGRAM CHANGE MANAGEMENT**

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**Nuclear Refurbishment - Program  
Change Management**

**N-MAN-00120-10001-PC-12-R000**  
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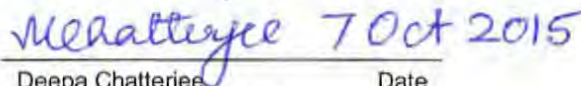
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**Revision Summary**

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R000	2015-09-15	Initial issue.

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**Records Table**

The following Records may be generated by use of this document and shall be registered in the appropriate document management system in accordance with the following table:

Record Created	Associated Form or Template Number	QA Record? Y/N	Filing Information/Retention (AIMS Type/Sub-Type)
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### 1.0 BACKGROUND

*Change* is inevitable in a project, well managed and controlled projects must manage change. A robust change management process provides guidance on how changes are assessed, implemented and reported on a project. This change procedure will be reviewed and updated periodically to reflect the changing environment with respect to project controls tools, including the implementation of a new cost management tool, workflows and an *Integrated Data Base* (IDB).

### 2.0 PURPOSE

The primary purpose of Program Change Management is to control cost, schedule and scope changes against approved *baselines*, to manage the proper allocation of contingency funds, to document the nature and cause of changes and to analyse and minimize the impact to cost and schedule.

### 3.0 DIRECTION

#### 3.1 Principles

- The *executing organization* will first attempt to mitigate the impacts of change by evaluating alternatives, such as reassigning resources to other available work, to mitigate the impact of change.
- Change is managed at the lowest level of the organization that has the authority to do so.
- Change that has a significant potential impact on project or program scope, cost and schedule is reviewed in detail and the recommended direction is approved at the appropriate level.
- The process must balance flexibility and control.
- All changes are documented, tracked and included in relevant reports.
- Detailed evaluation of the impacts of the change takes place when necessary.
- Trends of changes are identified and followed up; the Station Condition Record (SCR) system is utilized when applicable.
- Only after the change is approved by the appropriate authority level, the work is assigned for action by the executing organization.
- Changes are not made solely for the purposes of correcting performance issues that are within the control of the work program owner.

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## **3.2 Definition of Change and Change Management**

For the purposes of this procedure, a *change* is any deviation from an approved plan or procedure that results in a real or potential impact on program or project cost, schedule or scope.

*Change Management* is the Project Management process (including the supporting tool) that provides a framework to identify and record changes in cost, schedule and or scope against the approved baselines.

See Section 11.0 for a complete list of definitions for this procedure.

## **3.3 Program Baseline and Performance Measurement Baselines**

The Change Control Process as defined in this document is performed from project inception through completion. The constraints of cost, schedule and scope must be continuously and rigorously managed either by rejecting or approving changes and subsequently incorporating approved changes into the revised *Program* and *Performance Measurement Baseline*, where applicable.

### **Program Baseline**

The aggregate planning efforts during Definition Phase will converge to an overall Program Plan at Release 5, or Release Quality Estimate (RQE). This is the point when the majority of projects have sufficiently defined their execution strategies, cost, schedule and scope that will allow an overall Program Baseline to be set. The Program Baseline will be maintained as a high confidence estimate for all four units and project level changes assessed as part of the Gated Process.

### **Performance Measurement Baseline**

The Performance Measurement Baseline is the Project cost, schedule and scope approved during the Gated Process for Project and Bundle Releases. The Performance Measurement Baseline for Functions is the Functional work cost, schedule and scope approved during the business planning release process. The Project Performance Measurement Baseline will be maintained and cost and schedule performance against the baseline monitored.

The use of Baseline in this document refers to the Performance Measurement Baseline.

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### 4.0 SCOPE

This document takes authority from N-STD-AS-0028 Project Management Standard and guidance from N-MAN-00120-10001-PC, Project Controls.

This Change Control Process (refer to Appendix A, Change Process Flow) for NR Funded work including transfers in and out of the Program, is applicable to the following:

- Changes that occur between Gates to Projects already approved by the gating process and approved by the Gate Review Board (GRB), including scope transfers between Projects, Bundles or sub-Bundles;
- Recording changes to Projects approved by the GRB at Gates post Gate 3.
- Changes to OPG functional work programs approved by the Functional Business Planning Release;
- Changes to contractual agreements between OPG and external contractors, suppliers or vendors when the change impacts project scope, cost or schedule;
- Engineering change control process outputs that impact project scope, cost or schedule;
- New/Changed Project Numbers when the baseline is impacted;
- New/Changed Work Packages when the baseline is impacted;
- Changes to *Work Breakdown Structure (WBS)* when the baseline is impacted;
- Approved Funding variances to baseline cost, schedule or scope.
- Changes to cost, schedule or scope that are approved by other governing documents or bodies, including the Project Decision Meetings, Options Review Boards, or alternative localized decision making committees.
- Management Reserve draws.
- Project, bundle and program contingency changes irrespective of value, either drawn or returned back to contingency.
- Advancing or transferring funds that have not been released by the GRB in circumstances where the work must be performed prior to the next Gate and funding is required to proceed in order to control risk.
- Administrative updates to the Program Baselines as approved by senior management.



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This Change Control process is **not** applicable to:

- Projects that have not yet been presented and approved by the Gate Review Board (GRB), i.e., projects for which there is no approved baseline.
- Changes to correct performance issues that are within the control of the work program owner.
- Changes to budget amounts in closed accounting periods (example, changing history).
- Project *forecast* updates unless the update results in a change to project baselines.

## 5.0 ORGANIZATION, ROLES AND RESPONSIBILITIES

All project team members are empowered and encouraged to identify and initiate the Change Control Process.

The OPG behaviours of “Say it, Do it, Simplify it, Think Top and Bottom Line, Integrate and Collaborate and Tell it as it is” are applied in the change management process. Early identification of changes and their impacts and trends allow NR Management to focus attention on performance improvements, and drive the core behaviours.

### 5.1 Change Initiator

The Change Initiator, in conjunction with their manager, is responsible for reporting a change to cost, schedule or scope of their work immediately. Anyone can be a change initiator. The change Initiator completes all relevant sections of the *Change Control Form* (CCF) N-FORM-11252.

### 5.2 Project Manager

The Project Manager (PM) is responsible for:

- Executing the full scope of project within constraints of working safely, meeting quality requirements, and performing within the approved schedule and budget.
- Reacting to change trends, taking corrective action and identifying and mitigating project risks.
- Limiting, controlling and recommending use or return of project contingency.
- Managing contractors to control and mitigate increases to cost and delay to schedule.
- Ensuring no commitment (including Project Change Directives (PCD), Project Change Authorizations (PCA), Consent to Proceed (CTP), or any other

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commercial commitment) is entered into with vendors or contractors, or into the approved baseline, prior to having sufficient budget and/or approval when necessary via a CCF.

- Providing all required data on the CCF and the required supporting documents for YELLOW and RED CCFs.
- Assessing the impacts of changes to cost, schedule and risk as well as to commercial, union jurisdiction, safety and environment, work and radiation permits, decontamination, material handling and storage, change in resource, quality, other impacts if applicable and impacts to other projects.
- Approving YELLOW changes and recommending to the Director changes involving project contingency draws.
- For *Scope Transfer* changes both receiving PM and transferring PM will recommend to the Director/Change Control Board (CCB). All scope transfers are considered RED changes.
- Updating the Project Management Plan.

Within the context of the change management process, the PM has the ultimate accountability to ensure changes are fully documented via a CCF and approved by the appropriate authority level as outlined in Section 6.0 and that the processes documented within this procedure are adhered to.

### 5.3 Project Director

The Project Director is responsible for:

- Reviewing and challenging changes proposed by the PM that are within PM's approval authority.
- Approving YELLOW changes in cases involving project (Director or Bundle owner as applicable) contingency draws.
- Recommending changes to the CCB that are outside Project authority.

### 5.4 Unit Outage Manager

The Unit Outage Manager is responsible for:

- Ensuring new work orders are reviewed and urgent actions taken to protect the critical path schedule, while ensuring follow up with Project Managers to ensure baselines are maintained.
- Ensuring new work orders are assigned to Project Managers for acceptance of scope.

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- Screening new scope through the Daily Work Screening process.
- Referring new scope that is not accepted by the Project Manager to the Project Decision Meeting.

**5.5 Planning & Controls (P&C)**

**5.5.1 Director, Planning and Controls, NR**

The Director Planning and Controls is responsible for:

- Establishing and setting the direction for Program Change Management activities for NR.

**5.5.2 Manager Project Controls, Cost Management, NR**

The Manager Project Controls, Cost Management is responsible for:

- Establishing and managing the processes, guides, and tools necessary to facilitate successful implementation of Program Change Management process.

**5.5.3 P&C Leads**

The P&C Leads are responsible for:

- Coordinating evaluation and disposition/approval of the change including routing the CCF to the appropriate functional department or subject matter expert to perform an independent evaluation of the impacts of the change.
- Assisting the PM with preparation of change documentation.
- Creating a SCR for adverse trends identified from GREEN change pattern analysis if applicable as defined in Section 6.
- Assessing if the change requires immediate action where delay in approving the CCF has further adverse impact on cost and expedites immediate action if required.

**5.5.4 P&C Cost/Schedule Analyst (CSA)**

The P&C CSAs are responsible for:

- Supporting the P&C Leads in coordinating evaluation and disposition/approval of changes.
- Reviewing the CCF and supporting documentation to ensure compliance with the criteria set out in this procedure.
- Communicating disposition of the CCF to the stakeholders.

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- Updating the cost management system.
- Maintaining the change register.

### 5.5.5 P&C Reporting Department

The P&C Reporting Department is responsible for:

- Providing monthly metrics including trend reports and reporting out of the Change Management process.

### 5.5.6 P&C Senior Process Specialist (Cost)

The P&C SPS Cost is responsible for:

- Administration of the CCB process.
- Reviewing CCF's for compliance with the principles and governance of this procedure and providing feedback and coaching on requirements.
- Analyzing CCF trends and presenting analyses to the CCB as required.
- Tracking and following up on requests made or actions assigned by the CCB.
- Following up on SCR actions related to this procedure and/or CCF trends.
- Providing an interface between the committees and boards in this Change Management Process.

## 5.6 NR Controllership

NR Controllership is responsible for:

- Deciding the correct accounting determinations and project funding sources.
- Reviewing the change register including selected review of individual CCFs (Finance Assurance).

## 5.7 Functional Departments

Functional Department processes are governed by their functional procedures; however when changes in functional work impacts NR project cost, schedule or scope baselines the Change Management process applies. Example:

- To draw contingency when a contract change (an amendment, PCD, PCA or CTP) is required for additional scope, a CCF must be raised and approved prior to updating the vendor documentation and contract and commencing work.

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Functional Department Managers' annual budgets released through the business planning release process are governed by this Change Management process if the change meets the criteria detailed under section 6.0 below. For the purposes of this procedure, Functional Managers hold the same accountabilities as a Project Manager.

#### 5.8 Subject Matter Experts

Depending on the nature of a change, a Subject Matter Experts (SME) may be requested to provide written feedback and recommendations on a proposed change. SME's provide an independent assessment for consideration by the approving authority.

#### 5.9 New Work Screening Committee

The Director Unit Outage is responsible for the New Work Screening process. Chaired by the Project Control Centre (PCC) Manager, the New Work Screening Committee is comprised of:

##### Required Attendees:

Operations   Work Management   Planning & Controls   Maintenance

##### Optional Attendees:

Engineering   Finance   CPAAC Member

All proposed scope changes will be screened by the New Work Screening Committee prior to being released to the Project Manager to execute. The Project Manager confirms the correct project has been assigned and raises a CCF upon acceptance for approval based on the Decision Criteria. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB. Appendix B describes the screening requirements and process.

#### 5.10 Change Control Board

Chaired by the Vice President, Refurbishment Execution, the Change Control Board (CCB) is a diverse group of individuals who are responsible for making the ultimate decision regarding project changes. The CCB considers the implications of changes that exceed a Project Managers authority, approves Tier 3 Milestone changes and refers significant new or changed scope to the Project Decision Meeting or if deemed necessary obtain concurrence of the Program Scope Review Board (PSRB) or Program Change Control Board (PCCB). See Appendix C for the Terms of Reference for the CCB.

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#### **5.11 Project Decision Meeting**

When significant new or changed scope requires a decision as to whether or not it should be included in the NR Program or be moved to Darlington Station for processing through their change management process, a Project Decision Meeting (PDM) will be held.

The chair of the PDM is the Vice President, Refurbishment Execution (or delegate) along with senior representatives from Refurbishment Operations & Maintenance and Station Engineering.

Meeting participants will consider the appropriateness and implications of adding new scope. The following considerations should be made when evaluating the proposed scope:

- The scope requires the reactor to be defueled/dewatered.
- The scope could significantly exceed normal outage durations.
- The scope could significantly extend normal outage durations.
- The scope has other overriding long term operational impacts to the Station.

If the PDM decides that the proposed change warrants further work by the NR Program, a sponsor will be designated to create a DRAS as appropriate.

#### **5.12 Options Review Board**

In cases where there are multiple potential options to address new scope, and the option set does not provide a clear preferred option, an Options Review Board (ORB) will review each option and decide which will be pursued. The ORB is responsible for making an informed and business-conscious decision. The ORB is administered by NR Execution.

The ORB is chaired by the Vice President, Refurbishment Execution along with senior representatives from Operations and Maintenance, Engineering, Planning and Controls, Execution, Supply Chain, Finance and External Oversight.

The ORB is empowered to make decisions which progress work toward full definition. Cost implications require a CCF and approval via this Change Management Process.

#### **5.13 Program Change Control Board**

The PCCB, Chaired by the Director Planning and Controls is convened to approve significant Program level cost and schedule changes. The PCCB also approves all Program Contingency draws or returns and impacts to Tier 1 and 2 Milestones. See Appendix C for the Terms of Reference for the PCCB.

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## 6.0 CHANGE MANAGEMENT PROCESS

### 6.1 Change Decision Criteria

The Change *decision criteria* utilize GREEN, YELLOW, RED labels to identify the level of impact the change has on the project baseline, and consequently the level of approval required. The criteria are noted in the diagram below:

LEVEL	LIMIT	FLOW		
<b>GREEN</b>	the lower of: <\$100K or 2% of the Baseline or Equivalent schedule delay multiplied by the project burn rate	Consequences can be addressed by the Executing Organization with the Project Manager's agreement	Change Review	Entered for Trending and Reporting
<b>YELLOW</b>	the lower of: <\$5M or 10% of the Baseline or Project Contingency or Equivalent schedule delay multiplied by the project burn rate	Consequences can be Addressed within Approved Baseline and Contingency and within Project Manager's Authority	Change Review, Evaluation & Recommendation	PM and Director CCB/PCCB for information
<b>RED</b>	the lower of: >\$5M or 10% of the Baseline or Bundle Contingency or Program Contingency or Tier 1, 2, 3 Milestone Impacted or All Scope Transfers	Significant Program Level Consequences	Change Review, Evaluation & Recommendation	CCB for Bundle Contingency and Tier 3 Milestone Delays PCCB for Program Contingency and Tier 1 & 2 Milestone Delays

The cost percentages noted are the percentages of the approved funding released by the last Gate or annual business planning and all subsequent CCF's.

Separate schedule criteria based on durations are not laid out as it is assumed that all schedule changes/delays will be translated to cost based on the *project burn rate* and the cost criteria applied.

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### 6.1.1 Green Changes

GREEN changes are addressed within the level of authority of the project/function (within the approved purchase order value). An example is a change to contractor field execution work where an agreed alternate arrangement has been developed by the executing organization; a CCF will be entered for a GREEN change and will be tracked for trends. Green changes will be reviewed to ensure that they are accurately labelled as Green. Adverse trends will be reported to Project Managers to ensure action is taken to correct, and re-submitted as YELLOW or RED when required.

Individual GREEN changes may not have an immediate significant impact on cost, schedule, or scope but they may be symptomatic of a larger problem that may cause more significant impacts in the future or may affect other projects. For example delay in or unavailability of a field service such as radiation protection, scaffolding or permitry may not cause a significant impact for one particular case if alternate work arrangement is possible; however future similar service issues could have much larger impacts if this trend continues and the systematic issues go unresolved.

### 6.1.2 Yellow Changes

YELLOW changes are addressed within the level of authority of the Project Manager and Director within the envelope of the latest approved project's baseline and contingency. YELLOW changes will go through rigorous review and evaluation. YELLOW changes do not require CCB approval, but will be reported to the CCB and PCCB who may request additional information or approval. YELLOW changes will be tracked for trends.

### 6.1.3 Red Changes

RED changes have a material impact on the Gate approved cost, schedule or scope, or fundamental changes to Contracting Strategy, Execution Strategy or Design Requirements or intent regardless of cost impact. RED changes will go through rigorous review and evaluation. RED changes may require a revised Gate submission per N-MAN-00120-10001; GRB Nuclear Projects Gated Process in lieu of this process if the Director NR P&C deems it necessary. All scope transfer requests are considered to be RED changes that require significant review for impacts.

The material cost impact threshold requiring a revised Gate submission or RED CCF is considered:

Projects, the lower of	\$5M	10%	of the current approved baseline budget
NR Functions, the lower of	\$5M	10%	of the annual business planning release



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The material schedule threshold is considered a revision to any of the Tier 1, 2 or 3 milestones as listed below (refer to N-MAN-00120-10001-SHT-06: Nuclear Refurbishment- Milestone Definition Framework):

Milestone	Description	Example
Program Tier 1	Milestones that are commitments to the Board or decisions at Board Level	Release Quality Estimate, and Unit Start/Finish Dates
Program Tier 2	Critical Impact Milestones normally documented in Phased based Program Business Case Summaries per Release Strategy	CNSC Approval of Integrated Safety Review (ISR)
Program Tier 3	Program Controls, including the NR Annual Incentive Plan (AIP) Milestones and NR AIP Scorecard, Milestones that manage the health of the Program and keep it on track	All Projects Scope Freeze/Detailed Engineering Finished

Program Tier 1 and 2 Milestone schedule delays require approval by the PCCB.  
Program Tier 3 Milestone schedule delays require approval of the CCB.

Schedule impacts that do not impact on Tier 1, 2, or 3 milestones may also be considered to be a Red change if the cost impact of a delay reaches one of the cost thresholds listed above when taking the *project burn rate* into account.

The Schedule Change Control process is governed by N-MAN-00120-10001: SCH-11, DR Schedule Management Plan for Integrated Level 3 Execution.

## 6.2 Change Classification

The Initiator will choose a *Change Classification* from a drop down list. The following is a list of change classifications:

Classification			
1	Scope - OPG	8	Contract Management - Vendor
2	Scope - Vendor	9	Quality & Conformance - OPG
3	Resources/Materials - OPG	10	Quality & Conformance - Vendor
4	Resources/Materials - Vendor	11	Safety - OPG
5	Process & Communication - OPG	12	Safety - Vendor
6	Process & Communication - Vendor	13	External Influence Nuclear Refurbishment
7	Contract Management - OPG	14	Refurbishment Program Strategy & Integration

*Change classifications* are assigned to all levels of changes to facilitate reporting on trends in situations. Change classifications also have potential commercial implications related to contractor changes or claims.



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## 6.3 Change Type

There are three (3) basic *Change Types*: *Directed Changes*, *Scope Transfers* and *Funding Variances*. The PM will request the type of change depending on the funding being requested. P&C will recommend acceptance of the Change Type chosen. Definitions for the three Change Types are included in Section 11.0 Acronyms and Definitions.

The table below contains details of which categories are updated in the baseline depending on the type of change:

Change Type	Schedule Impacts			
	Baseline Start Date	Baseline Finish Date	Forecast Start Date	Forecast Finish Date
<i>Directed Change</i>	Update if applicable	Update if applicable	Update if applicable	Update if applicable
<i>Scope Transfer</i>	Update if applicable	Update if applicable	Update if applicable	Update if applicable
<i>Funding Variance</i>	No Update	No Update	No Update	No Update
Change Type	Cost Impacts			
	Original Budget	Baseline (Planned Value PV)	Approved Funding (AF) Variance	Forecast
<i>Directed Change</i>	No Update	Update PV and BAC	Update: AF = PV	Update
<i>Scope Transfer</i>	No Update	Update PV and BAC	Update: AF = PV	Update
<i>Funding Variance</i>	No Update	No Update	Update	Update

## 6.4 Contingency Changes

The development of contingency amounts and time-phased planning and monitoring of contingency forecasts are governed by the Risk Management and Cost Management Sections respectively using N-MAN-00120-10001: RISK, Nuclear Projects Risk Management.

The Program Change Management process provides the structured framework and the mechanism to document, review and approve "draw" or "return" of contingency funds for projects or functional groups.

To facilitate tracking contingency usage, unused contingency must be returned to program contingency account using a CCF; it cannot be transferred between projects or bundles. The process of returning contingency does not apply to an underrun or savings realized on completed work.

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Note that schedule contingency/float shall be reviewed for the impact on critical path, reference procedure N-MAN-00120-10001: SCH, Nuclear Projects Schedule Management.

#### 6.4.1 Project Contingency

Draws from **Project** contingency for cost increased within the Project Manager's authority are considered to be YELLOW changes that require a CCF prepared by the Project Manager recommending the use of contingency; and approved by the Project Director. Project Contingency is held in a contingency work package in the project when project contingency exists and is based on the discrete risks established and controlled by the Project Manager. Schedule contingency is not allocated at the Project Contingency level.

#### 6.4.2 Bundle Contingency

Draws from **Bundle** contingency for cost or schedule are considered to be RED changes based on the Decision Criteria and require a CCF prepared by the Project Manager, recommended by the Bundle owner to the CCB for approval where cost or schedule contingency exists. For contingency draws where the Bundle does not have cost or schedule contingency, or it is not sufficient, the CCF must be elevated to the PCCB.

#### 6.4.3 Program Contingency

Draws from and returns to **Program** contingency for cost are considered to be RED changes and require a CCF prepared by the Project Manager and approved by the CCB and the PCCB. The PCCB will ensure that the required approvals for draws from Program contingency are obtained (i.e., SVP Nuclear Projects or CEO). The PCCB will also evaluate Program draws and, if necessary, escalate a required draw from Management Reserve to the CEO and, where necessary, the Darlington Refurbishment Committee/Board.

#### 6.4.4 Management Reserve

Draws from and returns to **Management Reserve** are considered to be RED changes and require a CCF prepared by the Project Manager and approved by the PCCB once required CEO or Darlington Refurbishment Committee/Board approvals have been obtained.

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## 6.5 CCF Approval Authority Level

The CCF approval authority level is based on the cumulative change impact, not incremental change. When a project is re-baselined, the cumulative approvals of remaining contingency apply to the re-baselined value and not to the original project baseline value. Example:

	Incremental Change	Cumulative Change	Total	Growth	Authority Level
Project Baseline			\$6,000,000		
CCF #1	\$550,000	\$550,000	\$6,550,000	9%	within PM Authority, <10% or \$5M of Project or Functional Baseline
CCF #2	\$400,000	\$950,000	\$7,500,000	15%	not within PM Authority, >10% or \$5M of Project or Functional Baseline



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### 7.0 CHANGE MANAGEMENT STEPS:

The Change Management process is made up of five key steps:



See Appendix D, Process Overview.

### 7.1 Screening, Scope Changes/Additions

All proposed scope changes and additions initiated by creation of a new Work Order or work request will be screened daily by the New Work Screening Committee. The process of screening scope is further defined in Appendix B. The Project Manager accepts the scope change and initiates a CCF if required based on the criteria of this procedure for approval at the CCB. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

Significant new or changed scope will be referred by the CCB to the PDM and if approved, a scope sponsor prepares a DRAS for budget approval by the PSRB. In cases where there are multiple potential options to address new scope, the ORB will review the options and decide which will be pursued.

### 7.2 Initiation

The initiator starts the process with a CCF. Refer to Appendix E for an example of a CCF with instructions for completing the form.

For GREEN changes, the initiator completes Section 1 of the CCF. Section 1 provides the minimum information required to register a change for trending. GREEN changes are reviewed and if agreed to be GREEN go directly to Implementation. The output of Implementation for a GREEN change is trending metrics.

For RED or YELLOW changes, the initiator completes all Sections of the CCF.

All required data on the CCF must be completed and the following supporting documents as applicable are required for RED and YELLOW level CCFs.

- Business rationale or justification for the requested change.
- Technical supporting documents if applicable.
- Cost Estimates prepared by OPG and/or Contractors in sufficient detail to allow review, including hours, rates, quantities and assumptions. Contractor estimates are reviewed and validated by OPG estimators.

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- A resource loaded schedule with affected activities and Critical Path impacts listed if applicable.
- Identify impacts to the *Work Breakdown Structure (WBS)* including to the overall Program WBS if applicable.
- Identify impacts to the Risk Register, including listing any additional risks, closed risks, changes in impacts on probability, schedule and cost and mitigating actions required.
- A listing of the *Work Packages* affected by the proposed Change in the required *Proliance Import File (PIF)* format.
- Identify impacts to remaining Contingency.
- Identify the impact to the Project Life Cycle Estimate at Completion (EAC), provide a definitive EAC and compare to the approved Gate Budget.
- Any other relevant supporting documents that facilitate review and evaluation of the change.

## 7.3 Review and Evaluation

The CCF is reviewed to ensure that an adequate amount of information and backup to fully support the proposed change is included as listed in Section 7.2 and that all required fields of the CCF are completed and correct.

The evaluation of the impacts of change on the project is integral to the success of the Change Management Process. If required, the CCF is routed to the appropriate functional department or subject matter experts to perform an independent evaluation of the impacts of the change. Impacts that must be independently evaluated are:

- Cost
- Schedule
- Basis of Estimate and Estimate at Completion
- Risk

The evaluation will also review in detail for compliance to this procedure.

The key outputs of the Review and Evaluation of a CCF are:

- Independent written feedback regarding the identified impacts.
- Recommend action to the approving authority.

Outputs of evaluation are attached to the CCF as backup documentation.

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### 7.4 Decision

The core expectation of this procedure is that change is managed at the lowest level of the organization that has the authority to do so and that change that has a significant potential impact on project or program scope, cost and schedule is reviewed in detail and the recommended direction is approved at the required level. Approval is based on the decision criteria applied in section 6.1.

#### Change Control Board:

The CCB is Chaired by the Vice President, Refurbishment Execution (or delegate) and scheduled as/when required. CCB Terms of Reference are provided in Appendix C.

The CCB approves draws from Project or Bundle Contingency and Tier 3 Milestone schedule impacts.

Based on input from the Review and Evaluation phase, the CCB Chair may decide that the change should proceed through the gate process for approval where significant change to the base assumptions exists. The CCB may also refer a change for additional approval as required.

#### Program Change Control Board:

The Program Change Control Board (PCCB) Chaired by the Director, Planning and Controls is scheduled as/when required. The PCCB convenes to approve significant Program level cost and schedule changes that require additional approval.

The PCCB approves draws from Program Contingency and Tier 1 and 2 Milestone schedule impacts.

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### 7.5 Implementation

The final decision and disposition of a CCF will be communicated in writing to all stakeholders listed on the CCF. The status of a CCF will be changed to "implemented" once all actions are completed.

The following systems and tools shall be updated, as applicable:

ACTION	RESPONSIBLE
Budget cost and cash flow ("PV") baseline	NR P&C Cost Management Section
Schedule baseline plan in Primavera P6	NR P&C Schedule Management Section
Risk Management and Oversight (RMO) database	NR P&C Risk Management Section
Project Management Plans	Project Managers, or designate
Contracts/Purchase Orders with Suppliers	Supply Chain
Update Change Register	NR P&C Cost Management Section
Update IDB Data Sets	Data Stewards



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### 8.0 CHANGE REGISTER

A Change Register will be maintained by the P&C Cost Management Section to record the sources of change, track and monitor status and provide inputs for key change related metrics.

The following are maintained in the Change Register:

- (a) CCF Number
- (b) Date Received
- (c) Change Title
- (d) Project Number
- (e) Project Title
- (f) Schedule impact number of days
- (g) Cost impact in \$ CAD
- (h) Change Classification
- (i) Change Level (GREEN, YELLOW, RED)
- (j) Change Type (DC, FV, ST)
- (k) Contingency Draw Source of Funds (Project, FI&P, SIO, Bundle or Core Program)
- (l) CSA or P&C Lead contact name
- (m) Change Initiator
- (n) Name of Approving Authority
- (o) Approval Date
- (p) Approval Status (Pending, Rejected, Approved, Implemented)
- (q) Date CCF Record Submitted to OPG Records
- (r) Proliance PIF Reference #
- (s) Comments

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## 9.0 METRICS AND REPORTING

The data compiled in the Change Register will be used to generate Program and Project metrics. These metrics will be generated on a monthly basis and include statistics such as:

- (1) Number initiated
- (2) Number Approved
- (3) Number Rejected
- (4) Cost Impact (\$)
- (5) Schedule Impact (days)
- (6) Change Classification Trends by Decision Criteria
- (7) Contingency budgets drawn percentage
- (8) Remaining Contingency value
- (9) CCF Cycle Time (received by P&C Lead date to approval date)

The CCB will receive weekly metrics on YELLOW and RED CCFs and trends for GREEN CCFs, the PCCB will receive monthly metrics on YELLOW and RED CCFs and trends for GREEN CCFs. PM's will receive monthly trend metrics on GREEN CCFs.

A Station Condition Report (SCR) shall be created for adverse trends identified from GREEN change pattern analysis if applicable. The intent of the SCR is to put in place corrective actions that are consistent with the consequences involved.

## 10.0 CCF DOCUMENTATION FLOW

Pending implementation of the automated tool for Change Management, CCF's will be submitted to the P&C Lead and the P&C CSA for disposition of the CCF. The nominal timing of the CCF process for non-urgent CCF's is two weeks from initiation to approval. The quality and completeness of the CCF and supporting documents is essential for timely approval.

All CCFs will be entered into the Change Register. GREEN CCFs will be confirmed GREEN and will then be saved in the P&C Sharepoint site. YELLOW and RED CCFs will be routed to the P&C Leads and/or P&C CSA who will send to subject matter experts when required, they will then be saved in the P&C Sharepoint site post final disposition by the appropriate level of authority. All CCFs will be uploaded as official records.

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### 11.0 DEFINITIONS

A comprehensive listing of P&C Terms, Acronyms and Definitions are provided in N-MAN-00120-10001 PC-16. Acronyms and definitions used in this document are summarized below.

Term/ Acronym	Definition
Baseline	See Performance Measurement Baseline
Change	For the purposes of this procedure, a change is any deviation from an approved plan or procedure that results in a real or potential impact on project or program cost or schedule.
Change Classification	Used to differentiate the reasons for a change to facilitate trending analysis.
Change Control Form (CCF)	Change Control Form N-FORM-11252; used to document changes for trending and approval purposes.
Change Management Process	Change Management is the Project Management process (including the supporting tool) that provides a framework to identify and record changes in cost, schedule and or scope against the approved baselines.
Change Type	There are three (3) basic Change Types: <i>Directed Changes</i> , <i>Scope Transfers</i> and <i>Funding Variances</i> , see individual definitions in this section.
Comprehensive Work Package (CWP)	A CWP is a collection of all necessary information required to complete the field implementation of construction work. It provides a systematic approach to completing the installation while taking into account nuclear, conventional, radiological and environmental safety.
Decision Criteria	RED, YELLOW or GREEN labels applied to differentiate the severity of a change so that the right risk-based change management controls are applied.
Directed Change (DC)	A Directed Change constitutes a change to the Program or Project Baseline and is generally caused by situations beyond the control of the work program owner. Examples are: <ul style="list-style-type: none"> <li>• Addition or deletion of scope;</li> <li>• Imposed on the project by NR management with direction to implement (e.g. un-lapping of unit outages).</li> <li>• Major change in execution or contracting strategies;</li> <li>• Cumulative effect of multiple non-Directed Changes renders the existing baseline no longer meaningful.</li> <li>• A Gate Release</li> </ul>
Executing Organization	The Project Team, OPG Function or Contractor's organization executing the scope of work.
Forecast	Forecast represents the projected cost of the Work Package, including any pending changes yet to be approved.

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Term/ Acronym	Definition
Funding Variance (FV)	A Funding Variance is a change that does not meet the criteria of Directed Change but requires a change in funding requirements. An approved funding variance will result in changes to the Approved Funding (AF) of the appropriate function or project only. Approved Funding automatically updates the Estimate at Completion (EAC). This type of change allows a drawdown of contingency to fund over-expenditures and allows Purchase Order values to be increased; however no re-baseline takes place.
Integrated Data Base (IDB)	IDB is Nuclear Refurbishment's data repository where integration and mapping occur. Information is pulled into IDB for the purpose of integration, mapping, data quality analysis, data integrity, and reporting.
Performance Measurement Baseline (PMB)	The Performance Measurement Baseline is the Project scope, cost and schedule approved during the Gated process for Project and Bundle Releases The approved budget and schedule allocated to Work Packages indicate cost and schedule performance which will be measured against Current Budget in the Proliance Cost Management System and the Project Baseline Schedule. The Performance Baseline will be established for both Cost and Schedule: <ul style="list-style-type: none"> <li>• Project Performance Baseline – Will be established at each Gate.</li> <li>• Functional Performance Baseline – Will be established at each Release</li> </ul> The Performance Measurement Baseline will not include: <ul style="list-style-type: none"> <li>• Contingency</li> <li>• Management Reserve</li> </ul>
Program Baseline	The aggregate planning efforts during Definition Phase will converge to an overall Program Plan at Release 5, or Release Quality Estimate (RQE). This is the point when the majority of projects have sufficiently defined their execution strategies, cost, schedule and scope that will allow an overall Program Baseline to be set. The Program Baseline will be maintained and actual cost versus budget monitored.
Proliance Import File (PIF)	Proliance Import File is a specifically formatted excel spreadsheet that contains work packages and budget change details being requested via the CCF. It is required to upload the changes into Proliance Cost Database upon CCF implementation.
Program Integrated Master Schedule (PIMS)	The Program integrated Master Schedule is the Level 1 schedule controlled by OPG senior management and contains all control accounts from all projects, OPG functional as well as for program management work.
Program Milestone Schedule (PMSS)	The Program Milestone Schedule is the Level 0 schedule controlled by OPG senior management.
Program Tier 1 Milestone	Program tier 1 milestones are milestones that are commitments to the Board or decisions at Board Level.
Program Tier 2 Milestones	Program tier 2 milestones are milestones that are critical to the Program, normally documented in Phased based Program BCS's per Release Strategy.
Program Tier 3 Milestones	Program tier 3 milestones are milestones that manage the health of the Program and keep it on track
Project burn rate	The cost a project incurs on a daily or weekly basis as a result of overheads, direct expenses (e.g. equipment rental) and labour.

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Term/ Acronym	Definition
Program Work Breakdown Structure (PWBS)	The Program Work Breakdown Structure is a hierarchical decomposition of the entire scope of work to be executed by the program team to accomplish the program deliverables.
Scope	Within the context of this document scope refers to the data sets that are used to manage projects and the Darlington Refurbishment Program. These include for example, Darlington Scope Requests, Engineering Changes, Work Orders, <i>Comprehensive Work Packages</i> , Construction Completion Declarations (CCDs).
Scope Transfer (ST)	A Scope Transfer is the transfer of scope and associated budget and schedule from one project to another either between bundles, or sub-bundles for the intent of re-planning already approved scope of work. These changes have no cost impact and will lead to a change in the baseline. Scope Transfers to cover over or under-run to budget are not permitted. Transfers of historic budgets are not permitted.
Work Breakdown Structure (WBS)	A hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables. The main purpose is to breakdown the scope of work into more controllable components and to identify responsible organizations for the completion of all components.

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## 12.0 REFERENCES

### 12.1 Performance References

- [R-1] N-MAN-00120-10001-PC: Project Controls
- [R-2] N-MAN-00120-10001-GRB: Nuclear Projects Gated Process
- [R-3] N-FORM-11252: Change Control Form
- [R-4] NK38-PLAN-09701-10003: Darlington Refurbishment Program – Program Scope Review Board – Terms of Reference
- [R-5] N-MAN-00120-10001: RISK, Nuclear Projects Risk Management
- [R-6] N-MAN-00120-10001:SCH-06, NR Milestone Definition Framework
- [R-7] N-MAN-00120-10001: SCH, Nuclear Projects Schedule Management
- [R-8] N-PROC-AS-0042: Quality Assurance Records
- [R-9] N-PROC-AS-0003: Controlled Document Management
- [R-10] OPG-STD-0017: Organizational Authority Register
- [R-11] N-PROC-RA-0022: Processing Station Condition Records
- [R-12] N-MAN-00120-10001: SCH-11, DR, Schedule Management Plan for Integrated Level 3 Execution.

### 12.2 Developmental References

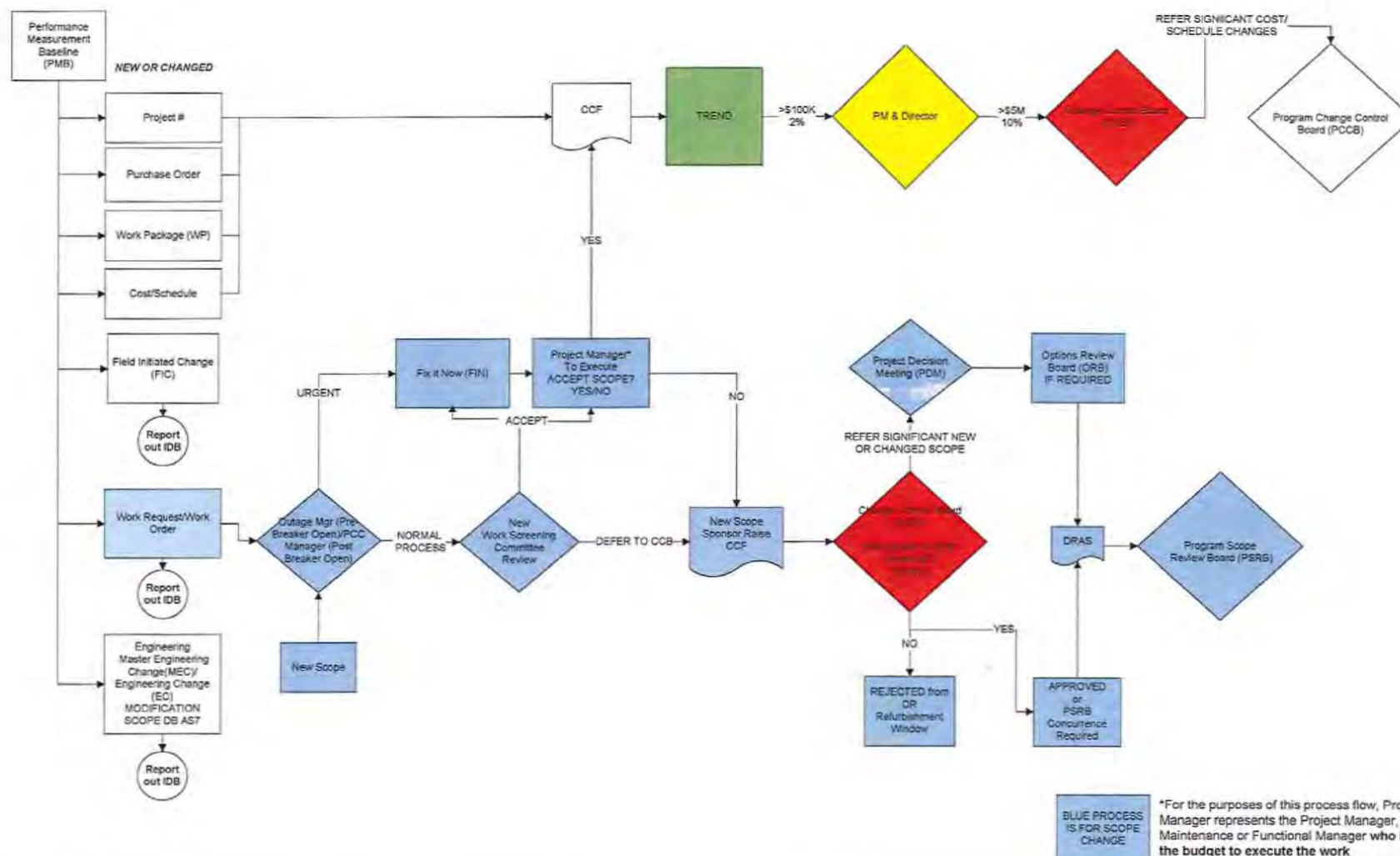
- [R-13] A Guide to the Project Management Body of Knowledge, 5<sup>th</sup> Edition (PMBOK Guide)
- [R-14] Managing Change in Organizations, PMI Practice Guide
- [R-15] Total Cost Management Framework: An Integrated Approach to Portfolio, Program, and Project Management, 1<sup>st</sup> Edition, Revised (TCM)
- [R-16] Project Control Handbook, September 2004 U.S. Department of Energy

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### Appendix A: Change Process Flow



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### Appendix B: Scope Change/Addition Screening Process

For the purposes of this document, "Project Manager" represents the Project Manager, Maintenance or Functional Manager who holds the budget to execute the work.

During Refurbishment execution, all requests for new scope will be handled through Asset Suite through the OMS Work Order Approval Process. A New Work Screening Committee (Screening Committee) will review work requests on a frequency depending on the volume received and categorize the work as to either execute during the Refurbishment outage or deferred as post-breaker close work.

For all types of new work orders not linked to current projects, consideration of the impacts of union jurisdictional issues and the Chestnut Park Accord Addendum (CPAA) work assignments should be made, reference file NK38-CORR-09701-0408278-T10. The CPAA Committee is available to assist with this impact assessment (contact Dan Smith dan.smith@OPG.com).

#### 1.1 Emergent Work

##### Non-Project Emergent Work

Emergent work categorized as Refurbishment by the Screening Committee and accepted by the Project Manager will be added to OMS and dispositioned by the Outage Manager as being an Available for Service requirement. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

Significant new or changed scope will be referred by the CCB to the PDM and if approved, a scope sponsor prepares a DRAS for budget approval by the PSRB.

##### New Work Team - Fix It Now (FIN)

If the emergent work requires immediate action due to station conditions, the Outage Manager (pre-breaker open) or the PCC (post-breaker open) will assign the work to the FIN Team.

The FIN team is a multi discipline team that reports to Director of NR Operations & Maintenance, which will support the Unit Director. The team will act as "first responders" for emergent work on the unit where repairs are required on Operating Systems not in the control of an EPC vendor.

Work Orders for urgent work generated from the FIN process must be accepted by the Project Manager the next business day. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

Work Orders that cannot be completed by FIN process will be prioritized, planned and integrated with appropriate windows in the outage schedule with the acceptance of the Project Manager.



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#### Project Emergent Work

Individual projects will manage their own project schedule and plan in P6, but these plans will interface with the Outage execution integrated schedule.

Additional work may be added to scope though the Screening Committee, CCB or PDM. The work must be characterized (mandatory or nice-to-have) based on work in progress, schedule and cost. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance.

## 1.2 Cyclical Outage

The Cyclical portion of the Refurbishment will be executed by the Refurbishment organization using Asset Suite and will follow the Refurbishment Planned Outage Management milestones and planning process.

#### Cyclical Scoping

Cyclical scoping will require a collaborative effort of Station & NR Engineering, Operations, Maintenance and Work Control. Accountability is maintained by Unit Director (NR Work Control). The Cyclical Scope selection will include the following:

##### Must Do:

- Station License or Regulatory Requirements.
- Testing/inspections required for normal shutdown and start-up of the Unit.
- Mandatory Inspections due during the Outage Period.

##### Need or Want To Do:

- Life Cycle Management inspections or Maintenance as required to facilitate RTS (Return to Service) expectations.
- Preventative Maintenance, Deficient Maintenance (DM) and Corrective Maintenance (CM) Work Orders as requested to achieve RTS expectations. These will be a subset of: PRL (Plant Reliability List) Work to Improve Unit Reliability, Reduce Forced Loss Rate, Station Cycle Plan Support and Operating Backlog Targets Support.
- Cyclical outage scoping strategy will consider scope that can be proven to add value to the station operations in future by improving maintenance method saving costs on outages, optimizing resources or improving operations. Replacement of components which due to scale of work makes economic sense.
- Operator Burden and Operator Work-Around elimination.

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This work is assigned to the Project Manager by the Screening Committee. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

**Note:** The cyclical scoping process cannot be used to circumvent the CCF or DSR/DRAS process.

#### Cyclical Schedule

The Unit Director is accountable for the preparation of cyclical schedules that will include all cyclical outage approved scope (Operations & Maintenance work orders, from breaker open to closed, required to allow operation until the next planned outage, D2221).

The cyclical outage schedule will include Operations I RTS detailed shutdown and return to service activities. Additionally, this schedule shall be reviewed for horizontal and vertical integration with the IL3 (Integrated Level 3) and CCL2 (Coordination and control level 2) schedule. Refer to N-MAN-00120-10001-SCH-11 (Darlington: Schedule Management Plan for Integrated Level 3 Execution) for more details on IL3.

The cyclical outage scoping process is initiated following the last planned outage prior to the start of the unit as per the Work Management Ownership Transfer Plan (NK38-PLAN-09701-10113-WM-01).

### **1.3 Major Scope**

Significant new or changed scope will be referred by the CCB to the PDM and if approved, a scope sponsor prepares a DRAS for budget approval by the PSRB. In cases where there are multiple potential options to address new scope, the ORB will review the options and decide which will be pursued.

Major program scope changes referred to the PSRB by the CCB or PDM follow the Darlington Nuclear Program Scope Control, NK38- INS-09701-10001.

### **1.4 New Projects and Station Sponsored Work**

During the time period when NR is the scheduling authority, the Station may desire to have work (new scope) performed on the unit. Since there is only one schedule to perform work in the Refurbishment unit, all Station or Projects & Modifications work groups must ensure their tasks are approved and shown on the Refurbishment schedule once approved.

New scope identified at the Screening Committee requires a scope sponsor who prepares a CCF for approval at the CCB. Significant new or changed scope will be referred by the CCB to the PDM and if approved a DRAS for budget approval by the PSRB is required. In cases where there are multiple potential options to address new scope, and that option set does not provide a clear

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preferred option, an Options Review Board (ORB) will review each option and decide upon which of the options will be pursued.

### 1.5 Decision Escalation (Appeal) Process

In the situation where a scope addition or change has been rejected by the Project Manager, a request can be made to escalate the decision to the CCB and PDM.

In the situation where a scope addition or change has been rejected by the CCB, a request can be made to escalate the decision to the PSRB. In such cases, a written request by the Sponsor must be made to the Chair of the PSRB with rationale. The PSRB chair will arrange an ad hoc PSRB meeting to consider the request.

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### Appendix C: Terms of Reference for the CCB & PCCB

#### Change Control Board:

**Mission:** To consider the implications of changes that exceeds a Project Manager's and Project Director's authority. To reject or approve changes assessed to have acceptable cost and schedule implications.

#### Membership

##### Quorum Members:

- VP, Refurbishment Execution (or delegate) Chair
- Director, Refurbishment Engineering
- Director, Refurbishment Operations & Maintenance
- Director Planning & Controls NR (or delegate)
- Director Unit Outage, NR
- Director Nuclear Projects Controllershship

##### Non-quorum Members:

- P&C Change Administrator
- P&C Support Staff as required
- Other subject matter experts may be invited by the Chair for issue-specific input

##### Approval:

- VP, Refurbishment Execution

#### Process

A quorum is the Chair and three members noted in the membership list, including the lead of the organization impacted by the change (example, if an Engineering change, the Engineering Director must be at the CCB meeting). The PM may also be invited to attend depending of the nature of the change. This quorum represents the minimum breadth of expertise that must be present to represent the full range of stakeholder interests.

The CCB will convene at a frequency dependant on the volume of changes received, and may be required to convene on an urgent basis if the evaluation of a change warrants.

The P&C Change Administrator will summarize the conclusions for presentation to the CCB. The P&C Change Administrator will maintain a list of actions arising from the CCB and provide follow-up reporting to the CCB.

Based on the change review and evaluation input, the CCB may decide that the change should proceed through the gate process for approval, for significant new or changed scope refer the change to the PDM for assessment, refer the change to the PSRB or refer the change to the PCCB. Otherwise if the change is brought to the CCB, the following outcomes are possible. The change is approved, requires more information or is rejected.

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**NUCLEAR REFURBISHMENT - PROGRAM CHANGE MANAGEMENT**

### Program Change Control Board:

**Mission:** To consider the implications of changes that exceeds the CCB's authority and/or to approve Program Contingency draws. To reject or approve changes assessed to have acceptable cost and schedule implications and where required, elevate for CEO for approval and Management Reserve assessments.

### Membership

#### Quorum Members:

- Director Planning & Controls NR, Chair
- SVP, Nuclear Refurbishment
- VP, Nuclear Finance
- VP, Assurance
- VP, Engineering, Nuclear Refurbishment
- VP, Refurbishment Execution
- VP, Operations and Maintenance

#### Non-quorum Members:

- P&C Change Administrator

#### Approval:

- Director Planning & Controls NR

### Process

A quorum is the Chair and four members noted in the membership list. This quorum represents the minimum breadth of expertise that must be present to represent the full range of stakeholder interests.

The PCCB will convene at a frequency dependant on the volume of changes received, and may be required to convene on an urgent basis if the evaluation of a change warrants.

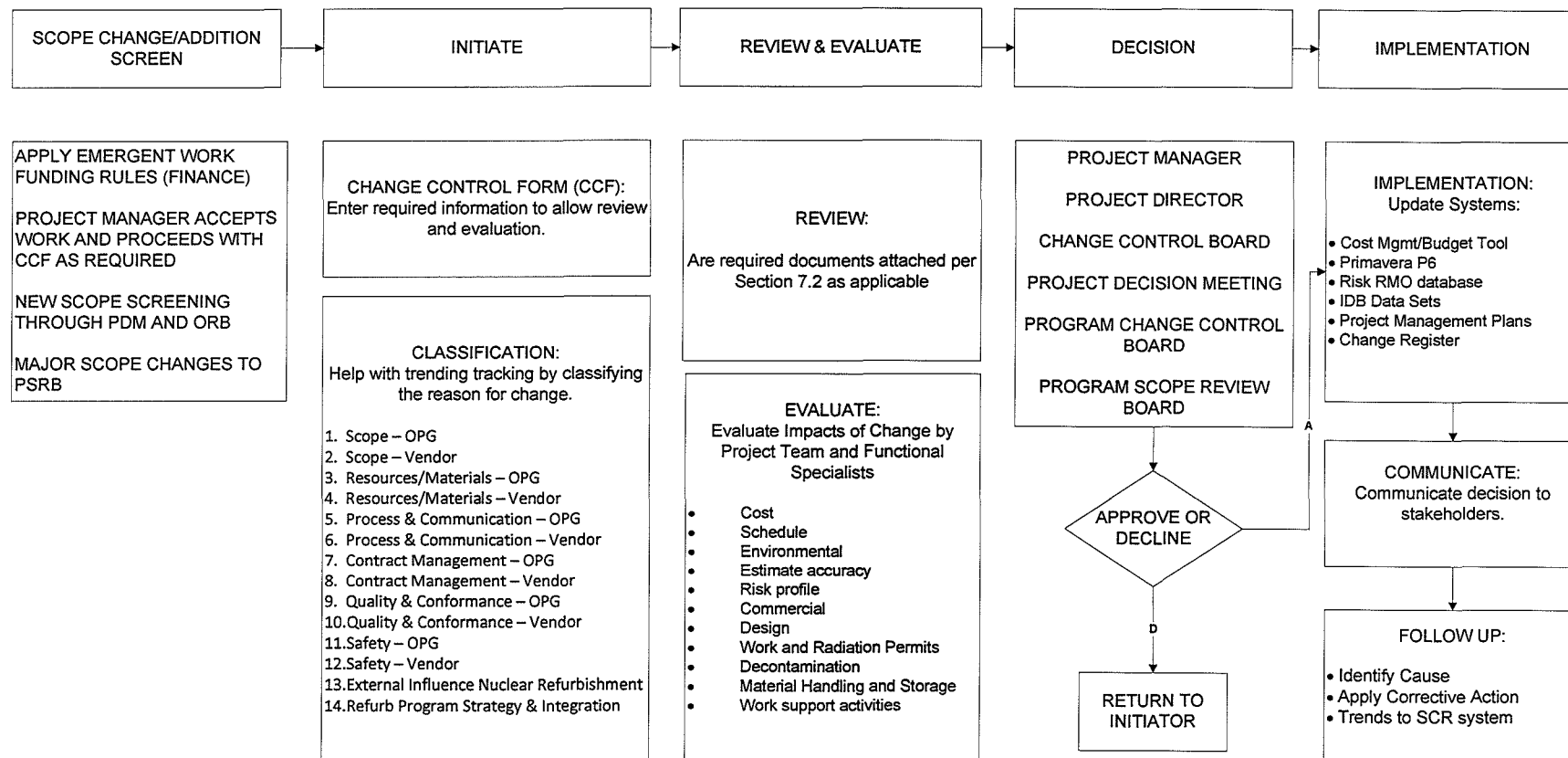
The P&C Change Administrator will summarize the conclusions for presentation to the PCCB. The P&C Change Administrator will maintain a list of actions arising from the PCCB and provide follow-up reporting to the PCCB.

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### Appendix D: Process Overview



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## Appendix E: Example of CCF



Records File Information:  
Management for File

Internal Use Only  
N-FORM-11252-R003\*

### Nuclear Refurbishment Change Control Form

Management for File Internal Use Only N-FORM-11252 003 Nuclear Refurbishment Change Control Form N-MAN-0012-100001-PC-12 Program Change Management

Date: 7 October 2015 CCF #: \_\_\_\_\_ PIF #: \_\_\_\_\_

#### SECTION 1: INITIATE

DATE RECEIVED:                      *Date received by P&C Lead*

<b>Project No.:</b>	<u>12345</u>	<b>Project Title:</b>	<u>Nuclear Work</u>		
<b>Initiator:</b>	<u>Your Name</u>	<b>Initiating Organization</b>	<u>Your organization (example P&amp;M)</u>		
<b>Change Title:</b>	<u>A brief title that is descriptive of the change, example: Contingency draw required to fund additional scope x being added.</u>				
<b>Description:</b>	<p><i>A key component for the evaluation of a CCF is the description of the change. A quality narrative aids in the approval and trending of the CCF.</i></p> <p><i>In a quality narrative, Initiators need to explain what has changed and how the work is being managed to minimize impacts. Demonstrate that corrective actions are being taken and that SCR's, OPEX and Lesson Learned are being completed where necessary. Demonstrate that project risks are being reviewed with mitigation action plans in place. Discuss the state of contingency and this CCF's impact on contingency.</i></p> <p><i>A list of work packages being impacted by the change is not a description of change. Avoid explanations such as "poor estimates", changes are variances against an estimate that contained assumptions, explain what changed in the assumptions.</i></p>				
<b>Reason:</b>	<p><i>The reason or cause of change should provide approvers with sufficient information to understand the business reasons of the change or the operational reason for change.</i></p> <p><i>Example of a business reason is scope change required due to an EC and an operational reason is an organizational change that requires a baseline adjustment.</i></p>				
<b>Classification:</b>	<u>Choose an item.</u> <i>Select Classification from drop-down menu.</i>	<b>Level:</b>	<u>Choose an item.</u> <i>Select Level from drop-down menu.</i>	<b>ROM:</b>	<u>Enter Rough Order of Magnitude \$ Impact</u>

#### SECTION 2: REVIEW & EVALUATE (Attach Supporting Documentation)

(Double-click on images below to update in Excel. After updating, click outside image to exit Excel)

Original Budget:									0	
Previous CCF 1									0	0.0%
Previous CCF 2									0	0.0%
Previous CCF 3									0	0.0%
Previous CCF 4									0	0.0%
Subtotal Current										
Approved Budget	0	0	0	0	0	0	0	0	0	
This CCF									0	0.0%

<b>COST REBASELINE IMPACT:</b>	
Is a re-baseline of the Planned Value being requested for this change?	YES <input type="checkbox"/> NO <input type="checkbox"/>
<b>ESTIMATE AT COMPLETION IMPACT:</b>	
Will the Estimate at Completion exceed the Proposed Budget?	YES <input type="checkbox"/> NO <input type="checkbox"/> EAC \$:



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**NUCLEAR REFURBISHMENT - PROGRAM CHANGE MANAGEMENT**

SCHEDULE IMPACT: <i>Ensure Schedule is Updated</i>				
Milestone/ Work Package ID	Description	Approved Date (mm/dd/yyyy)	Requested Date (mm/dd/yyyy)	Variance Days
				0
				0
				0
				0

<b>SCHEDULE REBASELINE IMPACT:</b>	
Is a re-baseline of the schedule being requested for this change?	YES <input type="checkbox"/> NO <input type="checkbox"/>

RISK IMPACT: <i>Ensure RMO tool is Updated</i>		
Risk ID	Description	Impact
123456	Risk Description from RMO	

Change Type Requested	Direct Change: <input type="checkbox"/>	Scope Transfer: <input type="checkbox"/>	Funding Variance: <input type="checkbox"/>
-----------------------	---	--	--

<b>Review &amp; Evaluation Issues:</b>
<i>Record any issues identified by the subject matter experts that could not be addressed by the initiator that need to be communicated to the approving authority. Attach email or other written feedback and information.</i>

### SECTION 3: DECISION

Title	Name	Signature	Date (YYYY-MM-DD)	Approve	Reject
Initiator:					
Project Manager:				<input type="checkbox"/>	<input type="checkbox"/>
Project Director:				<input type="checkbox"/>	<input type="checkbox"/>
CCB (Chair):				<input type="checkbox"/>	<input type="checkbox"/>
Additional Approvals:				<input type="checkbox"/>	<input type="checkbox"/>

<b>Decision Additional Notes:</b>			
Change Type Approved	Direct Change: <input type="checkbox"/>	Scope Transfer: <input type="checkbox"/>	Funding Variance: <input type="checkbox"/>
<b>Rebaseline Approval:</b>			
Is a re-baseline approved for this change?		YES <input type="checkbox"/>	NO <input type="checkbox"/>

### SECTION 4: IMPLEMENTATION

IDB: <input type="checkbox"/>		US Cost: <input type="checkbox"/>
MPL: <input type="checkbox"/>		P6: <input type="checkbox"/>
Proliance: <input type="checkbox"/>		





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**DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL**

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**Darlington Nuclear Refurbishment  
Program-Scope Control**

**NK38-INS-09701-10001-R006**  
2014-10-22

Order Number: N/A  
Other Reference Number: N/A

**Internal Use Only**

Prepared by:

 Oct 22, 2014

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**Instruction**

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## DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL

### Revision Summary

Revision Number	Date	Comments
R006	2014-10-22	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to incorporate the processes for Darlington Station owned non-IIP DSRs, and PSRB transition.</p> <ul style="list-style-type: none"> <li>• Addition of Section 2.1, 2.2, 2.3 for PSRB transition</li> <li>• Addition of HoS N/A.1, N/A.2, N/A.3, N/A.4</li> <li>• Removed HoS 4</li> <li>• Clarification of HoS 05 and 10</li> <li>• Rewording of HoS 4.1, 4.2 4.3, 4.4, 3 and 90</li> <li>• Rewording of 4.17.4: Requirement to Progress HoS</li> <li>• Updated diagram in section 4.1</li> <li>• Section 4.3 : DSR (Not Refurb) and Non-IIP</li> </ul>
R005	2013-12-10	<p>Revised and issued by Nuclear Refurbishment, Work Control to reflect current practices and incorporate DCR 0120354. This is an intent revision. Due to extensive changes, revision bars are not used.</p> <p>ISR flag in 3.2 – scope categorization paragraph and any other mentions in the body of this document have been removed.</p> <p>Section 4.6 PSRB, clarified role of PSRB secretary from “whom will ensure that all decisions are recorded within a scope database.” to “whom will ensure that all decisions are implemented in a timely manner.”</p> <p>The following has been added:</p> <ul style="list-style-type: none"> <li>• HoS 03, 04.1, 04.2, 04.3 and 04.4</li> <li>• Appendix B, questions concerning parts</li> <li>• Appendix K, attached a copy of the mentioned memo</li> <li>• GAR/IIP tracking</li> <li>• Migration of a draft DSR to the live database</li> <li>• Intent vs. non-intent changes</li> <li>• DSR status</li> <li>• DSR type</li> <li>• Initiating work requests from DSR line items</li> </ul>
R004	2012-12-12	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to Incorporate the requirement for Cost Benefit Analysis to accompany any new proposed scope post May 11, 2011 Major Scope Freeze Milestone, add the Life Cycle of a DSR, Screening and Funding committee quorum clarification. Scope Change Section added. Document numbers updated to align with Business Transformation initiative 2012.</p>
R003	2012-04-30	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to Incorporate revised Appendix A, Appendix B, added Appendix C (Scope Decision Matrix), added Appendix H (Scope Hierarchy) Added Appendix J (Scope Decision Matrix Summary Table), and references to the Integrated Safety Review (ISR) and DRAS processes. Incorporated NK38-GUIDE-09701-10012 Guide to Scope Health Definition Planning into this instruction section 7.</p>
R002	2010-12-23	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to Incorporate Screening and Funding Committees additions and governance alignment changes.</p>
R001	2010-06-30	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls</p>
R000	2009-04-29	<p>Initial Issue.</p>

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### 1.0 BACKGROUND

The Program Scope Review Board (PSRB) reviews and approves proposed additions or deletions of major program level scope for refurbishment of the Darlington Nuclear Generating Station (DNGS) as described in the Darlington Refurbishment Program – Program Scope Review Board - Terms of Reference (NK38-PLAN-09701-10003), DNGS Refurbishment Project Reference Plan – Scope Definition (NK38-PLAN-01060-10003) and in accordance with the Darlington Refurbishment Program Charter (D-PCH-09701-10000).

The process of identification of Program scope and the management of scope changes is described in this instruction and applies to all phases of the Darlington Refurbishment Program. This will ensure that the proposed additions and/or deletions have undergone a thorough assessment based on the return on investment, impacts on plant safety, reliability, project schedule and cost, program resourcing, regulatory requirements and environmental impacts. Refurbishment scope is maintained in the Darlington Scope Request (DSR) database.

Scope in the Darlington Refurbishment Program will support the Darlington Refurbishment Principle Program Objectives:

- (a) Confirm feasibility of refurbishing DNGS reactors
- (b) Plan and execute all work required to refurbish the Darlington units
- (c) Ensure the scope of the refurbishment outages will enable economic operations of each unit for an additional 30 years post-refurbishment.

Refer to Program Structure and Summary Management Plan, NK38-PLAN-09701-10067 Sht: 0001, for an overview of the Program and NK38-PLAN-09701-10067 Sht: 0002, Refurbishment Program Scope Management Plan, identifies how the program scope will be defined, managed and controlled throughout the Darlington Refurbishment program.

### 2.0 DIRECTION

This instruction applies to all staff performing or supporting the identification and definition of scope related to the Darlington Refurbishment Program. This instruction describes the process for submission and approval of scope additions by the Darlington Refurbishment Program Scope Review Board (NK38-PLAN-09701-10003). Scope changes and deletions will also follow the process outlined in this instruction.

Rigorous identification and control of the Darlington Refurbishment Outage Program scope and execution is essential to successful completion of the refurbishment on budget and on schedule and shall be based on the following principles:

- Project safety and defense-in-depth is maintained

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- Established Dose Targets are not exceeded
- Appropriate Program and Project work is completed
- Project schedule is not extended unnecessarily and recovery plans are developed as required
- The Program costs do not unnecessarily exceed budget
- Planning and integration with key work management areas of the company (outage and online Darlington schedules)
- Reasonable contingencies are in place for unforeseen circumstances that may arise, i.e. discovery work, during the Darlington Refurbishment Program
- Identify, prioritize, track and mitigate risks associated with the project.

For the purpose of supporting this scope control instruction, the Refurbishment Program scope will include core scope and non-core scope. Scope categories are chosen by the scope initiator and confirmed by the technical screening and funding committees and approved by the PSRB. Scope categories are used to ensure the correct work is accepted into scope with clear justification to support the Program Objectives. Once scope is accepted into the Program, the scope must still follow the Gate Review Board approval process for funding and scope management, in accordance with Nuclear Projects – Gated Process (N-MAN-00120-10001-GRB). Refer to Appendix G of this document for a flowchart of Refurbishment Scope Review Process.

### 2.1 Transition to Ad-Hoc PSRB Meetings

As of May 2014, the quarterly PSRB and Funding Committee Review will be replaced with Ad-Hoc meetings. The NR Project Planning and Controls will have the responsibility in scheduling the need-based PSRB and setting up the agenda.

## 3.0 SCOPING PRINCIPLES

### 3.1 Darlington Refurbishment Objectives

The goal of the refurbishment project is to extend the service life of the units by an additional 30 years of post-refurbishment operations. Refurbishment will involve an outage for replacement of life-limiting components, as well as maintenance or replacement of other components which can be most effectively done during the refurbishment outage period.

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### 3.1.1 Primary Objectives

- Successful refurbishment of Darlington Station Life Limiting Components in order to allow Darlington to operate for 30 years beyond the current predicted end of service life.
- The Refurbishment Project will return the unit in better condition than which it was received.
- A successful refurbishment project requires delivery of all core and approved non-core scope within the timeline and budget established in the Release Quality Estimate and as documented in the project Business Case Summary (BCS).
- Project cost and schedule as well as post-refurbishment performance goals are met with quality, because they will come under extreme scrutiny due to the high profile nature of this project and its impact on OPG's reputation.
- Where scope is approved by PSRB, NR (Nuclear Refurbishment) may recommend inclusion of scope to pre-refurbishment station outage.
- The Refurbishment Program must ensure that all scope is known and is executable.

### 3.1.2 Secondary Objectives

- Refurbishment will assess the scope and overall economics of the program, with consideration of the following:
  - Hardened Backlog
  - 10 Year Investment Program
  - Minor Modification Program
  - Margin Management Plan
  - System Health and Lifecycle management plans
  - System Available for Service (SAFS)/Ready for Service (RFS) process with respect to plant status and operational burdens.
  - Outage Improvement Initiatives
- Support the station vision by delivering value enhancing station improvements (non-core scope).

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- The amount of non-core scope executed during the refurbishment outage will be based on priority of work, and cost benefit assessment. This scope will be optimized to minimize the risk to the refurbishment critical path schedule, and overall project costs.
- All non-core scope must meet strict financial hurdle rules prior to consideration i.e. 9.5% discount rate and 6 year payback (per memo from Chief Financial Officer). Refer to Appendix K for a copy of the memo.

## 3.2 Scope Categorization

All scope is categorized as core scope (CS) or non-core scope (NCS). All core scope will be linked back to the program objectives and non-core scope will be categorized to control and monitor types of scope added and deleted from the Program. Refer to Appendix D of this document for a chart of all scope categories and their description.

### 3.2.1 Core Scope

Consists of work that must be done to achieve the Primary Objective. Core scope will determine the critical path for the refurbishment outage and sets the lower boundary for the cost estimate. Refer to Appendix E of this document for a brief summary of the current document major components of core scope. Core scope includes:

- **Regulatory scope** – Scope that supports station license and regulatory requirements (not optional), as agreed with the regulator and documented in the Integrated Improvement Projects based on Environmental Assessment, Integrated Safety Review and other activities such as Global Assessment which do not require Economic Assessment.
- **Station Life Limiting Components** – modification, repair, or replacement of station life limiting components that must be replaced in order to support the primary objective to allow DNGS to operate for 30 years beyond the current predicted end of service life. This includes items which have an asset class tied to station life and can only be done in a drained and defuelled state. Examples include: Calandria Tubes, Pressure Tubes and Feeders.
- **Component Upgrades** – work to upgrade components, which have a high station priority that can only be done during an extended refurbishment outage with units in a drained/defueled state. Examples include LISS (Liquid Injection Shutdown System) nozzle inspections & repairs, Shutoff Rod guide tubes, and Calandria vessel inspections and repairs.
- **Programmatic work** – Typically performed online or in a normal station outage that must be done in the refurbishment period in order to maintain station licence, including mandatory preventive maintenance, inspections, etc.
- **Prerequisite Scope** – Inspections to determine refurbishment scope and Modifications/upgrades that must be done before refurbishment starts to meet



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production requirements to enable a successful refurbishment. This includes islanding modifications and fueling machine upgrades.

- **Facilities & Infrastructure Plan** – construction of facilities and improvements to the infrastructure to support the refurbishment. See Scope Exclusions (3.2.4) below for exceptions.

### 3.2.2 Non-Core Scope

Consists of work that will be performed in the refurbishment period if it has no impact on the projects Core Scope critical path, does not add risk to the successful completion of core scope, and where cost or resource efficiencies and station priority warrant the work to be executed in the refurbishment period. A Business Case Assessment Summary (BCS) or Decision Record Analysis Summary (DRAS; N-FORM-11390) demonstrating the economic advantage; including risk management and/or reliability improvement, and priority of completing this work during, pre-, during or post-refurbishment will be required to gain approval.

Non-Core scope may include:

- **Safety Improvement Opportunities** – Safety or Environmental improvements beyond standard that provide benefits to the station in terms of increased reliability and/or lower operating costs some of which is documented in the Integrated Safety Review and Safety Factors Reports.
- **Station Improvement Opportunities** – Station improvements that provide benefits to the station in terms of increased reliability and/or lower operating costs, and where it is economically beneficial to OPG to perform the work in the refurbishment period.

### 3.2.3 Facilities & Infrastructure

Facilities & Infrastructure and Campus Plan projects, to support post-refurbishment operations will be funded by the Darlington Refurbishment program. The Darlington Site Infrastructure Co-ordination Committee will prioritize projects to be executed within this funding envelope.

### 3.2.4 Scope Exclusions

The following items are specifically excluded from the scope of Darlington Refurbishment Project:

- Operations and Maintenance work required to be performed to maintain the plant outside of the refurbishment outage window.
- Tritium removal facility improvements, upgrades, or replacements.
- Spare components, either capital or inventory (Other than per ECC (Engineering Change Control) )

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- New Maintenance Facility

## 4.0 PROCESS

Management of the Refurbishment Outage and the complexity over a long period of time will be a key factor in the success of the overall Program. The PSRB will approve the selection of only the correct scope to achieve success of the Program on schedule and within budget.

The Scope Management Process for the Darlington Refurbishment Program is graphically represented in Appendix A. This diagram represents (primarily) the Program Scope Review Board process and the Major Scope decision process. Approval of the further evolution of Major Scope is approved by the Gate Review Board (As per the Gated Process, N-MAN-00120-10001-GRB).

All work requested to be included in the scope of the Darlington Refurbishment Program must be initiated in the Darlington Scope Request database. Scope will originate from several areas of the Program, including the Environmental Assessment and Integrated Safety Review actions, Plant Condition Assessment, including Aging Management recommendations (through Component Condition Assessment's), infrastructure projects, Station Work Management requirements and Station Improvement Initiatives. Considering each scope origin, the scope request information originates in different forms and must be requested in a common format for the Program to control the scope. The Darlington Scope Request database for the Refurbishment Program will be the format in which DSR Line Items are submitted.

Once requested in the database, the scope will be processed accordingly through the database for consideration in the technical screening and funding committees and at one of the PSRB meetings.

Post Major Scope Milestone completion (May 2011) all proposed non-core scope will require a cost benefit analysis (i.e. BCS or DRAS) and project schedule impact review accompanying the DSR. Refer to Developing and Documenting Business Cases (OPG-STD-0076) for BCS process and Nuclear Refurbishment Actions, Issues, Decisions, and Key Assumptions Management (N-MAN-00120-10001-RISK-07) for DRAS process.

### 4.1 DSR life cycle

The DSR will go through a number of transitions from creation to reconciliation against a Work Order at 24 months before each unit's outage, and to close out as illustrated in the diagram below. A DSR starts as a high level thought and progresses from identification stage to the definition stage; depending on how well the scope is known and understood.

There will be five closeout reports, one per unit, as well as a final close out at the end of the project. The DSR managed in the DSR database is the currency of scope control until 24 months prior to the Refurbishment Outage (RO-24) at which time the

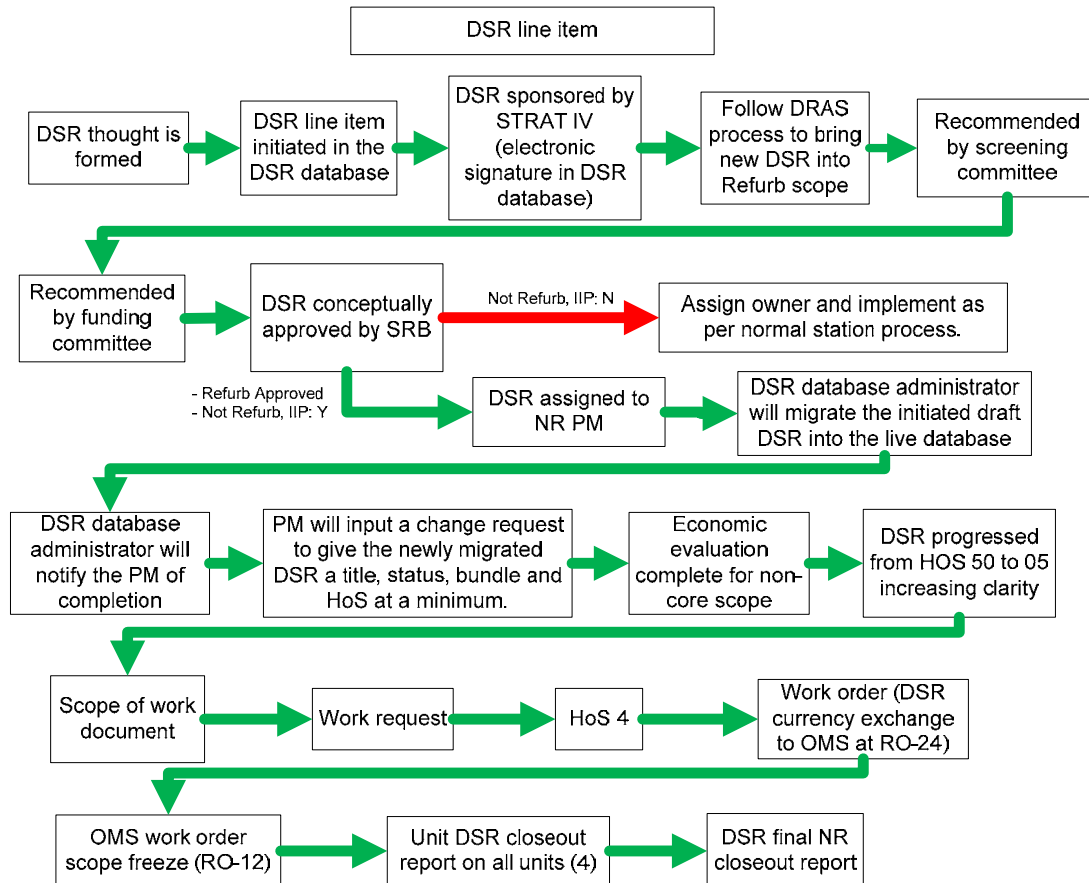
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currency will change to Work Orders managed in the Outage Management System (OMS). The reconciliation report will be complete by the RO-12 (Unit OMS Work Order Scope Freeze Milestone).



## 4.2 DSR database

The term DSR refers to a Darlington Scope Request line item. The DSR database is the source of scope control for the Darlington Nuclear Refurbishment Project. It is available on the project management section of the Darlington Refurbishment web page.

Refurbishment scope is maintained in the DSR data base. Scope management will be integrated into the Refurbishment program information management system through various processes; examples include schedules, contracts, scope of work documents, budgets and business plans. Scope information management shall follow approved OPG, Nuclear and Refurbishment governance, including, but not limited to, N-PROG-AS-0006, Records and Document Control.

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### **4.2.1 DSR initiation**

It is intended for anyone to be able to initiate a DSR. To initiate a DSR, open DSR database and follow on screen instructions; if unsure, STOP and ask the DSR database administrator for help. During the DSR creation, the scope initiator will be required to categorize the scope (outlined in Appendix D) and select a DSR type (outlined in Appendix J).

All scope requested in the Darlington Scope Request database must be supported by a Stratum Level 4 sponsor. The sponsor's electronic signature will be required at the time of scope request prior to review at any of the scope review boards. Post Major Scope Milestone completion (May 2011) all new proposed scope will require a cost benefit analysis (i.e. BCS or DRAS) and project schedule impact review accompanying the DSR. After PSRB approval, the DSR database administrator will migrate the initiated draft DSR into the live database and send out an email notification to the PMs (Project Managers) of completion.

If a new DSR is created through an administrative DRAS (does not change scope; i.e. part of an approved DSR is moved to a new DSR with an approved status) and does not require PSRB approval, the signed and issued DRAS can be brought to the DSR database administrator to have the new DSR migrated to the live database.

The PM will need to input a change request to give the newly migrated DSR (at minimum) a title, status, bundle and health. The PM must also review and update any effected work orders.

### **4.3 Scope hierarchy**

The scope hierarchy is a method of ranking the DSR line items in the DSR database to establish priority using Scope Type, Risk Rank, Prerequisite Indicator and Economic Valuation. The Scope Hierarchy is further detailed in Appendix H.

### **4.4 Technical Screening Committee**

After major scope has been requested and sponsored in the DSR database, a Technical Screening Committee will review the requests. The committee will review a specific list of requirements including Core and None Core designations to ensure the scope request is adequately prepared for the PSRB. The technical screening committee will be led by the Vice President (VP), Nuclear Refurbishment Engineering.

The committee will make technical acceptance recommendations on specific scope items to the Refurbishment Funding Committee and the PSRB.

The Screening Committee Chair and Quorum is as follows:

**Chair:** Vice President, Nuclear Refurbishment Engineering

**Quorum Required (Voting Members):**  
Vice President, Nuclear Refurbishment Engineering

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Director, Operations and Maintenance, Darlington  
Director, Operations and Maintenance, Nuclear Refurbishment  
Director, Engineering, Darlington

Technical Screening Committee meetings require all quorum members or empowered delegates present.

See Appendix C for decision matrix to be used as a guideline by the Technical Screening Committee to make technical acceptance recommendations.

#### **4.5 Funding Committee**

After Major Scope has been requested and sponsored in the DSR database, and the Technical Screening Committee has recommended the proposed scope addition the Funding Committee will make funding stream recommendations. The Funding Committee will be led by the Director, Nuclear Refurbishment Planning and Controls.

The Funding committee will make funding recommendations on specific scope items to the PSRB.

The Funding Committee Chair and Quorum is as follows:

**Chair:** Director, Nuclear Refurbishment Planning and Controls

#### **Quorum Required** (*Voting Members*):

Director, Nuclear Refurbishment Planning and Controls  
Director, Business Support, Darlington  
Director, Asset Planning and Integration  
Controller, Nuclear Refurbishment

The Funding Committee meetings require all quorum members or empowered delegates present.

See Appendix F for funding matrix to be used as a guideline by the Funding Committee to make decisions.

#### **4.6 Program Scope Review Board**

The PSRB shall be a senior cross-functional board with representation from the site and supporting business units. The review board shall consist of voting members and nonvoting members. Non-voting members are scope sponsors or advisors in the Board. All scope presented at the PSRB should be supported by at least one sponsor among the Board membership. This is to ensure that there is support for the scope that is requested and knowledge of the scope that is requested at each meeting. The PSRB voting members will strive to arrive at a consensus for all scope requests. The Director of Planning and Control, Nuclear Refurbishment shall be the Chairperson of the PSRB and will designate a secretary to the PSRB whom will ensure that all

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decisions are implemented in a timely manner. Required quorum for PSRB meetings shall be all of the voting members. In the event of the unavailability of the individual specified below, the Board member may delegate the meeting attendance to an empowered delegate.

The Program Scope Review Board Chair, Quorum and non-voting members are as follows:

**Chair:** Director, Planning and Controls, Nuclear Refurbishment

**Quorum Required** (*Voting Members*):

SVP or Deputy VP, Darlington Nuclear  
SVP, Nuclear Refurbishment  
SVP, Nuclear Engineering and Chief Nuclear Engineer

**Non-Voting Members of the PSRB** (*Sponsors & Advisors*):

VP, Engineering, Nuclear Refurbishment  
VP, Execution, Nuclear Refurbishment  
VP, Corporate Business and Investment Planning  
VP, Science & Tech, or Director, Eng Services  
Director, Operations & Maintenance, Darlington Nuclear  
Director, Operations & Maintenance, Nuclear Refurbishment  
Director, Engineering, Darlington Nuclear  
Director, Engineering, Nuclear Refurbishment  
Director, Work Management, Darlington Nuclear  
Director, Planning and Control, Nuclear Refurbishment  
Director, Investment Management, Nuclear Finance  
Director, Commercial Projects and Facilities  
Director, Business Support Director, Darlington Nuclear

**Note:** The VP, Science and Technology and Director, Engineering Services shall be responsible for scope recommendations within their respective areas of responsibility and attend as appropriate.

In order to record a decision at the PSRB, consensus must be reached between the three (3) Voting Members. This applies to scope approvals and rejections. The PSRB Voting Members will strive to meet the meeting objective of reaching consensus on all scope items during the meeting or by requesting additional information to be provided by the scope sponsors and initiators, in order to support a decision.

## 4.7 Scope Challenge

The scope is challenged a number of times throughout the scoping process. It is challenged at the Technical Screening Committee meeting, financially at the Funding Committee meeting and finally as part of the PSRB, requested scope will be scrutinized to determine whether it must be completed in the Refurbishment Outage and whether it adversely affects the refurbishment outage(s) cost and schedule.

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For each scope request, the PSRB will utilize a list of questions that will challenge the scope initiator to support justification. These questions will address necessity, business need, risk and impact on cost and schedule (Appendix B). Appendix C shows a Scope Flow Decision Matrix which also will be used to validate and challenge the scope. Following approval of Major Scope by the PSRB for inclusion in refurbishment (Refurb) scope, the scope is formally added to the DSR database as Approved. If scope has not been approved, rejection justification will be formally recorded and the scope will be set to "Not Refurb" in the database indicating that it is not part of the refurbishment project and will follow Darlington's normal processes for evaluation.

### **Scope Challenge Meeting** (Prior to Gate 1 and 3 of the Gated Process N-MAN-00120-10001-GRB)

As per N-MAN-00120-10001-GRB, Nuclear Projects Gated Process there is a requirement for a Review of Scope to reassess and confirm need. This is accomplished through a Scope Challenge Meeting. The meeting is chaired and led by the Project Manager who owns the work being proposed to progress the project through the next decision Gate. For each DSR, the PM will utilize the Scope Decision Matrix (Appendix C) to justify / challenge the scope. The PM will complete the summary table in Appendix I and present to the Scope Challenge meeting Quorum for challenge of content and methodology. The completed table confirming recommendations will be submitted with the documents for the Gate Review Board Meeting (N-MAN-00120-10001-GRB). A DRAS will be completed as required and presented at next PSRB.

The Scope Challenge Meeting members are as follows:

**Presenter / Chair:** Project Manager, Nuclear Refurbishment Execution

**Quorum:** Vice President, Nuclear Refurbishment Engineering  
Director, Operations and Maintenance, Nuclear Refurbishment  
Director, Project & Controls, Nuclear Refurbishment

**Advisors:** Director, Nuclear Safety, Nuclear Refurbishment  
Director, Engineering, Nuclear Refurbishment

## 4.8 DSR Changes

If the DSR has not been through Gate 1 of the Gated Process (N-MAN-00120-10001-GRB), i.e. funding not yet allocated for this project, changes are requested through the change control form (change request) within the DSR database. Contact DSR Database Administrator for assistance.

If one of the PM's has been to Gate 1 for the DSR requesting funding, then a Change Control Form (N-FORM-11252) must be completed and approved prior to any DSR database changes.

DSR Change process:

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- For scope changes, DRAS completed by Project Manager and approved by PSRB
- If at or past (funding) gate 1, complete N-FORM-11252 prior to any DSR database changes
- Change control form Initiated in DSR database by an individual
- Change control form concurred (electronically signed) by Project Manager and appropriate stakeholders.
- For intent changes, the change control form also needs to be approved by System Engineering Manager, Nuclear Refurbishment.
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.
- Review and update any affected work orders in Asset Suite.

**Note:** At this time, the DSR Database Administrator is a WCTL (Work Control Team Leader) working for the NR Outage Manager.

#### **4.9 Decision Record and Analysis Summary (DRAS)**

Decision records are critical in maintaining an auditable trail of the NR Program changes, including changes in strategy, regulatory interactions, technology, resource, scope, etc. These important decisions should be validated by the appropriate authority to ensure alignment across all NR organizations. Refer to N-MAN-00120-10001-RISK-07, Nuclear Refurbishment Actions, Issues, Decisions, and Key Assumptions Management for full DRAS process. If a DRAS affects DSRs, then the follow the steps in section 4.8, DSR change process.

#### **4.10 DSR Database change request**

Changes to an approved DSR (before gate 1) are requested using the change control form in the DSR database with supporting document (i.e. DRAS), for auditable trail. DSR change control form is an electronic form found in the DSR database in the DSR menu, called "Request change to DSR info". When the form opens up, select the correct DSR and enter your proposed changes in the blue fields on the right of the original DSR. The specific approval is dependent on what is being changed, i.e. intent or non-intent.

This electronic method of change control which allows an individual to propose a change which will then be approved by the Project Manager. The time, date, and LAN ID associated with the change are all recorded in the DSR database.

##### **4.10.1 Intent Change process**

Changes in Scope, context or title of a DSR are considered intent changes.



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- For scope changes, DRAS completed by Project Manager and approved by PSRB
- Change control form completed (quoting DRAS number) in DSR database by the Project Manager, Nuclear Refurbishment
- Change control form concurred (electronically signed) by Engineering Project Manager, Nuclear Refurbishment
- For intent changes, the change control form also needs to be approved by System Engineering Manager, Nuclear Refurbishment.
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.
- Review and update any affected work orders in Asset Suite.

### 4.10.2 Non-Intent Change process

Fixing spelling errors or splitting one DSR into multiple DSRs (which doesn't change scope or context) are considered a non-intent change and does not require engineering approval.

- Change control form completed in DSR database by the Project Manager, Nuclear Refurbishment
- Change control form concurred (electronically signed) by appropriate stakeholders.
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.

**Note:** If unsure, default to intent change or contact DSR database administrator.

### 4.11 DSR Ownership Change

- Change control form completed in DSR database by Sending Project Manager, Nuclear Refurbishment
- Change control form concurred (electronically signed) by Receiving Project Manager, Nuclear Refurbishment
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.

**Note:** If one of the PM's has been to Gate 1 for the DSR requesting funding, then a Change Control Form (N-FORM-11252) must be completed and approved prior to any DSR database changes.

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### **4.12 DSR GAR (Global Assessment Report) and IIP (Integrated Implementation Plan) Tracking**

NR Engineering is responsible to identify DSRs committed in the GAR/IIP. NR Engineering will input change requests and the DSR database administrator will ensure the changes reflect approved documentation. All work orders generated from IIP identified DSR line items will require regulatory tracking in AssetSuite.

### **4.13 DSR (Not Refurb) and Non-IIP**

Darlington Generation Station is responsible to use the current station processes to monitor, track and close the work per the following governances and processes.

- N-PROC-MP-0060: Aging Management Process
- N-PROC-MA-0024: System Performance Monitoring
- N-GUID-01510-10001: Site Component Health and Engineering Program Health Reporting Process
- N-PROC-MA-0097: Equipment Reliability Implementation

### **4.14 DSR status**

DSR Status	Description
Approved	PSRB approved scope for the Darlington Refurbishment Project.
Cancelled	Work that will not be completed by the station or Refurbishment organization.
Closed	All work, actions and reports have been completed.
Not Refurb	DSR is not part of the refurbishment project and will follow Darlington's normal processes for evaluation.
Not Required	Contingency work that has been analyzed and determined to be not required, usually due to a report, analysis or inspection results.
Superseded	The DSR's scope is covered by another existing or new DSR. Superseded to station AR, ASIC project, PM, etc for Non-IIP Station owned DSR.

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### **4.15 Initiating work requests from DSR items**

Detailed work orders will be required during the Detailed Planning phase. D-GUID-09701-10013, Initiating Work Request for DSR Items, helps establish the correct nomenclature and sufficient level of detail used when initiating the work request.

When Unit, SCI, Device, Scope of Work and Unit condition information is known, the DSR line item is ready to initiate a work request, as per N-PROC-MA-0008, Work Initiation and Prioritization.

### **4.16 Work Requests to Work orders**

Work Control SPOC reviews submitted work requests for N-PROC-MA-0008 compliancy, assigns appropriate attributes/tags and approves the work request to a work order.

### **4.17 Health of Scope (HoS)**

#### **4.17.1 Background**

The Darlington Nuclear Refurbishment scoping strategy includes a Health of Scope grouping number representative of the work required to progress a DSR from the identification stage to the definition stage. Each DSR in the DSR database has been categorized with a Health of Scope number identifying how well the scope is known and understood. A unit suffix has been added to HoS 04 and the newly created HoS N/A. Therefore each unit will need to be dispositioned for every DSR. This will enable a better history of the DSR when doing the DSR closure report for each unit. The target is to get Health of Scope to 04.X (work orders have been input on X unit) or N/A.X (work orders will not be input on X unit). This will enable the work to have sufficient clarity that it can enter into the Work Management processes (ECC, work order etc.) at RO-24 (OMS Work Order Scope Definition Complete Milestone).

#### **4.17.2 Health of Scope number definitions:**

HOS	Definition
0	New items which have not been assigned a Health of Scope by the Project Manager. The expectation is that the HoS is assigned within 2 weeks after the PSRB approval.
03	No further work required on DSR.
N/A.1	This DSR line item will not generate work orders on Unit 1 and does not require any other work orders to support Unit 1's Refurb Outage.
N/A.2	This DSR line item will not generate work orders on Unit 2 and does not require any other work orders to support Unit 2's Refurb Outage.
N/A.3	This DSR line item will not generate work orders on Unit 3 and does not require any other work orders to support Unit 3's Refurb Outage.
N/A.4	This DSR line item will not generate work orders on Unit 4 and does not require any other work orders to support Unit 4's Refurb Outage.

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04.1	All Work Orders that this DSR requires on Unit 1 and to support Unit 1's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
04.2	All Work Orders that this DSR requires on Unit 2 and to support Unit 2's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
04.3	All Work Orders that this DSR requires on Unit 3 and to support Unit 3's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
04.4	All Work Orders that this DSR requires on Unit 4 and to support Unit 4's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
05	DSR is adequately known such that it is ready for Work Order to be input on all Units (Scope of work and unit condition known).
10	Work is known at the component / MEL level (unit, SCI and Device known).
20	Work is known at the system or project level but not component
30	Actions to implement selected, may be a component strategy across many systems. Options developed and preferred selected at system level (potentially many systems).
40	Analyze the completed report to determine actions / path forward. Required assessments or analysis have been completed and issue, priority, constraints and success criteria are understood.
50	Further assessment is required to build a report for analysis to understand the identified issue before the scoping process can begin. At this point the extent, the impacts, the significance, nor the potential resulting actions are known
60	Pure engineering or procedures with no likely field work (i.e. provide CNSC with a report, update procedure, etc). Activities identified as pure engineering or requiring documentation update will be planned by the responsible functional organizations and will be scheduled in the functional organization schedule ensuring that the deliverables meet the timelines identified in the overall Project Integrated Master Schedule.
90	DSR recommended to be removed from NR scope and will not be executed in Nuclear Refurbishment. DSR will be removed from NR scope, pending PSRB approval. The expectation is that the Project Manager who owns the Scope Health 90 item will have the DRAS completed and approved 14 days prior to the next SRB and communicated to the NR Outage Manger for inclusion and scope removal approval at the next SRB.

Note: Any required unit 0 work will be tagged with the unit requiring the implementation.

### 4.17.3 HoS change process

- Change request initiated in DSR database
- Change request approved by the Project Manager, Nuclear Refurbishment
- Change request concurred (electronically signed) by appropriate stakeholders
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.
- Review and update any affected work orders in Asset Suite.

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**Note:** HOS 90 scope removals approved by SRB at next scheduled meeting.

### 4.17.4 Requirements to Progress HoS

This section identifies deliverables required to take a DSR from the Identification phase to Definition phase at a system level through identifying examples of deliverables for each category.

#### **Health of Scope 50 to 40**

Review the scope for the need to prepare an assessment for further analysis. Deliverables to move DSR to 40 may include:

- Nuclear Safety Assessments/Analysis
- Detailed system assessments
- Code gap analysis
- Reliability assessments
- Life Cycle Management plan
- Material/fatigue analysis

To obtain these deliverables an in-house resource may be assigned or a contracting strategy developed and an outside vendor used. The assessments, plans, analysis should end in recommendations that lead to a better understanding of the issue identified in the DSR. At this point the DSR is considered to be HoS 40.

#### **Health of Scope 40 to 30 or 20 if only 1 System or Project**

Review results of the assessments and identify if DSR requires a modification to the plant, maintenance on a system (i.e. repair, replace) inspection or test. Identify options and select preferred to resolve the DSR issue. Steps to progress to 30 may include the following:

- New DSR presented to PSRB for approval
- Prepare and process DRAS form N-FORM-11390 as per N-PROC-LE-0008 if required to either progress DSR or close the item.
- Prepare EDM (Engineering Decision Making Meeting) materials and hold EDM if required to progress complex scope issues as per N-GUID-01900-10001, if EDM agrees with potential scope then generate ECR (Engineering Change Request)
- Prepare Project Gate documents as per N-MAN-00120-10001-GRB.

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- Prepare Conceptual Study/Report as required identifying potential options to address the problem/needs statement. May be prepared by Refurbishment, OSS (Owner Support Services) or EPC (Engineer, Procure, Construct) vendors.
- Generate inspection requirements or plans to support planning of recommended testing or inspections

Additional assessment or analysis may be required to further define the options where the initial assessment cannot conclusively recommend a path forward to resolve the DSR. In this case the DSR Health of Scope is returned to 50 for further assessment.

#### **Health of Scope 30 to 20**

Work scope should be defined at a system level. Inspections and Conceptual studies may define a need for further scope to be added into the project, contingencies should be planned for by this time and high risk contingency items should progress through the gated process as required if the inspection work cannot be done until a later date. Activities to progress to 20 may include:

- Options developed and preferred selected at system level.
- Prepare Project Gate documents as per N-MAN-00120-10001-GRB

#### **Health of Scope 20**

Work is known at the system or project level but not component. Initiation Phase complete, the following activities can begin:

- Generate a project charter or needs statement for potential modifications to be implemented outside of the Darlington Refurbishment organization.
- Identify non-modification work recommended in the assessments and contact Nuclear Refurbishment WCTLs to input work request for the work, if DSR item issue can be resolved through execution on non-modification work the DSR item can be reclassified as 5 in the Health of Scope
- Develop Preliminary Design Requirements for potential modifications where scope has been adequately defined
- Definition Phase begins. System or project scope is defined. ECR can be generated (ECR identifying problem statement for potential modifications as per N-PROC-MP-0090)
- Sufficient information available to begin to prepare preliminary and detailed design scope of work for EPC RFP (Request for Proposal)
- Long lead items identified

#### **Health of Scope 20 to 05**

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Unit, SCI, Device, Scope of Work and Unit condition is known for the DSR and is ready to initiate work requests, as per N-PROC-MA-0008, Work Initiation and Prioritization. Detailed work orders will be required during the Detailed Planning phase. D-GUID-09701-10013, Initiating Work Request for DSR Items, helps establish the correct nomenclature and sufficient level of detail used when initiating a work request from a DSR. It is expected that once ECR's are approved, conceptual design options are identified and preliminary design requirements are prepared. The EPC contracts can then be issued where the contractor will further define the work and ensure that work order planning is completed. Work will be managed via the Gated Process (N-MAN-00120-10001-GRB).

### **Health of Scope 05 to 03 or 04.X or N/A.X**

Work have been input for unit X (04.X) or work orders will not be input for unit X (N/A.X). This requires each unit to be dispositioned for every DSR, which creates a better history for DSR closure reports. If there is no work required for DSR, it can go to HoS 03.

## **4.18 Scheduling**

Darlington Refurbishment Project Managers are accountable to identify the deliverables required to progress DSRs through the Scope Health Definition levels to Health of Scope 03 or 04.X or N/A.X. P6 schedule activities will be created for the deliverables that progress a DSR to HOS 03 or 04.X or N/A.X. The Project Managers will update and maintain the health of scope rating of the DSR in the DSR database.

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### 5.0 DSR DATABASE DEFINITIONS

<b>Acct_Org</b>	Accountable Organization
<b>Add_Info</b>	Additional information
<b>APP_ISR</b>	Indicates that the DSR is included in the Integrated Safety Review (ISR)
<b>Bundle</b>	Work Grouped by Project Manager area of responsibility (i.e. Balance of Plant [BOP], Fuel Handling [FH]) translates to Complex code on the work order.
<b>CCA</b>	Component Condition Assessment Number
<b>CONTINGENCY</b>	Contingency Flag
<b>Cost_Element</b>	Category from original Darlington Refurbishment Business Case to which the cost is allocated
<b>Cost_Estimate</b>	Cost estimate
<b>Description</b>	Description of work encompassed by the DSR (usually from CCA)
<b>DSR</b>	DSR related to the Line item
<b>DSR_Init</b>	DSR initiator (LAN ID)
<b>Dsr_Line</b>	DSR Line Item Number
<b>Ex_Owner</b>	Execution Owner by name
<b>Fog</b>	Functional Outage Grouping
<b>FUN_STR</b>	Funding Stream i.e. Station funded or Refurb funded, etc.
<b>Gate</b>	Last Gate of the Gate Review Process the DSR has passed through
<b>Grouping</b>	Health of Scope indicator
<b>Economic Evaluation</b>	Indicator of completion of the economic evaluation (Y=yes economic evaluation completed, N=no economic evaluation not completed, Not Required= economic evaluation not required; i.e. HOS 60 DSRs and Core Scope DSRs)
<b>Hierarchy</b>	Priority Ranking of DSRs
<b>Inspection</b>	Indicator that an inspection is required
<b>Item</b>	DSR Line item number
<b>Meet_Date</b>	SRB meeting date
<b>Not_Refurb_Reason</b>	Reason for the scope being rejected by PSRB and not included in the Refurbishment of Darlington
<b>Prereq_Type</b>	Categories for Prerequisite work. (The scope bucket may be non Pre-req but have some pre outage Work Orders)
<b>Priority</b>	Not Used at This Time
<b>PSRB_Sponsor</b>	Manager level or higher who sponsors the scope for consideration by PSRB



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<b>Risk_Rank</b>	Risk Ranking per Risk Governance (N-MAN-00120-10001-RISK)
<b>SCI</b>	System Component Identification number
<b>Scope_Owner</b>	Nuclear Refurbishment Project Manager who owns the scope Execution and Planning
<b>Scope_Bucket</b>	Darlington Refurb Window for Execution of the Scope (i.e. Pre-req means work execution is completed prior to Refurb)
<b>SCOPE_TYPE</b>	Scope type (Refer to Appendix D)
<b>Status</b>	DSR Status, Refer to section 4.13 of this document.
<b>SUB_Bundle</b>	Smaller work grouping of a Bundle (i.e. Safety Systems is a sub bundle of BOP)
<b>TEC_REC1</b>	Technical Screening Committee Recommendation
<b>Title</b>	DSR Title
<b>Type</b>	Work type, i.e. regulatory, campus plan, technical, etc.
<b>Unit</b>	Darlington Unit
<b>WBS</b>	Work Breakdown Structure ID

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### 6.0 ACRONYMS

BCS	Business Case Summary
CCA	Component Condition Assessment
CCF	Change Control Form
CS	Core Scope
DNGS	Darlington Nuclear Generating Station
DRAS	Decision Record Analysis Summary
DSR	Darlington Scope Request Line Item
EA	Environmental Assessment
ECC	Engineering Change Control
ECR	Engineering Change Request
EDM	Engineering Decision Making Meeting
EPC	Engineering, Procure, Construct
GAR	Global Assessment Report
HOS	Health of Scope
IIP	Integrated Implementation Plan
LISS	Liquid Injection Shutdown System
MEL	Master Equipment List
NCS	Non-Core Scope
NR	Nuclear Refurbishment
OM&A	Operations, Maintenance and Administration
OMS	Outage Management System
OSS	Owner Support Services
PM	Preventative Maintenance or Project Manager
PSRB	Program Scope Review Board
Refurb	Refurbishment
RFP	Request for Proposal
RFS	Ready for Service
RO	Refurbishment Outage
SAFS	System Available for service
SVP	Senior Vice President
VP	Vice President
WCTL	Work Control Team Leader

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## 7.0 REFERENCES

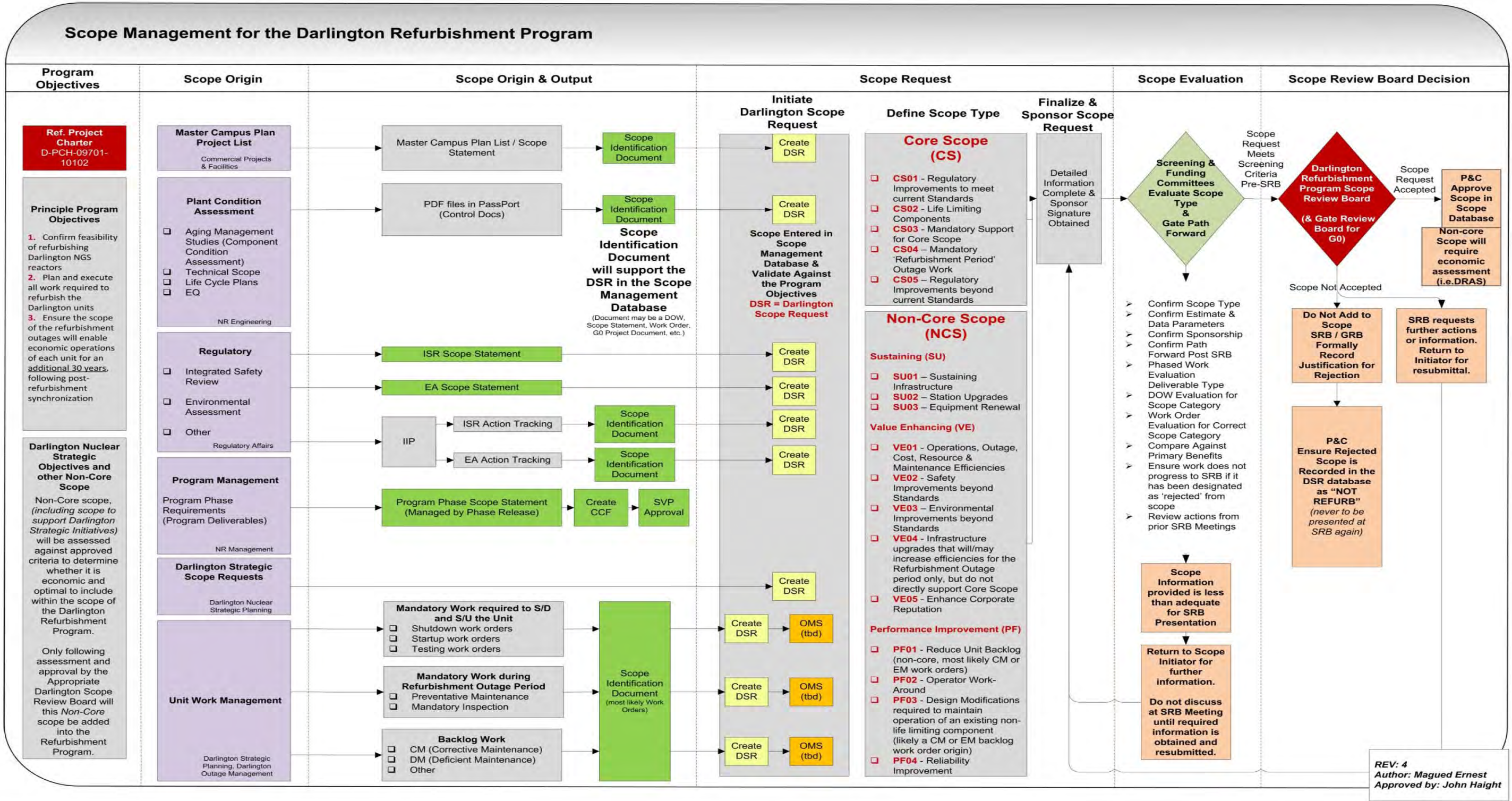
- [R-1] Darlington NGS Refurbishment Project Reference Plan – Scope Definition (NK38-PLAN-01060-10003)
- [R-2] Darlington Refurbishment Program – Program Scope Review Board – Terms of Reference (NK38-PLAN-09701-10003)
- [R-3] Darlington Refurbishment Planning activities Project Charter (D-PCH-09701-10000)
- [R-4] Developing and Documenting Business Cases (OPG-STD-0076)
- [R-5] Nuclear Refurbishment – Darlington (N-PROG-LE-0002)
- [R-6] Nuclear Projects gated Process (N-MAN-00120-10001-SHT-GRB)
- [R-7] Nuclear Refurbishment Actions, Issues, Decisions, and Key Assumptions Management (N-MAN-00120-10001-RISK-07)
- [R-8] Decision Record and Analysis Summary form (N-FORM-11390)
- [R-9] Nuclear Refurbishment Change Control Form (N-FORM-11252)
- [R-10] Refurbishment Program Structure and Summary Management Plan (NK38-PLAN-09701-10067-SHT-0001)
- [R-11] Refurbishment Program Scope Management Plan (NK38-PLAN-09701-10067-SHT-0002)
- [R-12] Initiating Work Request for DSR Items (D-GUID-09701-10013)
- [R-13] Work Initiation, Approval, and Prioritization (N-PROC-MA-0008)
- [R-14] Records and Document Control (N-PROG-AS-0006)
- [R-15] Modification Process (N-PROC-MP-0090)
- [R-16] Engineering Decision Making (N-GUID-01900-10001)
- [R-17] NR Planned Outage Management (NK38-MAN-09701-10005)

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Appendix A: Darlington Refurbishment Outage Scope Management Process



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## DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL

### Appendix B: Darlington Refurbishment Program Scope Categories and Standard Scope Justification Questions

#### B.1.0 CORE SCOPE

Core Scope directly supports the Program Objectives to ensure the success of Refurbishment.

Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>CS01</b>	Regulatory Improvements to meet current Standards	<ul style="list-style-type: none"> <li>Scope that is not optional in order to support the Station License and Regulatory Requirements.</li> </ul>	Q. What is the required regulatory commitment date? Is it required to be completed during the Refurbishment Outages?	<ul style="list-style-type: none"> <li>Environmental Assessment and IIP Actions.</li> <li>Integrated Safety Review and IIP Actions.</li> </ul>
			Q. Are there any technical alternatives for this particular regulatory requirement (i.e. can it be met in any other way? Is there another solution?)	
<b>CS02</b>	Life Limiting Components	<ul style="list-style-type: none"> <li>Major component modification, repair or replacement that cannot survive operation for an additional 30 years (post-synchronization for each unit) – note the exception below.</li> </ul> <p><i>** Note: Components which are assessed to be able to operate effectively for a significant time post-refurbishment, but would then need extensive repairs or replacement, are not to be included in the proposed refurbishment scope, unless they would have a detrimental impact on unit reliability, safety or if they could only be repaired or replaced under refurbishment outage plant condition (i.e. De-</i></p>	Q. Is the proposed scope supported by a life cycle management plan?	<p>Major life limiting components are identified as:</p> <ul style="list-style-type: none"> <li>Replacement of pressure tubes</li> <li>Replacement of calandria tubes</li> <li>Replacement of Feeders</li> <li>Balance of Plant System components (supported by Plant Condition Assessment)</li> </ul>
			Q. Is it considered necessary (component would otherwise be not fit for service)?	
			Q. Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
			Q. Is the work only feasible in the drained and defueled state achieved in the refurbishment outage?	
			Q. Is the work date-sensitive?	
			Q. Can the work be completed while the unit is online?	
			Q. Can the work be completed during a regularly scheduled maintenance outage before or after the Refurbishment Outage? If so, what is the impact on that maintenance outage?	

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
		<i>fuelled/dewatered). These recommendations will be made through the review of Technical Scope documentation (Plant Condition Assessments).</i>	<p><b>Q.</b> Has the alternative of doing the work during the pre-refurbishment period been considered/assessed? Provide clear rationale why not feasible; i.e. discuss drawbacks, major risks.</p> <p><b>Q.</b> Is the equipment assessed to operate for a significant time post-refurbishment?</p> <p><b>Q.</b> Does the proposed solution impact on refurbishment outage schedule?</p> <p><b>Q.</b> Is it more economical to complete the work when scheduled in the refurbishment outage (rather than before or after)? If so, provide economic rationale.</p>	
<b>CS03</b>	Mandatory Support for Core Scope	<ul style="list-style-type: none"> <li>Must do in order to support execution of Core Scope.</li> </ul>	<p><b>Q.</b> Would the refurbishment core scope still be possible to execute without this scope / infrastructure?</p>	<ul style="list-style-type: none"> <li>Program Management deliverables (non-construction work): Program and Project Management, QA, Supply Chain, Op&amp; Commissioning Management, Health and Safety Management.</li> <li>Required Pre-Outage Inspections (to support definition of Core Scope) - Station Outage or Online work management required.</li> <li>Islanding activities for each unit outage.</li> <li>Infrastructure Master Campus Plan listed work that is mandatory only to support Core Scope (i.e. Retube Control Centre) and absolutely must be executed. The Core Scope could not be executed without this Infrastructure in place (with or without efficiencies).</li> <li>All work required to</li> </ul>
			<p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</p>	
			<p><b>Q.</b> Are the parts:</p> <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
				shut down, start-up and test the unit for the Refurbishment Outage.
<b>CS04</b>	Mandatory 'Construction Period' Outage Work	<ul style="list-style-type: none"> <li>Preventative Maintenance Work that would normally be executed during the time period during the Refurbishment Outage</li> <li>Mandatory Inspections that would normally be executed during the time period during the Refurbishment Outage.</li> </ul>	<b>Q.</b> Is the proposed scope Preventative Maintenance included in the PM strategy document for each unit? If not, why is it being requested now?	<ul style="list-style-type: none"> <li>PM for oil change on auxiliary boiler feed pump</li> <li>PM for electrical breaker testing</li> <li>FAC program inspections on service water pipe work</li> <li>Mandatory RV testing/calibrations</li> </ul>
			<b>Q.</b> Is the inspection considered mandatory? Why (what is the supporting mandating documentation)?	
			<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>CS05</b>	Regulatory Improvements beyond current Standards	<ul style="list-style-type: none"> <li>Regulatory suggested improvements that are not required as per current codes and standards.</li> </ul>	<b>Q.</b> Are there any technical alternatives for this particular regulatory requirement (i.e. can it be met in any other way? Is there another solution?)	<ul style="list-style-type: none"> <li>Improvements To EPS Availability</li> <li>Emergency Heat Sink for Accidents</li> </ul>
			<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	



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### B.2.0 NON -CORE SCOPE (NCS)

#### B.2.1 Sustaining (SU) - Non - Core Scope

Sustaining Scope is not mandatory to execute the Refurbishment Outage and achieve the Program Objectives. It may provide long term benefits to the Darlington Site and stations outside the primary Program Objectives. All Non-core Scope requires economic justification (i.e. DRAS).

Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>SU01</b>	Sustaining Infrastructure	<ul style="list-style-type: none"> <li>Infrastructure upgrades required to sustain an additional 30 years of operations.</li> <li>Work is listed as part of the Darlington Master Campus Plan and the Darlington Program Campus Plan Scope Statement</li> <li>Is not part of, nor does it directly support core scope.</li> </ul>	Q. Can the work be executed after Refurbishment is complete without impacting ongoing plant operations?	<ul style="list-style-type: none"> <li>Salt Shed</li> <li>Heavy Vehicle Storage Building</li> <li>Boiler House</li> <li>Lakeshore Garage</li> <li>Gas Bottle Storage</li> </ul>
			Q. What is the economic benefit to refurbishment or to the continued operation of DNGS for an additional 30 years?	
			Q. What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			Q. Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>SU02</b>	Station Upgrades	<ul style="list-style-type: none"> <li>Non-infrastructure station upgrades required to sustain an additional 30 years of operations.</li> <li>Is not part of, nor does it directly support core scope.</li> </ul>	Q. Can the work be executed after Refurbishment is complete without impacting ongoing plant operations?	<ul style="list-style-type: none"> <li>New or improvements to permanent stairway, lifting device, floor grating, access hatches.</li> <li>Logistics improvements to loading bays, cafeteria, walkways</li> </ul>
			Q. What is the economic benefit to refurbishment or to the continued operation of DNGS for an additional 30 years?	
			Q. What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			Q. Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>SU03</b>	Equipment Renewal	<ul style="list-style-type: none"> <li>One time replacement at current end of component life</li> </ul>	Q. Would the refurbishment core scope still be possible to execute without this scope / infrastructure?	<ul style="list-style-type: none"> <li>Steam Turbines and Turbine Auxiliaries: Main Lube Oil Pump</li> </ul>

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Category	Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
	(Nominal 30 years). <ul style="list-style-type: none"> <li>Replacement of obsolete components</li> <li>Inspections to determine equipment condition not part of normal PM program.</li> </ul>	<p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</p> <p><b>Q.</b> Are the parts:</p> <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	<ul style="list-style-type: none"> <li>Main Condensate System: LP Heaters</li> <li>Fuel Handling Inverters Replacement</li> <li>Turbine Control Upgrade</li> </ul>

### B.2.2 Value Enhancing (VE) - Non - Core Scope

Value Enhancing Scope is not mandatory to execute the Refurbishment Outage. There may be significant advantages to the station or to OPG by executing some value enhancing scope. It will primarily have an impact on the post-refurbishment time period. Value Enhancing scope would optimize (primarily) the cost efficiencies post-refurbishment and may help the Station meet efficiency targets (these are not Refurbishment targets). Value Enhancing scope could also provide cost or resource efficiencies during Refurbishment, but are not absolutely essential in completing the work. All Non-core Scope requires economic justification (i.e. DRAS).

Category	Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>VE01</b>	Operations, Outage, Cost, Resource & Maintenance Efficiencies	<ul style="list-style-type: none"> <li>Scope can be proven to add value to the station operations in future by improving maintenance methods, saving costs on outages, optimizing resources or improving operations.</li> </ul>	<ul style="list-style-type: none"> <li>Outage Heat Sink modification expected to reduce outage durations post-refurbishment.</li> <li>Modification to enable a valve to be replaced with a new design instead of repairing a valve.</li> <li>Modification to allow specified maintenance to be completed at-power rather than during an outage condition.</li> <li>Technically required work which is known to extend outage duration or incur greater dose in regular outages and makes an economic case to include in the Refurbishment Program.</li> </ul>
		<p><b>Q.</b> Has a clear explanation been provided as to why the expected impacts/ savings (e.g. OM&amp;A costs, planned outage time, forced loss rate, operator work around, dose reduction, etc) are defensible and attributable to this specific scope of work?</p>	
		<p><b>Q.</b> Has a review been done to ensure that the expected savings/impacts of this scope of work have not already been included in other proposed work scope?</p>	
		<p><b>Q.</b> Have all major stakeholders (and potentially an independent 3rd party) validated the expected savings/ impacts?</p>	
		<p><b>Q.</b> Have all potential post-project implementation costs been included?</p>	
		<p><b>Q.</b> Have required infrastructure and support work costs been included?</p>	
		<p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do</p>	

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
			in Refurb rather than later?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>VE02</b>	Safety Improvements beyond Standards	<ul style="list-style-type: none"> <li>Station or Refurbishment suggested improvements that are not required as per current codes and standards.</li> </ul>	<b>Q.</b> Has the improvement been requested by a group in the Station or an external stakeholder?	<ul style="list-style-type: none"> <li>Installation of a new railing, signage, overhead door or ergonomic enhancement is currently not in place and is in compliance with safety standards and not in violation of any OPG standards.</li> </ul>
			<b>Q.</b> Is there a time constraint for this improvement? If so, what is it? What are the reasons for the constraint?	
			<b>Q.</b> Why should this improvement be considered for execution during refurbishment? Can it be done before Refurbishment?	
			<b>Q.</b> What are the benefits to executing this during the refurbishment outage?	
			<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>VE03</b>	Environmental Improvements beyond Standards	<ul style="list-style-type: none"> <li>Station or Refurbishment suggested improvements that are not required as per current codes and standards.</li> </ul>	<b>Q.</b> Has the improvement been requested by a group in the Station or an external environmental stakeholder?	<ul style="list-style-type: none"> <li>Installation of a new oil dyke around equipment that was not previously in place and is currently in compliance with environmental laws and not in violation of any OPG standards.</li> </ul>
			<b>Q.</b> Is there a time constraint for this improvement? If so, what is it? What are the reasons for the constraint?	
			<b>Q.</b> Why should this improvement be considered for execution during refurbishment? Can it be done before Refurbishment?	
			<b>Q.</b> What are the benefits to executing this during the refurbishment outage?	

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Category	Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>VE04</b>	Infrastructure upgrades that are expected to increase efficiencies for the <u>Refurbish</u> Outage period only, but do not directly support Core Scope.	<ul style="list-style-type: none"> <li>Q. What are the economic benefits to executing the work during the refurbishment outage? What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</li> <li>Q. How can the station benefit from this work post-refurbishment?</li> <li>Q. Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Increased security monitors or security equipment to make entrance to the station more efficient</li> <li>Moving existing facilities closer to the work face to decrease travel time for trades or management staff</li> </ul>
<b>VE05</b>	Enhance Corporate Reputation	<ul style="list-style-type: none"> <li>Q. Is the scope directly related to Refurbishment? (Is this something where funding would normally be obtained through another business unit as part of that unit's core business?)</li> <li>Q. How will the scope improve OPG's corporate reputation?</li> <li>Q. Why should this scope be part of the Refurbishment program (and not part of Darlington Nuclear's ongoing operations?)</li> <li>Q. What external groups does this impact (i.e. is there a group that is specifically interested in this initiative?).</li> <li>Q. Is there a strategy in place to communicate this improvement, should it be added to scope?</li> </ul>	<ul style="list-style-type: none"> <li>Modification to improve environmental emissions</li> <li>Modification to reduce sound emissions from the station</li> <li>Public Affairs communications (billboards, additional temporary communication stations in the community).</li> </ul>

### B.2.3 Performance Improvement (PF) - Non - Core Scope

Performance Improvement Scope is non-core scope that supports the reduction of Unit backlog work orders or supports System Health targets beyond the condition at unit turnover to the Refurbishment Program management team. All Non-core Scope requires economic justification (i.e. DRAS).

Category	Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>PF01</b>	Reduce Unit Backlog (non-core, most likely CM or	Q. Does this work exceed the condition in which Refurbishment received the unit from Operations?	Valve that has been in disrepair for many years (through many outages). Parts have

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### DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL

Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
	EM work orders)	<ul style="list-style-type: none"><li>Work may be required for unit start-up (i.e. you need the CM or EM equipment fixed to perform start-up of the unit). This may be mandatory to execute for unit condition, but is still not core scope.</li></ul>	<div><div>Q. Does this work contribute to the backlog reduction for the unit?</div><div>Q. Has the unit been started before (after a previous outage) with this condition present? Were there significant conventional safety, nuclear safety, maintenance or operations issues?</div><div>Q. What is the impact on the refurbishment outage schedule?</div><div>Q. What is the impact on the outage cost? What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</div><div>Q. Are the parts:<ul style="list-style-type: none"><li>Available (for purchase or spares on hand)?</li><li>Obsolete?</li><li>Long lead items?</li></ul></div></div>	<div>not been available and this has not been a high priority and does not significantly impact the operation of the system.</div> <ul style="list-style-type: none"><li>Switch that breaks upon commissioning of a system that previously had no work performed on it during the refurbishment outage, but must be repaired or replaced in order to start up the unit/system.</li></ul>
PF02	Operator Work-Around (non-core)	<ul style="list-style-type: none"><li>Non-core work that will remove a requirement for an Operator Work Around. Work <u>may</u> be mandatory for start-up, but is still not core scope.</li></ul>	<div><div>Q. Can this work be executed pre-Refurbishment?</div><div>Q. What is the impact to Operations and the unit if the work is not completed in Refurbishment?</div></div>	<ul style="list-style-type: none"><li>PNGS B example: moderator spool piece for refill was removed years ago during moderator commissioning and not reinstalled. Ops cannot use refill header from S&amp;I tanks to refill moderator, uses a hose under a jumper. Increases refill duration. Mod could be done while unit is operating.</li></ul>
PF03	Design Modifications (non-core) required to maintain operation of an existing non-life limiting component (likely a CM or EM backlog work order	<ul style="list-style-type: none"><li>Proposed modification may be required to continue operations of a system or component, but is not core scope and does not contribute in the greater '30 year' life span of the equipment or system.</li><li>May be required for Unit start-up if it is</li></ul>	<div><div>Q. Is this a requirement for unit start-up?</div><div>Q. If the request is before the scope freeze date; can the work be completed pre-Refurbishment?</div><div>Q. The work does not support core scope and was not identified by Aging Management or Life Cycle Plans as a requirement for an additional 30 years of</div></div>	<ul style="list-style-type: none"><li>Modification to install a balancing weight on a fan due to unacceptable vibrations at system start-up/commissioning – it is minimal work to fix a balance issue, but is not a 30 year fix. May actually be required for start-up, but is not related to core scope</li></ul>

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
	origin).	emergent.	operation. Provide justification for this modification and the near-term benefits to the station.  <b>Q.</b> Is there a better alternative that will contribute to a longer life-span of the equipment?  <b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?  <b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	and does not guarantee that equipment or mod will last for the life of the station.
<b>PF04</b>	Reliability Improvement	<ul style="list-style-type: none"> <li>Proposed scope has high likelihood of improving unit reliability and contributes to reducing unit forced loss rate and optimizing unit capacity factor.</li> <li>Has caused an Equipment Reliability Reset (see criteria below): <ol style="list-style-type: none"> <li>Causes of Reactor Trip, Stepback or Setback</li> <li>Causes a Turbine or Generator Trip</li> <li>Results in a Unit Transient &gt; 5%</li> <li>Results in &gt; 250 Mwhr Forced Loss</li> <li>Categorized as a Reactivity Management Event (Categories 1&amp;2 per N-STD-OP-0009)</li> <li>Results in a Unit/Station entering = 24 Hr Shutdown Clock per AIM</li> <li>Categorized as an Event Reset</li> </ol> </li> </ul>	<b>Q.</b> Can this scope be performed online or in an outage prior to or post-refurbishment?          <b>Q.</b> What is the priority on this improvement for the station? Is it likely to contribute to another ER reset or has an investigation shown otherwise?  <b>Q.</b> Has this reliability issue occurred more than once at Darlington or other stations? What is the probability of reoccurrence?  <b>Q.</b> Does the cost of the proposed scope outweigh the cost of MW loss of generation? Has an economic assessment been completed?  <b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	<ul style="list-style-type: none"> <li>Unit 5 East F/M stuck on channel E-06. East B-ram will not retract to allow for separation of the second pair. 48 hour shutdown clock initiated June 2, 2009 @ 21:06. WR #00685020.</li> <li>5-71210-P2 tripped. Field investigation reported that the power supply 5-53200-CB7D tripped on a ground fault resulting in &gt;6MW loss in output.</li> </ul>

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
		(where an equipment failed that did not meet any of the above criteria but deemed as very significant)	<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>• Available (for purchase or spares on hand)?</li> <li>• Obsolete?</li> <li>• Long lead items?</li> </ul>	

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General Questions for all Scope Requests (in any category)	
<b>Stakeholders/ Integration/ Objectives</b>	<ul style="list-style-type: none"> <li>Has an assessment been done of other upcoming scope/projects to determine whether there are opportunities for integration of work to realize cost/schedule savings?</li> </ul>
	<ul style="list-style-type: none"> <li>Is this scope or proposed project dependent on other planned scope/ projects being included in refurbishment scope? If so, specify.</li> </ul>
	<ul style="list-style-type: none"> <li>Have all key stakeholders (e.g. DN Refurbishment, DN Operations, Nuclear Engineering, and Regulatory Affairs) provided input and have their issues been dispositioned?</li> </ul>
	<ul style="list-style-type: none"> <li>How does this scope or proposed project address one or more of the Refurbishment Program Objectives? Specify.</li> </ul>
<b>Alternatives</b>	<ul style="list-style-type: none"> <li>Has the alternative of doing the work during the pre- refurbishment period been considered/assessed? Provide clear rationale why not feasible; i.e. discuss drawbacks, major risks.</li> </ul>
	<ul style="list-style-type: none"> <li>Has the alternative of doing the work during the post- refurbishment period been considered/assessed? Provide clear rationale why not feasible, i.e. discuss drawbacks, major risks.</li> </ul>
	<ul style="list-style-type: none"> <li>Is the technical justification for completing the work during the refurbishment outage robust?</li> </ul>
	<ul style="list-style-type: none"> <li>Have all feasible alternatives (or alternative approaches) of executing the work during the refurbishment outage been developed?</li> </ul>
	<ul style="list-style-type: none"> <li>Has the impact on refurbishment outage schedule and cost of the preferred alternative been assessed?</li> </ul>
<b>Scope/ Project Cost Estimate</b>	<ul style="list-style-type: none"> <li>Has a scope and cost estimate been developed for all feasible alternatives?</li> </ul>
	<ul style="list-style-type: none"> <li>Is the basis for the estimate of scope/ project costs clearly stated?</li> </ul>
	<ul style="list-style-type: none"> <li>Have cost estimate ranges been provided for scope/ project costs to indicate the accuracy of the estimate?</li> </ul>
	<ul style="list-style-type: none"> <li>Does the estimate include contingency and provide the basis for the contingency?</li> </ul>
<b>Economic Analysis of Feasible Alternatives/ Risk Assessment of Preferred Alternative</b>	<ul style="list-style-type: none"> <li>Have major risks and mitigating actions been identified? (Risks areas include finance, schedule, quality, corporate reputation, regulatory, health &amp; safety, environment &amp; nuclear safety).</li> </ul>
	<ul style="list-style-type: none"> <li>Have potential incremental schedule /cost impacts been assessed if these risks materialize?</li> </ul>
	<ul style="list-style-type: none"> <li>Has specific contingency been included in the schedule/cost estimates to address these potential risks?</li> </ul>
	<ul style="list-style-type: none"> <li>Has the alternative of doing the work during the pre-refurbishment period been considered / assessed?</li> </ul>
	Does the NPV analysis include a table showing a breakout of the contributions to NPV of each of the expected savings/impacts?

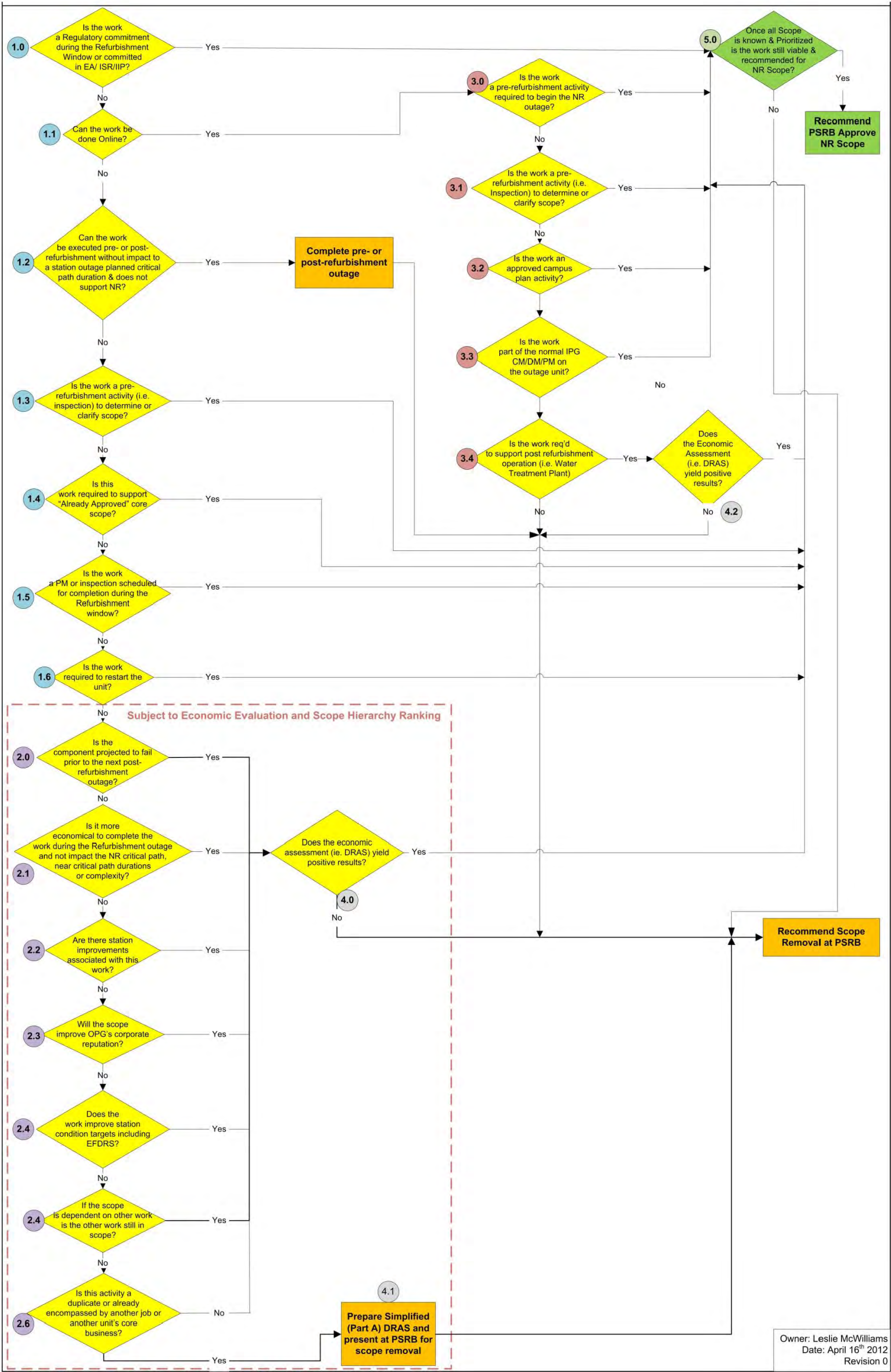


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Appendix C: Nuclear Refurbishment Scope Decision Matrix





**Scope Management for the Darlington Refurbishment Program**

```

graph TD
    PO[Program Objectives  
Ref. Project Charter  
D-PCH-09701-10102] --> CS[1.0 CS - Core Scope]
    PO --> SU[2.0 SU - Sustaining - Non-Core Scope]
    CS --> A[Accepted]
    SU --> VE[3.0 VE - Value Enhancing - Non-Core Scope]
    SU --> PF[4.0 PF - Performance Improvement - Non-Core Scope]
    VE --> CA1[Conditional Acceptance  
Assuming Economic Benefit (i.e. DRAS)  
and Doability]
    PF --> CA2[Conditional Acceptance  
Assuming Economic Benefit (i.e. DRAS)  
and Doability]
  
```

**Program Objectives**

**Ref. Project Charter**  
D-PCH-09701-10102

**Principle Program Objectives**

- Confirm feasibility of refurbishing Darlington NGS reactors
- Plan and execute all work required to refurbish the Darlington units
- Ensure the scope of the refurbishment outages will enable economic Top Decile operations of each unit for an additional 30 years, following post-refurbishment synchronization

**1.0 CS - Core Scope**

Core Scope directly supports the Program Objectives to ensure the success of Refurbishment.

**CS01 – Regulatory Improvements to meet current Standards**

- 1.01 Scope that is not optional in order to support the Station License and Regulatory Requirements.
- 1.02 Nuclear Refurbishment CNSC Commitments.
- 1.03 ISR / EA, IIP Regulatory Commitments.

**CS02 – Life Limiting Components**

- 1.04 Major component modification, repair or replacement that cannot survive operation for an additional 30 years
- 1.05 They could only be repaired or replaced under refurbishment outage plant condition (i.e. De-fuelled/dewatered)

**CS03 – Mandatory Support for Core Scope**

- 1.06 Must do in order to support execution of Core Scope.

**CS04 – Mandatory 'Construction Period' Outage Work**

- 1.07 Preventative Maintenance Work that would normally be executed during the time period during the Refurbishment Outage.
- 1.08 Mandatory Inspections that would normally be executed during the time period during the Refurbishment Outage.

**CS05 – Regulatory Improvements beyond current Standards**

- 1.09 Regulatory suggested improvements that are not required as per current codes and standards.

**2.0 SU - Sustaining – Non-Core Scope**

Sustaining Scope is not mandatory to execute the Refurbishment Outage and achieve the Program Objectives. It may provide long term benefits to the Darlington Site and stations outside the primary Program Objectives.

**SU01 – Sustaining Infrastructure**

- 2.01 Infrastructure upgrades required to sustain an additional 30 years of operations.
- 2.02 Work is listed as part of the Darlington Master Campus Plan and the Darlington Program Campus Plan Scope Statement. Is not part of, nor does it directly support core scope.

**SU02 – Station Upgrades**

- 2.03 Non-infrastructure station upgrades required to sustain an additional 30 years of operations. Is not part of, nor does it directly support core scope.

**SU03 – Equipment Renewal**

- 2.04 One time replacement at current end of component life (Nominal 30 years).
- 2.05 Replacement of obsolete components (criticality 1 + criticality 2).
- 2.06 Inspections to determine equipment condition not part of normal PM program.

**3.0 VE - Value Enhancing – Non-Core Scope**

Value Enhancing Scope is not mandatory to execute the Refurbishment Outage. There may be significant advantages to the station or to OPG by executing some value enhancing scope. It will primarily have an impact on the post-refurbishment time period. Value Enhancing scope would optimize (primarily) the cost efficiencies post-refurbishment and may help the Station meet efficiency targets (these are not Refurbishment targets). Value Enhancing scope could also provide cost or resource efficiencies during Refurbishment, but are not absolutely essential in completing the work.

**VE01 – Operations, Outage, Cost, Resource & Maintenance Efficiencies**

- 3.01 Scope can be proven to add value to the station operations in future by improving maintenance methods, saving costs on outages, optimizing resources or improving operations.
- 3.02 Replacement of components which due to scale of work makes economic sense.

**VE02 – Safety Improvements beyond Standards**

- 3.03 Station or Refurbishment suggested improvements that are not required as per current codes and standards.

**VE03 – Environmental Improvements beyond Standards**

- 3.04 Station or Refurbishment suggested improvements that are not required as per current codes and standards.

**VE04 – Infrastructure upgrades that are expected to increase efficiencies for the Refurbish Outage period only, but do not directly support Core Scope.**

- 3.05 Scope that can improve efficiencies during the refurbishment such as improved resource effectiveness, reduction of delays, improved site transportation/logistics.

**VE05 – Enhance Corporate Reputation**

- 3.06 Proposed scope that will/may enhance OPG's or Darlington Refurbishment Program's corporate reputation with Clarington, Ontario or other groups.

**4.0 PF - Performance Improvement – Non-Core Scope**

Performance Improvement Scope is non-core scope that supports the reduction of Unit backlog work orders or supports System Health targets beyond the condition at unit turnover to the Refurbishment Program management team.

**PF01 – Reduce Unit Backlog (non-core, most likely CM or EM work orders)**

- 4.01 Non-core work that will help reduce backlogs on Darlington Units.
- 4.02 Work may be required for unit start-up (i.e. you need the CM or EM equipment fixed to perform start-up of the unit). This may be mandatory to execute for unit condition, but is still not core scope.

**PF02 – Operator Work-Around (non-core)**

- 4.03 Non-core work that will remove a requirement for an Operator Work Around. Work may be mandatory for start-up, but is still not core scope.

**PF03 – Design Modifications (non-core) required to maintain operation of an existing non-life limiting component (likely a CM or EM backlog work order origin)**

- 4.04 Proposed modification may be required to continue operations of a system or component, but is not core scope and does not contribute in the greater '30 year' life span of the equipment or system.
- 4.05 May be required for Unit start-up if it is emergent.

**PF04 – Reliability Improvement**

- 4.06 Proposed scope has high likelihood of improving unit reliability and contributes to reducing unit forced loss rate and optimizing unit capacity factor.
- 4.07 Has caused an Equipment Reliability Reset.
- 4.08 Allows station to achieve Top Decile performance.
- 4.09 Supports outage improvements.

**Accepted**

**Conditional Acceptance**  
Assuming Economic Benefit (i.e. DRAS) and Doability

**Conditional Acceptance**  
Assuming Economic Benefit (i.e. DRAS) and Doability



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## Appendix E: Core Scope of the Darlington Refurbishment Program

### Refer to NK38-PLAN-01060-10003, Darlington NGS Refurbishment Project Reference Plan – Scope Definition

Core Scope of the Refurbishment Program will support the primary objectives of the Program. Core Scope is included in the Business Case Summary for the Program.

The following is a **brief** summary of the current documented major components of Core Scope.

- Replacement of all Fuel Channels (calandria tubes and pressure tubes)
- Replacement of all Feeders
- Balance of Plant life limiting components only where justified to support Program Objectives and support an economic business case
- Regulatory work required to be performed in order to extend the life of the station by an additional thirty years, as indicated in the CNSC approved Integrated Safety Report (ISR), Environmental Assessment (EA), and Integrated Implementation Plan (IIP).
- Work related to outage preparation, including development of tooling, mock-ups, training, unit islanding, installation of barriers, modifications, etc. to support the outage, and all planning activities related to items included in the scope of the Darlington Refurbishment Program.
- Infrastructure development to directly support the refurbishment outage
- Work Management work committed to be performed on the unit within the start and end date of that unit refurbishment outage.

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**Appendix F: Darlington Refurbishment Program – Funding Matrix for Program Level Scope**

The following is a funding guide for all scope related to the Darlington Refurbishment Project.

Funding Program \ Program Phase	Pre-Refurbishment Period	Refurbishment Period	Post-Refurbishment Period
	Schedule Accountability <sup>(1)</sup> – NGS Operations (Non-Outage, Outside Protected Area and Outage Work Control)	Schedule Accountability <sup>(1)</sup> – NR Program Management Office (PMO)	Schedule Accountability <sup>(1)</sup> – NGS Operations (On-line and Outage Work Control)
Darlington Operations (Business Plan)  <i>Operate and Maintain the plant pre- and post- refurbishment</i>	<ul style="list-style-type: none"> <li>Maintain the plant until Refurbishment:               <ul style="list-style-type: none"> <li>All Cyclic Outage work and inspection programs associated with normal operations and maintenance.</li> <li>Life-cycle management work including items identified in CCAs.</li> <li>Pre-refurbishment outages</li> <li>Minor Mods Program</li> </ul> </li> <li>Execution of station strategies to meet DN Station Vision</li> </ul>	<ul style="list-style-type: none"> <li>No budget for online and outage work programs for unit(s) during the refurbishment period.</li> </ul>	<ul style="list-style-type: none"> <li>Maintain the plant post Refurbishment:               <ul style="list-style-type: none"> <li>All Cyclic Outage work and inspection programs associated with normal operations and maintenance.</li> <li>Life-cycle management work including items identified in CCAs.</li> <li>Post-refurbishment outages</li> <li>Minor Mods Program</li> </ul> </li> <li>Execution of station strategies to meet DN Station Vision</li> </ul>
Darlington Refurbishment Program  <i>Prepare for and execute the refurbishment outage on time, on budget, and with 100% scope completed; as identified in Release Quality Estimate.</i>	<ul style="list-style-type: none"> <li>Any Core <sup>(2)</sup>, Scope approved by SRB where NR has requested delivery of scope prior to the refurbishment outage<sup>(3)</sup>, and / or where station work management agree to perform scope in pre-refurbishment period (outage or online).</li> <li>Non Core <sup>(2)</sup> scope, as approved by SRB, and where required to be done prior to the refurbishment outage; including</li> </ul>	All execution activities, including: <ul style="list-style-type: none"> <li>All Core <sup>(2)</sup> scope approved by the SRB, as generated by CCA, ISR, and EA process.</li> <li>All Non Core <sup>(2)</sup> scope approved by the SRB, where executed during the refurbishment outage period, and not funded by AISC.</li> <li>All staff engaged in the refurbishment program, whether directly assigned or other-business-unit support; including</li> </ul>	<ul style="list-style-type: none"> <li>Refurbishment funded scope, Core <sup>(2)</sup> or Non Core <sup>(2)</sup>, approved by the SRB, which is deferred to a post-refurbishment period <sup>(4)</sup>.</li> </ul>

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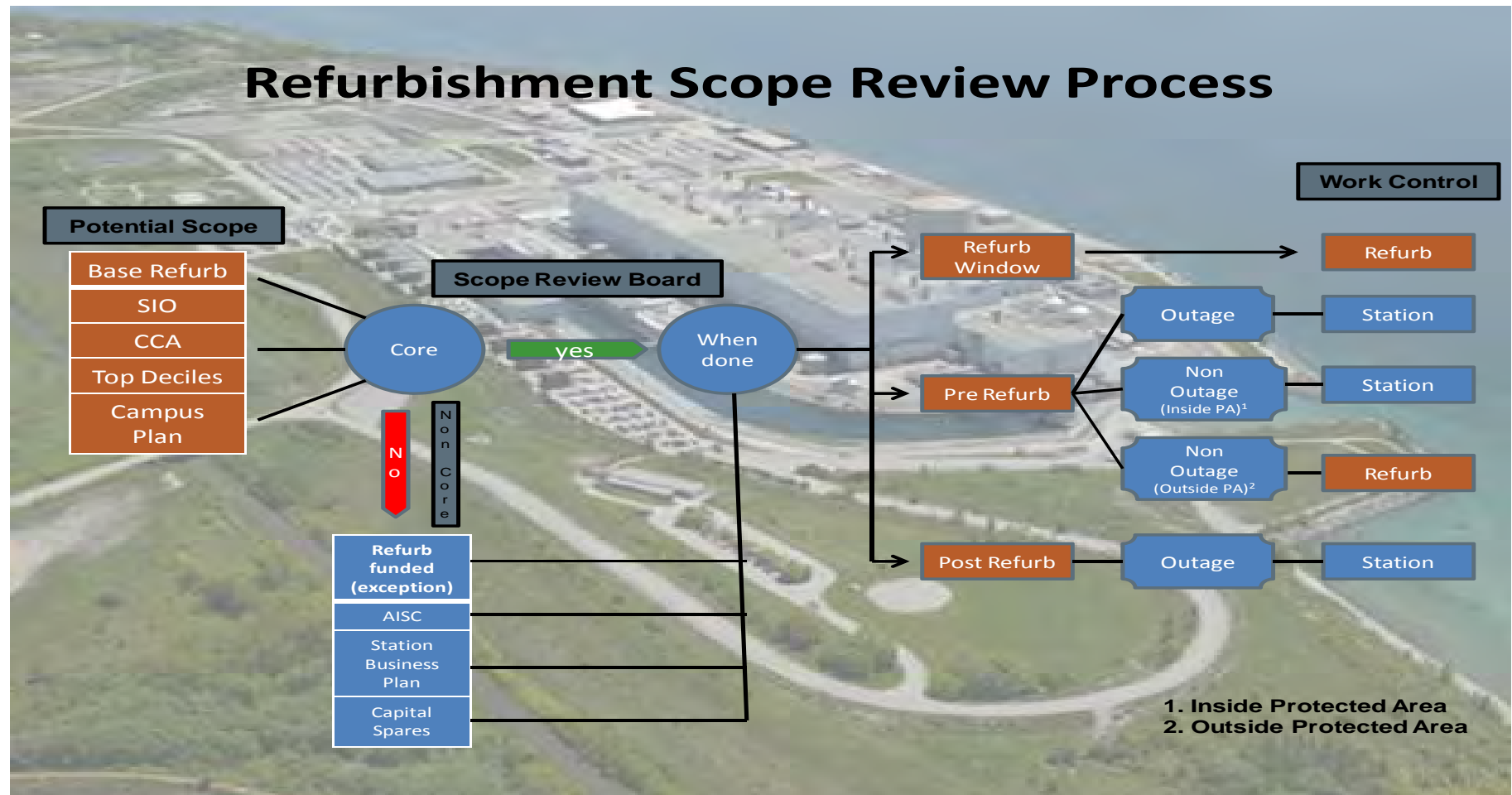
Funding Program	Program Phase	Pre-Refurbishment Period	Refurbishment Period	Post-Refurbishment Period
		Schedule Accountability <sup>(1)</sup> – NGS Operations (Non-Outage, Outside Protected Area and Outage Work Control)	Schedule Accountability <sup>(1)</sup> – NR Program Management Office (PMO)	Schedule Accountability <sup>(1)</sup> – NGS Operations (On-line and Outage Work Control)
		facility and infrastructure modifications, or islanding modifications in support of the refurbishment outage. <ul style="list-style-type: none"> <li>Incremental inspection programs, beyond normal life-cycle management inspection programs, required to define scope of work for the refurbishment outage.</li> <li>All staff engaged in the refurbishment program, whether directly assigned or other-business-unit support; including staff supporting planning, scoping, engineering, etc.</li> </ul>	staff supporting project oversight and/or execution activities. <ul style="list-style-type: none"> <li>All regular online and outage work programs optimized during the refurbishment period including mandatory PM's and Inspections.</li> <li>All commissioning and unit clean-up costs to turn-over the station to Operations.</li> </ul>	
Project Portfolio	Support the station in the development of regulatory or value enhancing modifications	<ul style="list-style-type: none"> <li>Approved projects per AISC</li> </ul>	<ul style="list-style-type: none"> <li>Approved projects per AISC where project is to be performed during refurbishment outage, and where Darlington Refurbishment Program Management Office approves work to be performed during refurbishment window.</li> </ul>	<ul style="list-style-type: none"> <li>Approved projects per AISC</li> </ul>
Capital Spares		<ul style="list-style-type: none"> <li>As identified by station to support 30 year end of life for major components</li> </ul>		

**Note:** Activities performed in station outages pre-refurbishment, and post-refurbishment, will be controlled by Darlington NGS (Operations) work control. Activities performed during Refurbishment, including station and project activities, will be co-ordinated through the Darlington Refurbishment Program Management Office to confirm do-ability and scheduling window.

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## Appendix G: Refurbishment Scope Review Process



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**Appendix H: Nuclear Refurbishment Scope Hierarchy**

CODE	SCOPE TYPE	ISR	RISK	PREREQ	NPV
AA1	CS01	Y		Y	
AA2	CS01			Y	
AA3	CS02			Y	
AA4	CS02		>=H15		
AA5	CS02		<H15		
AA6	VE02	Y		Y	>\$1M
AA7	CS05			Y	
AA8	CS01	Y	>=H15		
AA9	CS01	Y	<H15		
AA10	VE02	Y			>\$1M
AA11	CS05				
AA12	CS04		>=H15		
AA13	CS04		<H15		
AA14	CS03		>=H15		
AA15	CS03		<H15		
BA1	SU			Y	>\$1M or N/A
BA2	SU		>=H15		>\$1M
BA3	SU		<H15		>\$5M
BA4	VE/PF				>\$100M
CA1	VE/PF				>\$10M<\$100M
CA2	VE/PF				>\$5M<\$10M
CA3	VE/PF				>\$1000k<\$5000K
CA4	VE/PF				>\$500k<\$1000K
CA5	VE/PF				<\$500K

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---

**Appendix I: Scope Decision Matrix Summary Table**

#DSR's Owned:	<b>Appendix J: Scope Decision Matrix Summary Table</b>			Date :	
#DSR's Presented:	<i>Note: To be used in conjunction with Appendix C</i>			Project Manager:	
Item #	DSR Line Item	IN/OUT	Removal Point (i.e. 2.1,etc)	Comments / Recommendation	DRAS#
1					
2					
3					
4					
5					
6					
7					
8					
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13					
14					
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**DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL**

## Appendix J: DSR types (DSR number pre-fixes)

DSR Database

Select a DSR type

- ☒ Campus Plan (DR03)
- ☐ Refurb Technical (DR02)
- ☐ Regulatory (DR04)
- ☐ Strategic Initiative (DR05)
- ☐ Other
- ☐ Unit Work Management

Enter a descriptive Title (Cannot be changed after DSR created)

Back Next

(Prompt window from the DSR database)

DSR Type	Prefix		Description
Campus Plan (DR03)	CP	Campus Plan	Facilities & Infrastructure upgrades to (inside and outside) the plant to support a successful refurbishment
Regulatory (DR04)	IP	Improvement Plan	Station or Safety or improvements beyond standard that provide benefits to the station in terms of increased reliability and/or lower operating costs.
Other	MS	Maintenance Scope	Related to or generated by Maintenance. Includes assessment of station services and equipment.
Strategic Initiative (DR05)	SI	Strategic Initiative	It is not required but good to have (long term benefit).
Refurb Technical (DR02)	TS	Technical Scope	Engineering Design Support: Create; modify technical specifications and Standards within NR scope. Design within the EPC framework items assigned to the NR Design Department.
Unit work management	WM	Work Management (DR06)	Work schedule and windows management.

Instruction

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Appendix K: MEMO: Value-Enhancing Investment at DNGS during Refurbishment



700 University Avenue, H7G5, Toronto, ON M5G 1X6

MEMORANDUM

April 12, 2013

MR. D. REINER  
Senior Vice President  
Nuclear Refurbishment

Value-Enhancing Investment at DNGS during Refurbishment

The Refurbishment of Darlington represents a significant milestone in the evolution of OPG. During the life of this project, we will see the cessation of coal (2014) and the potential end of operations at both Pickering A and Pickering B (2020). Both of these major events will lead to a significant shrinking of OPG's operations. At this time, there is no guarantee of New Nuclear becoming a reality, or a repowering of the Thermal sites. This downsizing of operations, and the need to be cost competitive going forward puts significant pressure on our ability to raise capital and to sustain operations over the long-term.

To minimize our capital requirements during the refurbishment outage and to make quality investments in the plant that support high quality, profitable operations going forward, I am proposing that the Refurbishment Project adopt more stringent criteria for assessment of sustaining, value-enhancing and performance improvement work that is to be included in the refurbishment outages. The criteria will apply to all scope that is not considered core scope as defined by the Scope Review Board governance.

The adoption of more stringent criteria on sustaining, value-enhancing and performance improvement initiatives during the refurbishment outage, would help to constrain scope to only those high value scope items that show a significant contribution to the bottom line. These more stringent criteria would include a hurdle rate of 9.5% (WACC) valued on the forecast System Economic Values and a simple payback period of six years, or 2 outage cycles.

A handwritten signature in dark ink, appearing to read "Donn Hanbidge".

Donn Hanbidge

c: W. Robbins  
D. Power  
R. Heard



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**NUCLEAR REFURBISHMENT – MILESTONE DEFINITION FRAMEWORK**

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**Nuclear Refurbishment – Milestone  
Definition Framework**

**N-MAN-00120-10001-SCH-06-R001**

2015-12-18

Order Number: N/A


Other Reference Number:

**Internal Use Only**

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**Revision Summary**

Revision Number	Date	Comments
R000	2012-08-02	Initial issue. Previous document number N-GUID-09701-10009.
R001	2013-04-23	Revise Doc to include the AIP Scorecard & Elevated Tier 3 milestone instructions
R002	2013-11-27	Revised to update section 4.0.- Approval Process ; Part B – Milestone Completion – Final Signature and Milestone Recovery Plan form – Final Signatures
R003	2015-12-18	Revised to incorporate the Approval Process for the Readiness to Execute Plan (RTE) Milestones – Tier 4, 5. Update Recovery / Mitigation plan Process and Form (D-FORM-10763)

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### 1.0 DIRECTION

#### 1.1 Objective

The objective of this Guide is to outline the purpose and provide instructions on the management of Milestone definitions for Nuclear Refurbishment, within the Darlington (DN) Refurbishment Program.

The success of the Refurbishment program is highly dependent on timely completion of deliverables and achievement of milestones.

All phases will be controlled by Program Milestones (Tier 1,2,3). Adherence to milestone timelines and definitions is essential to ensure a successful Refurbishment. Each project will also have Milestones (Tier 4 and 5)

#### 1.2 Purpose

This Guide will standardize the framework for developing Darlington Refurbishment Milestone definitions.

The purpose of this Guide is to provide Darlington Nuclear Refurbishment staff and support organizations with knowledge of:

- Milestone Tier Structure
- Milestone Numbering Nomenclature
- Common Milestone Definition Template
- Milestone Completion Progress Monitoring
- Quality Requirements for Milestone Deliverables
- Milestone Closeout and Document Retention Requirements

#### 1.3 Intended Audience

The Darlington Refurbishment Program as documented in the DN Refurbishment Program Integrated Master Schedule NK38-PLAN-00300-10000, including all projects within the program.

All Milestones will be identified with a Milestone Tier Structure in accordance with Section 3.1 below.

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## 2.0 MILESTONE DEFINITION REQUIREMENTS

### 2.1 Tier 1, 2 & 3 Requirements

Individual Milestone Definitions in accordance with the requirements of this manual are required for all Milestones identified as Tier 1, Tier 2, and Tier 3.

Tier 1, 2 & 3 are at the NR Program Level and represents Key Program Control Milestones

Each project/ functional schedule, as a minimum, shall have the following program reportable (elevated Tier 3) milestones

- i. Detailed design complete
- ii. Scope Health progress to 20
- iii. Request for proposal
- iv. Contract (s) award
- v. Long Lead Material Identified
- vi. Start of Installation
- vii. Commissioning Start
- viii. Available for Service
- ix. Any project or functional specific milestone that has important consequences for the Program i.e. EDM for Refueling

### 2.2 Tier 4 & 5 Requirements

Tier 4 and Tier 5 Milestones are at a Project/ Functional Bundle level and requirements will be identified at the project level following the Task Instruction: DNG Refurb—Standard Projects Milestone List, N-MAN-00120-10001-SCH-02. A sample of Standard Milestones Listing completed with associated Milestone Tier coding Structure is shown in Appendix “B”

### 2.3 NR AIP Milestones Requirements

NR AIP Milestone is referring to Nuclear Refurbishment Program AIP level milestones.

A Milestone Definition Template (D-FORM-10762) is required for each identified NR AIP Milestone.

NR AIP Milestones should be identified at least as Tier 3 reportable milestones.

### 2.4 NR AIP Scorecard Definition Requirements

The Milestone Definition Template (D-FORM-10762) is required for each NR AIP Scorecard definition as outlined in the NR AIP Scorecard list. Included on the template will be the requirements for the NR AIP scorecard completion signoff.



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### 2.5 Milestone Schedules Structure

The Project/ Functional Bundles Milestones Schedules structure (including milestone P6 coding process) will be followed as described in the “DR Program P6 Schedulers User Guide” N-MAN-00120-10002-SCH-08

### 2.6 Readiness to Execute Plan Milestones (RTE)

Readiness to Execute Plan is in support of tracking all processes, tools, and deliverables to ensure readiness for execution phase.

The RTE plan consists of a series of significant milestones leading up to the start of the DNRU2 Outage. These milestones are mainly Tier 4 and Tier 5 with some being Tier 1, 2 or 3. Due to their importance, RTE T4 & 5 milestones will be controlled with slightly more rigor than other T4 & 5 milestones.

RTE Tier 1, 2, 3 milestones follow the same processes as other Tier 1, 2, 3 milestones.

The completion and approval process diagram (4.1.5 – RTE Process Diagram) should be followed for Tier 4 and Tier 5 only.

## 3.0 PROCESS

### 3.1 Milestone Tier Structure

There will be Milestones at the Program level and Gates/Projects Milestones (per Gated Process N-MAN-00120-10001-GRB & N-MAN-00120-10001-SCH-02) at the Project level.

The relationship between Program Milestones and the Gated Process is shown in Appendix A.

Milestone Reporting Tier Structure is required to identify Key Program Control Milestones and to easily identify the level in the Organization that the Milestone is reportable to and the Approval Level required for any deviation to the Milestone

#### (1) Program Tier 1 - Commitments to the Board

- Reportable to: EVP Nuclear Refurbishment
- Definition: Milestones that are commitments to the Board or decisions at Board Level.
- Example: RQE Release Quality Estimate, and Unit Start/Finish dates

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- (2) **Program Tier 2 – Critical Impact**
  - Reportable to: SVP Nuclear Refurbishment
  - Definition: Milestones that are critical to the Program, normally documented in Phased based Program BCS's per Release Strategy.
  - Example: CNSC Approval of ISR
- (3) **Program Tier 3 – Program Controls, including the NR AIP milestones and NR AIP Scorecard.**
  - Reportable to: SVP Direct Reports
  - Definition: Milestones that manage the health of the Program and keep it on track
  - Example: All Projects Scope Freeze/Detailed Eng. Finished
- (4) **Project Tier 4 – Project Gates**
  - Reportable to: VP Refurbishment Execution (or delegate)
  - Definition: Project Gates (checkpoints of project preparation progress at which funding is released for the next phase).
  - Example: G0 Project Scope Approval, G3 Definition Phase.
- (5) **Project Tier 5 – Standard Project Milestones & Project Manager Milestones**
  - Reportable to: Project Manager
  - Definition: Milestones that are within the gated process and are specific to the project life cycle.
  - Example: Turbine Generator Project Charter Approved (CHR), Management Plans completed, Project Long Lead Materials

## 3.2 Milestone Numbering Nomenclature

### 3.2.1 PIMS Milestones

The Activity ID from the Program Schedule (PIMS) will be assigned as the Major Milestone number.

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Same Activity ID will be used to identify the specific record number when filling D-FORM-10762 –Program Milestone Definition, or D-FORM-10763- Program Milestone Recovery Plan.

The Schedule Activity ID coding is as follow:

Activity ID Coding	Code Description
RG	Regulatory Key Dates
RL	Program Release Dates
CP	Campus Plan Dates
RP	Unit 0 Outage Preparation Key Dates
OP	Unit “*” Outage Preparation Key Dates
U”*”	Unit “*” Outage Key Dates
CL	Program Close out Key Dates

### 3.2.2 Elevated Tier 3 Milestones

The Activity ID from the Project/ Functional Bundles Schedule will be assigned as the Major Milestone number.

The Project/ Functional Bundles Schedules Activity ID coding structure will be followed as described in the “DR Program P6 Schedulers User Guide”. N-MAN-00120-10002-SCH-08.

### 3.2.3 NR AIP Milestones

The Activity ID from the Program/Project will be assigned as the NR AIP Major Milestone number.

### 3.2.4 NR AIP Scorecards

If the NR AIP Scorecard Measure is a combination of more than one schedule Activity IDs, or has an arbitrary background other than the schedule, the AIP scorecard nomenclature will illustrate the AIP measure description.

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### 3.3 Milestone Definition Template

The Milestone Definition Template (D-FORM-10762) is required for Tier 1, Tier 2, & Tier 3 Milestones only. Included on the template will be the requirements for the Milestone Completion signoff. Instruction on how to fill in D-FORM-10762 is shown in Appendix E.

### 3.4 Milestone Completion Progress Monitoring

Timely and quality completion of milestones is critical for executing Darlington Refurbishment on schedule.

In order to ensure quality and timely completion of Milestones, the following formal monitoring process is required to manage/control/review/report completion progress of all Tier 1,2 &3 milestones.

All Tier 4 & 5 milestones will be managed by the individual project manager through the normal project management process. The project management process will interface with this process when it impacts a Tier 1,2 or 3 milestone.

#### 3.4.1 Milestone Definition Signoff

The Milestone owners will signoff agreement to the definition of the milestone.

The signoff will be included on the Milestone Definition template D-FORM-10762 Part "A".

#### 3.4.2 Milestone Success Plan Presentation

Prior to the Milestone due date the Milestone owner will present, at the monthly program review meeting, their plan specifying how they will satisfy the requirement for a quality and timely completion of the Milestone.

The milestone success plan presentation should be done 3, 6 or 9 months prior to Milestone TCD date. (Refer to D- FORM-10762 Part "A")

A template for the Success Plan Presentation is shown in Appendix "C"

#### 3.4.3 Milestone Recovery and Mitigation Plans Requirements

Recovery or mitigation plans are required whenever the variance from plan is significant enough that completing a milestone within the committed timeframe and with quality, is at risk. The distinction between a recovery plan and mitigation plan is below.

Recovery Detailed plan that supports full recovery of the milestone within the

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Plan: committed time frame.

Mitigation Plan: Detailed plan that identifies how commitments within milestone will be achieved, however outside of the committed time frame. I.e. milestone will be missed.

Milestones identified as Tier 1, 2, or 3 require recovery or mitigation plans documented within D-FORM-10763. Instruction on how to fill in D-FORM-10763 is shown in Appendix F.

Where milestone recovery is not possible, and a mitigation plan has been initiated, a change in the milestone date may be required. Changes to Tier 1, 2, or 3 milestones commitments are required to follow the Change Control process and mitigation plan should be attached.

### 3.4.3.1 Recovery and mitigation plans shall address the following:

- Original milestone completion date
- Target date by which full recovery will be completed
- Description of why the Milestone became challenged
- Course of action to recover the Milestone including responsible individuals and due for actions
- Successor milestones that are affected and the impact.

### 3.3.4.2 Approval of the milestone recovery and mitigation plans will be consistent with milestone tier structure approval (Section 3.1).

### 3.4.3.3 A summary of the milestone recovery and mitigation process is shown in Appendix D”.

## 3.4.3 Milestone Change Control Process

In the event that the timely completion of the identified Tier 1, 2 or 3 milestone is in jeopardy a Milestone Recovery Plan should be followed as described under item 3.4.3

In order to cancel a Tier 1, 2 & 3 milestone the Change Control process has to be followed as described in N-MAN-00120-10001-PC-01.

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In the event that a Tier 1, 2 or 3 milestone is following the cancelation process, the milestone recovery form N-FORM -10723 shall be attached to the Change Control Form N-FORM-11252 as per N-MAN-00120-10001-PC-01.

Tier 4 & 5 milestones will be managed by the individual project manager through the normal project management process.

### 3.5 Quality Requirements for Milestone Completion

Completion of all the Program Milestones (Tier 1 to Tier 3) must be supported by a suitable quality verification process. Depending on the type of Milestone and the deliverables associated with completion, quality verification may be comprised of any one or more of the following:

- (a) Demonstration that preparation, review and approval of supporting deliverables have been controlled by an existing managed system (e.g. OPG/OPGN/DR governance, other Quality Assurance methods or processes adopted by OPGN/DR for conducting its business)
- (b) Demonstration that preparation, review and approval of supporting deliverables have been vetted or validated through other established work processes and practices in OPGN/DR, which may take the form of internal memos, presentations to and agreements from relevant stakeholder, minutes of meetings etc.
- (c) Demonstration that the quality of supporting deliverables has undergone independent, third-party verification.
- (d) Successful outcome from a Challenge Meeting or Challenge Process solely conducted for verifying adequate completion of a milestone against a pre-established set of expectations/success criteria agreed to between the milestone owner and the receiving stakeholder(s).

The requirement for a Challenge Meeting or Challenge Process will be embedded in each specific Milestone Definition.

Agreement to Milestone completion needs to be obtained from the organization accepting the deliverables. This ensures that the deliverable provided is useable by the organization that needs to complete the next activity.

### 3.6 Milestone Completion, Closeout and Document Retention Requirements

A Milestone shall not be declared complete until all requirements have been successfully completed or dispositioned. Completion needs to be fully documented and needs to be auditable.

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To ensure this, Milestone Closeout needs to be documented; a signed Darlington Refurbishment Signoff for Milestone Completion identifying the deliverables/documents that were completed will be presented at the monthly program review meeting.

If a Challenge Meeting is identified for a Milestone, this form will be presented at the Challenge Meeting.

Darlington Refurbishment Signoff for Milestone Completion signoff will be included as “Part B” on the Milestone Definition Template D-FORM-10762.

## 4.0 APPROVAL PROCESS

### 4.1 Routing and Authorization

The initiator shall complete all the section of the milestone templates form as required. Major steps on the routing and authorization process are as follows:

#### 4.1.1 Milestone Definition D-FORM-10762 Part A

- Owner Complete Milestone Definition Template D-FORM-10762 Part A
- Milestone Definition D-FORM-10762 (Part A) Signed by the Owner
- Route the signed D-FORM-10762 (Part A) to P&C Scheduling Department
- P&C SPOC Reviews D-FORM-10762 (Part A) for completeness & return to owner
- Milestone owner file D-FORM-10762 (Part A) in Asset Suite by forwarding PDF to DNG Doc Mgmt

Milestone owner retain original D-FORM-10762 for completion of Part B

#### 4.1.2 Milestone Definition D-FORM-10762 Part B

- Milestone Owner Success Plan Presentation (Item 3.4.3 from N-MAN-00120-10001-SCH-06)
- Milestone Owner completes all identified milestone requirements
- Milestone Completion D-FORM-10762 (Part B) issued by Owner
- Milestone Owner sends D-FORM-10762 (Part A & B) to RPET for recommendation to close
- RPET provides recommendation to close
- Milestone Owner sends D-FORM-10761 (Part A & B) to Director Project & Control for approval

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- Milestone Owner sends a copy of the approved D-FORM-10762 (Part A & B) to P&C Scheduling Department
- Milestone Owner file the final approved D-FORM-10762 (Part A&B) in Asset Suite by forwarding PDF to DNG Doc Mgmt

### 4.1.3 Milestone Recovery / Mitigation Plan D-FORM-10763

- Milestone Owner completes Milestone Recovery / Mitigation Plan D-FORM-10763
- Milestone Owner sends D-FORM-10763 to RPET for recommendation to close
- RPET provides recommendation to close
- Milestone Owner sends D-FORM-10763 to Director Project & Control for approval
- Milestone owner file D-FORM-10763 in Asset Suite by forwarding PDF to DNG Doc Mgmt
- Milestone Owner completes Change Control Form (CCF) as per N-MAN-00120-10001-PC-01
- Route the signed D-FORM-10763 and approved CCF to P&C Scheduling Department
- P&C Scheduling Department updates the Level 1 Schedule

### 4.1.4 Approval process Diagram

For approval process the attached completion and approval process diagram should be followed.



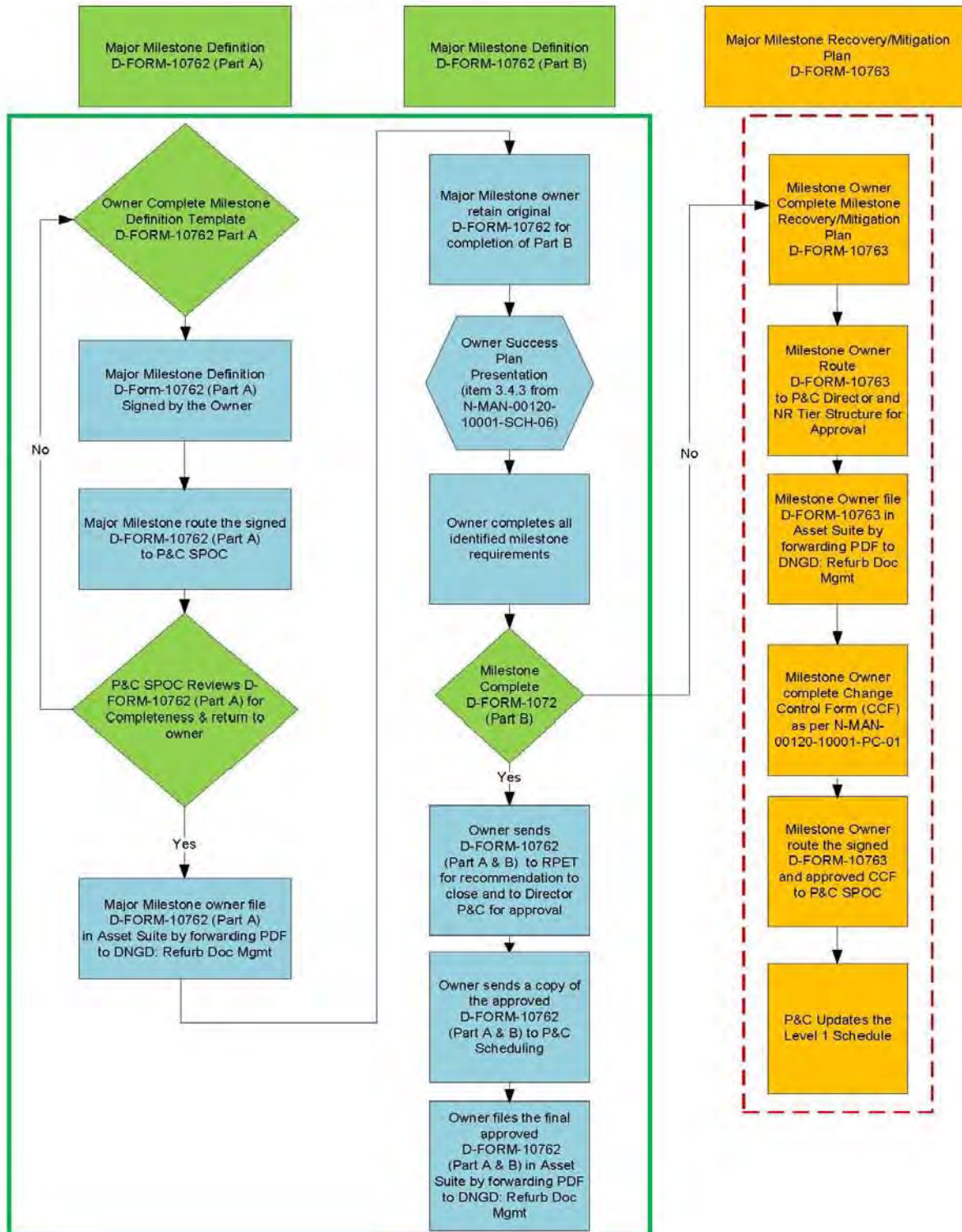
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## NUCLEAR REFURBISHMENT – MILESTONE DEFINITION FRAMEWORK

### MILESTONE DEFINITION TEMPLATE COMPLETION AND APPROVAL PROCESS



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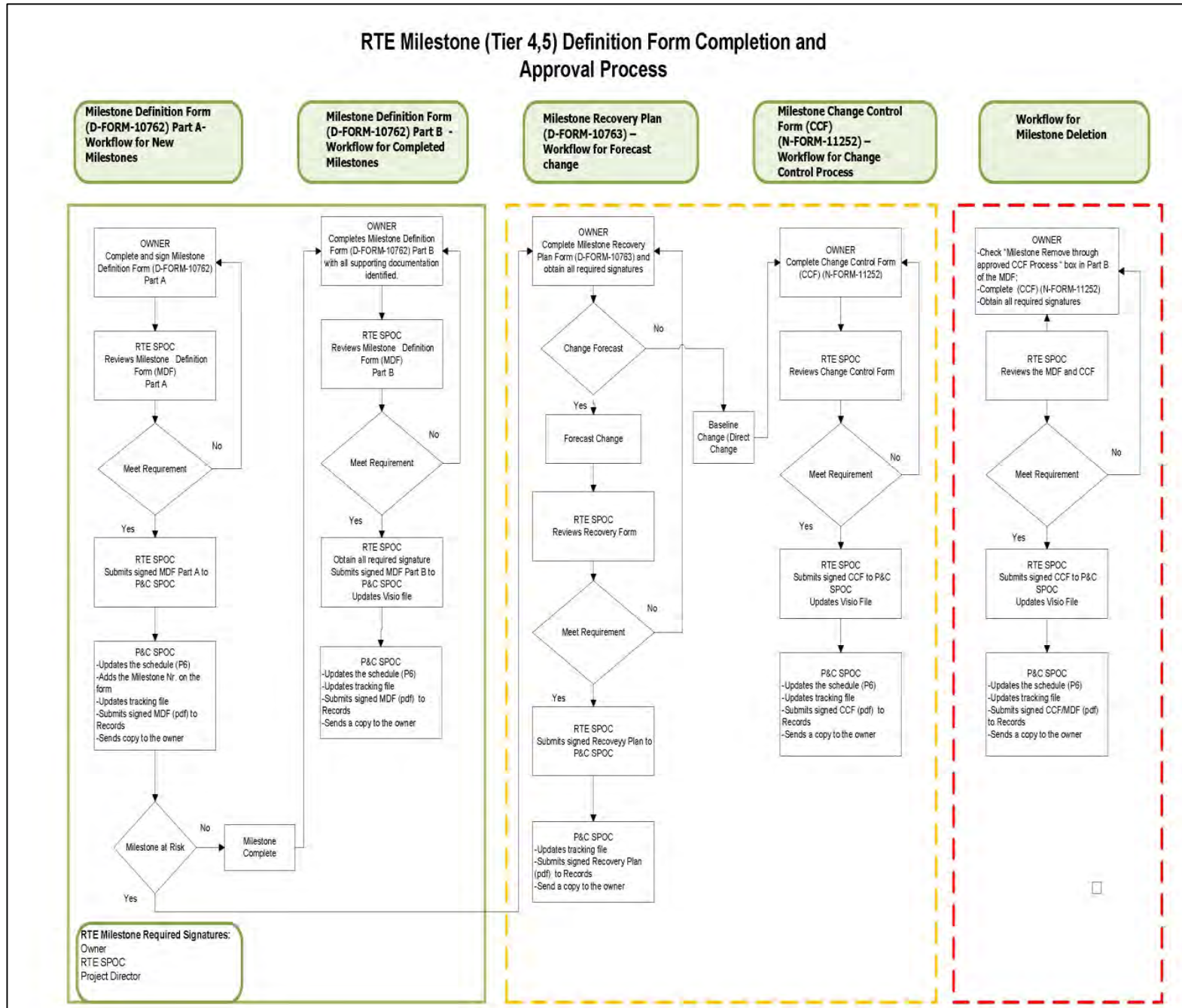
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## NUCLEAR REFURBISHMENT – MILESTONE DEFINITION FRAMEWORK

### 4.1.5 RTE Process Diagram (Tier 4, 5 only)

“RTE Milestones Definition Form and Approval Process” should be followed



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## 5.0 RECORDS AND REFERENCES

### 5.1 Records

The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (ASSET SUITE Type/Sub-Type)
Darlington Refurbishment Program Milestone Definition	D-FORM-10762	N	File as a record using the following document numbering configuration: (note: Milestone number will be recorded in doc number) NK38-REF-09701-xxxxxx Retention: 10 years after Completion/Settlement RRC: NO2-0049 Each milestone definition will be linked to the associated milestone
Darlington Refurbishment Milestone Recovery / Mitigation Plan	D-FORM-10763	N	File as a record using the following document numbering configuration: (note: Milestone number will be recorded in doc number) NK38-REF-09701-R-xxxxxx Retention: 10 years after Completion/Settlement RRC: NO2-0049

### 5.2 References

This Guide receives its authority from N-MAN-00120-10001-SCH NR Schedule Management.

- [R-1] N-MAN-00120-10001-GRB - Nuclear Projects Gated Process
- [R-2] N-MAN-00120-10001-PC-01 - Nuclear Refurbishment Cost and Schedule Change Control
- [R-3] D-FORM-10762 - Darlington Refurbishment Program Milestone Definition Template
- [R-4] D-FORM-10763 - Darlington Refurbishment Program Milestone Recovery / Mitigation Plan Template

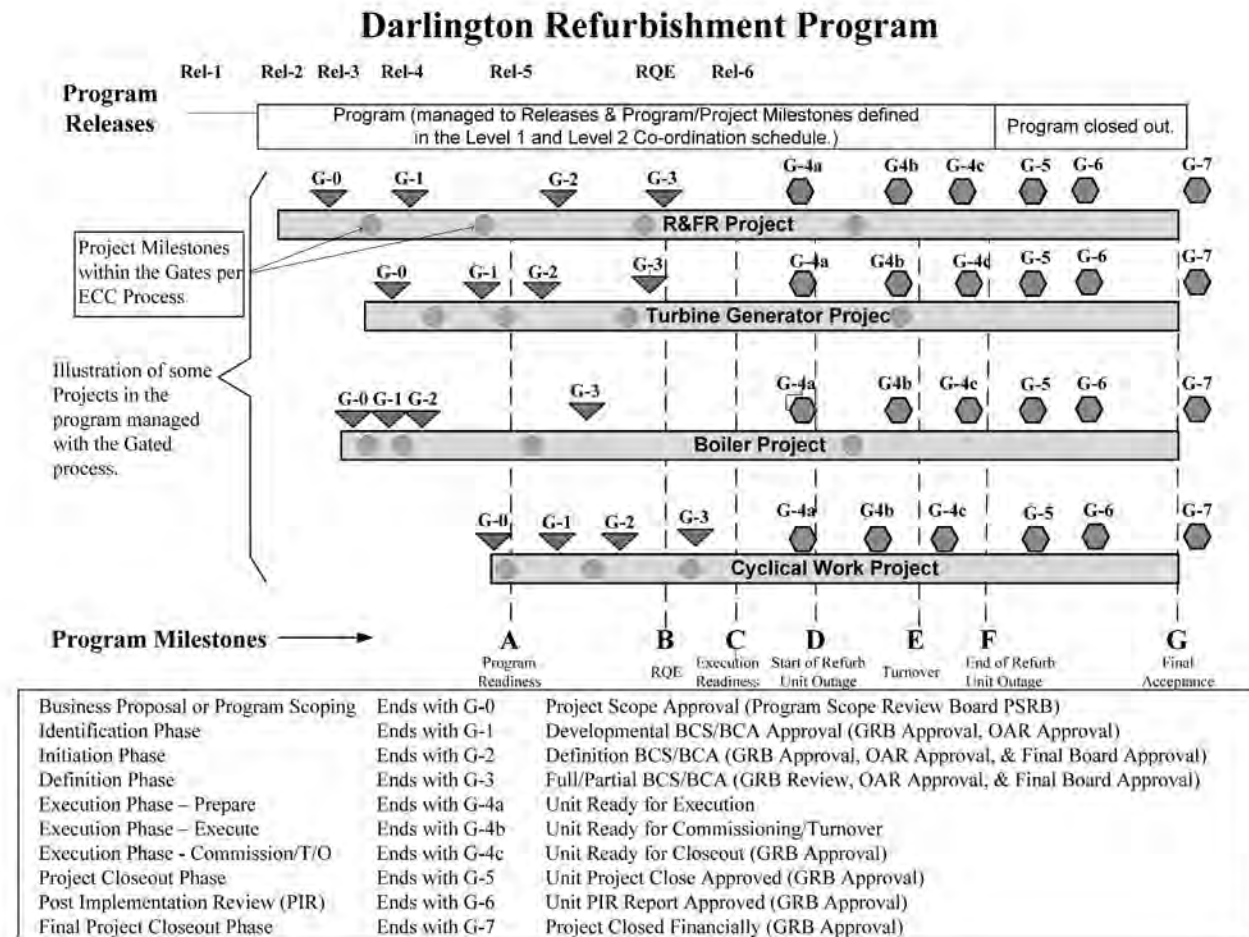
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## NUCLEAR REFURBISHMENT – MILESTONE DEFINITION FRAMEWORK

### Appendix A: Structure of Gated Process/Program/Project Milestones





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### Appendix B: Standard Milestone Listing

#### Darlington Refurbishment Standard Milestones Codes



Standard Milestone Listing						Milestone Tier Structure						
* = Milestones may be required more than once in the project baseline schedule. ** = Refer to Outage Milestones in N-PROC-MA-0013 (Planned Outage Management)						1 = Commitments to the Board (SVP Nuclear Refurbishment Milestone) 2 = Critical Impact (SVP Nuclear Refurbishment Milestone) 3 = Program Controls (SVP Direct Reports Milestones) 4 = Project Gates & Main Project Team Milestone (VP Refurbishment Execution) 5 = Project Milestone within Gates (Project Manager Milestones)						
Order	Milestone Type	Milestone Code	Notes	Milestone Title	Description and Use	Milestone Tier Structure Code	Associate Program Milestones for Reference	Milestone Completion Criteria	Responsibility	Mandatory Y/N	Project Life Cycle Phase	
1	Finish	CDL		Conceptual Design Complete	Completion of conceptual design activities to determine alternatives/options and recommendation of a preferred alternative.	5		All conceptual studies and reports pertaining to preparation of Modification Outline have been accepted by OPG.	• Owner: Engineering • Support: Vendor/Project	Y	Initiation	
2	Finish	GR1		Gate G1 Approval	Gate G1 approval for Refurb. projects.	4		Initiation Phase Approval (Refurb).	• Owner: Project • Support: PMO	Y	Initiation	
3	Finish	GR2		Gate G2 Approval	Gate G2 approval for Refurb. projects.	4		Definition Phase Approval (Refurb).	• Owner: Project • Support: PMO	Y	Definition	
4	Finish	GR3		Gate G3 Approval	Gate G3 approval for Refurb. projects.	4		Unfused Execution Phase Approval (Refurb).	• Owner: Project • Support: PMO	Y	Execution	
5	Finish	GR4		Gate G4 Approval	Gate G4 approval for Refurb. projects.	4		Unfused Project Closeout Phase Approval (Refurb).	• Owner: Project • Support: PMO	Y	Closeout	
6	Finish	GR5		Gate G5 Approval	Gate G5 approval for Refurb. projects.	4		Final Project Closeout Phase Approval (Refurb).	• Owner: Project • Support: PMO	Y	Closeout	
7	Finish	SR		Required For Proposal	All documentation required to initiate the contract procurement process have been issued.	3		• Key terms and conditions have been developed and accepted by legal • All required Engineering documents (e.g. PDR, spec) are issued • Supplier work is issued	• Owner: Supply Chain • Support: Project/Legal	Y	Definition	
8	Finish	EPC	Predecessor to MS-11 **	Award Contracts / PO Issued	All EPC contracts have been awarded. Purchase Orders are adequately funded to cover the agreed upon contract value. Milestone applicable for a unit or a planned outage. Individual associated Tier 5 milestones might be identified at lower level in the schedule.	2		• S-100M-10029 has been approved by appropriate level of O&M and PO is issued in Support. • EPC vendor has been given charging path for the services rendered to OPG.	• Owner: Supply Chain • Support: Project/Legal	Y	Definition	
9	Finish	DCA		Design Contracts Awarded / PO Issued	PO issued and approved in Support	4		• EPC vendor has been given charging path for the services rendered to OPG.	• Owner: Project • Support: Vendor	Y	Definition	
10	Finish	ICA		Installation Contracts Awarded / PO Issued	PO issued and approved in Support	4		• EPC vendor has been given charging path for the services rendered to OPG.	• Owner: Project • Support: Vendor	Y	Initiation	
11	Finish	PCA		Procurement Contracts Awarded / PO Issued	PO issued and approved in Support	4		• EPC vendor has been given charging path for the services rendered to OPG.	• Owner: Project • Support: Vendor	Y	Definition	
12	Finish	DCS		Preliminary Design Completed	Preliminary Design is complete for review against the criteria provided in the gated Process. Design is responsible for this milestone.	5		The approved Modification Outline, the issued Design Plan, the issued Design Requirements, and the issued Design Release Plan must be attached to the Master EC record. A forecast for the required Project Design resources and the schedule for the remainder of the project has been documented.	• Owner: Engineering • Support: Vendor/Project	Y	Definition	
13	Finish	LLT		Long Lead Time Materials Identified	EPC contractor to provide list and description of materials that potentially have equal or greater than 24 months lead time for delivery from the time OPG approval has been granted to proceed with purchase. Milestone applicable for a unit or a planned outage. Individual associated Tier 5 milestones might be identified at lower level in the schedule.	3	U2 OP2040 U1 OP2040 U2 OP2050 U1 OP2050 U2 OP2060 U1 OP2060	Supply Chain to identify / generate new CATT's and determine Q level for low lead materials	• Owner: Project • Support: Vendor	N	Initiation	
14	Finish	PST	Predecessor to MS-11 **	Work Identified in Support	Phase 1 assessment of Work Orders in Support is complete.	4	U2 OP2015 U1 OP2015 U2 OP2015 U1 OP2015 U2 OP2015 U1 OP2015	Vendor to identify: • 100% of approved work orders • Tasks for support work groups • Regulatory approvals • Where possible, required modifications, pre/post required work and revisions to procedures • 80% of Material Regulations	• Owner: Project • Support: Vendor	Y	Definition / Execution	
15	Finish	WPI	Predecessor to MS-20 **	Work Plans Issued	Contractor work plan has been authorized by OPG for use.	5		• All required signatures have been obtained • User classification is identified • Process for intent and non-intent changes is identified	• Owner: Project • Support: Vendor	Y	Execution	

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Appendix B: (Continued)

Darlington Refurbishment  
Standard Milestones Codes



Order	Milestone Type	Milestone Code	Order	Milestone Title	Description and Use	Milestone Tier Structure Code	Associate Program Milestones for Reference	Milestone Completion Criteria	Responsibility	Planning Y/H	Project Life Cycle Phase
1	Plan	PCA	10	Work Package Assessment Completed and Readiness Feedback to Field	Person has advised CPM construction Manager (construction in field) construction Work Package	4	101 CP2020 102 CP1070 103 CP3070 104 CP4070	<ul style="list-style-type: none"> <li>Ordered additional work order tasks in previous past phase 1 as required</li> <li>Submitted their requests (PCOs) to Operations for priority needs</li> <li>Obtained approval for Status Control Tags where possible</li> <li>Inspection and Test Plans have been submitted by ANS for use</li> </ul>	<ul style="list-style-type: none"> <li>Owner: Construction</li> <li>Support: Vendor/Project/Doc</li> </ul>	1	Execution
2	Plan	SCD	11	Design Complete	Detailed design normally an Engineering Change Package (ECP) or vendor equipment release is complete, approved, and issued. This includes drawings and regulatory approvals. The release may include a single unit, multiple units, or other packages of work as approved in the Engineering Change modification system. This milestone date should be aligned with the Engineering Department Key Milestone Milestone applicable for a unit or a planned outage. Individual associated Tier 3 milestones might be identified at lower level in the schedule.	3	101 AP130 102 CP2020 103 CP1050 104 CP3020 105 CP4020	No documentation required to authorize the Design Engineering Change (including updates to the AEs (Other Equipment List (OEL) of Materials) spare parts list, and catalogue (SL) has been issued. Notes may be on a "turn to build" basis. A forecast for the required Project Design Resources and the schedule for the remainder of the project has been documented. Note: In order to proceed at this milestone date, Design requires confirmation of both major equipment purchase orders being issued to vendors and the design schedule.	<ul style="list-style-type: none"> <li>Owner: Engineering</li> <li>Support: Vendor/Project</li> </ul>	1	Definition
3	Plan	REC	12	Material / Equipment Available	Equipment/Materials are available for Just in Time delivery	5		Delivery date and shipping location have been reviewed and accepted by CPM construction Manager in accordance with agreed upon manufacturing strategy.	<ul style="list-style-type: none"> <li>Owner: Construction</li> <li>Support: Vendor/Project</li> </ul>	1	Execution
4	Plan	SCD	13	Start of Installation	Milestones to track the start of installation in construction which includes removal. Milestone applicable for a unit or a planned outage. Individual associated Tier 3 milestones might be identified at lower level in the schedule.	3		Readiness Installation Tasks have been set to working.	<ul style="list-style-type: none"> <li>Owner: Construction</li> <li>Support: Vendor/Project</li> </ul>	1	Execution
5	Plan	POC	14	Finish of Installation	Milestones to track the finish of installation in construction which includes removal.	4		Readiness Installation Tasks have been set to finished.	<ul style="list-style-type: none"> <li>Owner: Construction</li> <li>Support: Vendor/Project</li> </ul>	1	Execution
6	Plan	CHS	15	Commissioning Start	Milestone required for commissioning start. Milestone applicable for a unit or a planned outage. Individual associated Tier 3 milestones might be identified at lower level in the schedule.	3		Readiness Commissioning Tasks have been set to working.	<ul style="list-style-type: none"> <li>Owner: Construction</li> <li>Support: Vendor/Project/DOH</li> </ul>	1	Commissioning
7	Plan	CHS	16	Commissioning Finish	Milestone required for commissioning finish.	4		Readiness Commissioning Tasks have been set to finished.	<ul style="list-style-type: none"> <li>Owner: Construction</li> <li>Support: Vendor/Project/DOH</li> </ul>	1	Commissioning
8	Plan	APS	17	Available for Service and/or Ready for Service Completed	System Readiness has been turned over to Operations and is available for service. For Maintenance type projects where available for service does not apply, the Ready for Service should be used. Milestone applicable for a unit or a planned outage. Individual associated Tier 3 milestones might be identified at lower level in the schedule.	3		APS Acceptance: A meeting is held for APS. If acceptance is required at the meeting, then APS Acceptance has been met. If the meeting is held and APS is NOT accepted, then the milestone is not active. If the meeting is moved, and APS is accepted when the meeting is held then APS Acceptance has been met. Design RUS (APS Date - 20%) Support is required prior to and during outage. SCD Approval and Commissioning results accepted. POI complete and APS accepted.	<ul style="list-style-type: none"> <li>Owner: Construction</li> <li>Support: Vendor/Project/DOH</li> </ul>	1	Commissioning
9	Plan	SHO	18	SL Close-out Completed	Verification that Design SL is closed-out within the 6 months of the APS. (Change close out of the project.)	3		All account to issue that design documents and close Readiness Design SL. All action tracking items are set to complete with the associated roles in governance.	<ul style="list-style-type: none"> <li>Owner: Engineering</li> <li>Support: Vendor/Project</li> </ul>	1	Closeout
10	Plan	SHO	19	Close-out Completed	Milestone to identify the completion of close-out activities, or to close-out a specific unit. (Financial close out of the project.)	4		Project Close-out activities are complete and Project Close Report issued for approval.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor/Construction</li> </ul>	1	Closeout
11	Plan	SHO	20	MOC Requirement Met	Milestone for tracking history of the Environment Requirements. Include action tracking number in activity description.	3		Action Tracking item is complete and closed.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Engineering/Operations/Vendor</li> </ul>	1	Definition / Execution
12	Plan	SHO	21	MOC Requirement Met	Milestone for tracking history of labour requirements (e.g. Status of Project, Project SDC). Include action tracking number in activity description.	3		Action Tracking item is complete and closed.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: HR (HR PMO/Construction/Vendor)</li> </ul>	1	Definition / Execution
13	Plan	SHO	22	Project on Functional Manager Milestone	User defined Milestone for Project on Functional Team specific tracking. Use this as an interim milestone to track specific progress not already identified in the listing.	3		Project on Functional Team met the intended criteria of PMO specific Milestones.	<ul style="list-style-type: none"> <li>Owner: Project</li> </ul>	1	Any phase is applicable
14	Plan	SHO	23	CHS/Regulatory Compliance Met	Milestone for tracking Reg. Ch. Include Action Tracking number in activity description.	4		Documents have been reviewed to confirm completion. Action Tracking item is closed in Readiness.	<ul style="list-style-type: none"> <li>Owner: Reg Affairs</li> <li>Support: Project/Engineering/Vendor</li> </ul>	1	Definition / Execution
15	Plan	SHO	24	CHS/Regulatory Compliance Met	Milestone for tracking Reg. Ch. Include Action Tracking number in activity description.	4		Documents have been reviewed to confirm completion. Action Tracking item is closed in Readiness.	<ul style="list-style-type: none"> <li>Owner: Reg Affairs</li> <li>Support: Project/Engineering/Vendor</li> </ul>	1	Definition / Execution
16	Plan	SHO	25	Plan Complete Milestone	Plan Complete Milestone. This milestone will identify the final completion of the entire plan.	4		Project Closure Report has been approved.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor</li> </ul>	1	Closeout
17	Plan	SHO	26	Inspection Complete	Milestone for tracking when inspection(s) are complete.	3		Inspections complete and signed documents have been issued.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor</li> </ul>	1	Any phase is applicable

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Darlington Refurbishment  
Standard Milestones Codes



Order	Milestone Type	Milestone Code	Status	Milestone Title	Description and Use	Milestone Fee Structure Code	Associated Program Milestones for Reference	Milestone Completion Criteria	Responsibility	Mandatory Y/N	Project Life Cycle Phase
33	Finish	DFC		Completion of the requests early complete	Completion of pre-request work, outage tools, equipment and facilities completed prior to refuel.	5		All pre-request work, outage tools, equipment and facilities associated with the project is now complete and signed off.	<ul style="list-style-type: none"> <li>Owner: Construction</li> <li>Support: Vendor/Project</li> </ul>	9	Definition
34	Finish	RCO		Procedure change requirements identified	Procedure revision/updating changes are identified.	5		There's no Operation and Maintenance procedure have been approved and submitted to Document Control for implementation. Response group to follow an AR to track the rollout of the revised procedure.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor</li> </ul>	9	Definition
35	Finish	RCO		Procedures issued	Procedures requiring updated changes issued.	5		Signal documents have been issued in Passport. The AR for rollout of the revised (procedures) has been signed off by the responsible manager.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor/RCM/Engineering</li> </ul>	9	Definition
36	Finish	PRC		OP Preventive Maintenance updated	All PM are now reviewed /updated	5		All Preventive Maintenance work associated with the project has been identified and required resources have been incorporated in Passport	<ul style="list-style-type: none"> <li>Owner: Engineering</li> <li>Support: Vendor/Project/RCM/Engineering</li> </ul>	9	Definition
37	Finish	TRC		Training Material Issues	All project specific training materials have been issued by the vendor.	5		Vendor to demonstrate that all project specific training materials have been verified by a qualified individual(s) and ready for use in accordance with agreed upon training plan.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor/Training</li> </ul>	9	Definition
38	Finish	TRC		Training Completed	All project specific training have been delivered in accordance with the agreed upon training plan	5		Vendor to provide training records for all trained staff and obtain approval to process staff credit in OPG's Training Information Management System	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor/Training</li> </ul>	9	Definition
39	Finish	TRC		Regulatory documents completed	Procedures to address requirements that we need to meet, but not for having regulatory approvals in place.	4	RCG20	Documents have been received to confirm completion.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor/Regulatory affairs</li> </ul>	9	Definition
40	Finish	RVA	Predecessor to RD-03	Revision 'A' schedule support	Vendor work has been submitted for outage REV 'A' schedule issuance	4	U2 OPG20 U3 OPG20 U4 OPG20	The duration of execution activities, work calendar and staff structure has been mutually agreed between Project Manager and vendor. Level 1 schedule has been signed off and submitted to the outage team for integration.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor</li> </ul>	9	Definition
41	Finish	RVB	Predecessor to RD-04	Revision 'B' schedule support	Vendor work 2 for non-critical path work has been submitted for outage REV 'B' schedule issuance. For refurbishment critical path work, vendor must submit level 2 schedule.	4	U2 OPG20 U3 OPG20 U4 OPG20	Major components of execution activities for non-critical path work have been identified and signed off by Project Manager and vendor.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor</li> </ul>	9	Definition
42	Finish	RVC	Predecessor to RD-05	Revision 'C' schedule support	Vendor must submit a fully resource loaded level 3 in support of Refurbishment integrated schedule issuance.	4	U2 OPG20 U3 OPG20 U4 OPG20	Full level 3 schedule has been issued. Reporting structure and communication plan with all major stakeholders have been approved.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor</li> </ul>	9	Definition
43	Finish	RVD		Rev D schedule issued	Vendor to submit a final level execution schedule	4	U2 OPG20 U3 OPG20 U4 OPG20	Execution schedule has been approved for project manager.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor</li> </ul>	9	Definition
44	Finish	LCC		Lesson Learned Corrosion	Project team to develop a comprehensive set of lessons learned through SCR, logs, etc	3		Project Manager to initiate a CR SCR to capture two lessons learned from the previous outage and get concurrence from the Evaluation Organization that are in the best position to validate the generated actions.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor/Engineering/Construction</li> </ul>	9	Definition
45	Finish	ROA		Phase 1 Assessment Complete	Phase 1 assessment of Work Items in Passport is complete.	3		OPC vendor to identify: <ul style="list-style-type: none"> <li>100% of approved work orders</li> <li>Times for support work groups</li> <li>Regulatory approvals</li> <li>Other positive required modifications, pre-proc requests and AR requests to procedures</li> <li>50% of Material Requirements</li> </ul>	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor</li> </ul>	9	Definition
46	Finish	WOC		WOC Closure Complete	All Project facility evaluations are now complete	6		All tasks added to the workorderbook have been accepted or rejected in evaluation books prior to start of execution activities	<ul style="list-style-type: none"> <li>Owner: Construction</li> <li>Support: Vendor/Project</li> </ul>	9	Definition
47	Finish	SAC		Scope Health Progress to 30	Work is known at the system or project level but not component. Milestone applicable for all packages issued. Individuals associated that is necessary might be modified at lower level in the schedule.	3	OP200	Definition Phase complete. Solution defined at system or project level. Plan to implement solution is defined. System or project scope is defined.	<ul style="list-style-type: none"> <li>Owner: Project</li> <li>Support: Vendor</li> </ul>	9	Definition
48	Finish	SDW	For Functional Work	Scope of Work Document Complete	This milestone will identify the Scope of Work document is completed.	5		Scope of Work Document (s) (including Preliminary) complete and issued.	<ul style="list-style-type: none"> <li>Owner: Project</li> </ul>	9	Definition
49	Finish	DRC	For Functional Work	Design Requirement Complete	This milestone will identify Design Requirement complete.	5		Design Requirement are complete and signed documents have been issued.	<ul style="list-style-type: none"> <li>Owner: Project</li> </ul>	9	Definition

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## Appendix C: Milestone Success Plan Presentation

### Milestone Success Plan Presentation

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Milestone No:

Milestone Description:

Milestone TCD:

#### Progress Status:

- Describe how the requirement for a quality completion of the Milestone is satisfied.
- Is the milestone completion date at risk of being delayed?

YES/NO	Comments

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• Safety • Human Performance • Reliability • Value for Money



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**NUCLEAR REFURBISHMENT – MILESTONE DEFINITION FRAMEWORK**

**Appendix D: DNG Refurb – Program & Project Milestones Recovery / Mitigation Process**

**DNG Refurb – Program & Project Milestones Recovery and Mitigation Process**

The following provides summary instructions on the process of documenting and managing the recovery and mitigation plans for program and project milestones that are at risk.

**Program Milestones – Tier 1, 2, or 3**

**Process Description:**

- In the event that the timely and quality completion of a tier 1,2, or 3 milestone is in jeopardy, a milestone recovery or mitigation plan using D-FORM-10763 is required
- In the event that the milestone recovery is not possible, and a mitigation plan has been initiated, a change in the milestone date may be required. Changes to Tier 1, 2, or 3 milestones commitments are required to follow the Change Control process and mitigation plan should be attached.

**Accountability:**

Who	What	When
Milestone Owner	Follow the Program Milestone Recovery and Mitigation Plan Requirements as per N-MAN-00120-10001-SCH 06 using D-FORM-10763 form.	Completion of the Major Milestone in jeopardy
CSA	Support Milestone Owner in Developing Milestone Recovery and Mitigation Plan and associated Change Control Form (if required)	Completion of the Major Milestone is in jeopardy and when the milestone date is not recoverable

**Process**

- Milestone Owner complete Milestone Recovery and Mitigation Plan D-FORM-10763
- Milestone Owner Route D-FORM-10763 to P&C Director and obtain approval
- Milestone Owner file D-FORM-10763 in passport by forwarding PDF to DNG Doc Mgmt
- If milestone is not recoverable, Milestone Owner may be required to complete Change Control Form (CCF) as per N-MAN-00120-10001-PC01
- Milestone Owner route the signed D-FORM-10763 and approved CCF to P&C Scheduling Department
- P&C updates the PIMS Schedule

**Application**

- All Program Milestones – Tier 1, 2, or 3

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**NUCLEAR REFURBISHMENT – MILESTONE DEFINITION FRAMEWORK**

**Appendix D: (Continued)**

**Project Milestones – Tier 4 or 5**

**Process Description:**

- Project milestone changes will be managed by strictly following the NR Change Control Process outlined on N-MAN-00120-10001-PC01-“Cost & Schedule Change Control” Procedure.
- Project milestone owners may be requested by senior management to document milestone recovery and mitigation plans using D-FORM.

**Accountability:**

Who	What	When
Project Manager	Follow the NR Change Control Process outlined on N-MAN-00120-10001-PC01	Completion of the Project Milestone is in jeopardy
CSA	Support Project Managers in completing Change Control Form	Completion of the Project Milestone is in jeopardy

**Process**

As per N-MAN-00120-10001-PC01

- Project Manger complete Change Control Form (N-FORM-11252).
- Route the approved Change Control Form to P&C SPOC.
- Project assigned CSA updates the Project Schedule.

**Application**

- All project Milestones – Tier 4 or 5

**References**

- DN Refurbishment Program Integrated Master Schedule (PIMS) NK38-PLAN-00300-10000.
- Nuclear Refurbishment Cost and Schedule Change Control N-MAN-00120-10001-PC01.
- NR Schedule Management N-MAN-00120-10001-SCH.
- DNG Refurbishment Standard Project Milestone List N-MAN-00120-10001-SCH 02.

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## Appendix E: Instruction to Fill Out D-FORM-10762 (Milestone Definition Form)



Records File Information:

Internal Use Only  
D-FORM-10762-R007\*

### Darlington Refurbishment Program Milestone Definition Template

Record Number: NK38-REF-09701- (1)

Darlington Refurbishment Units 1, 2, 3 & 4

Milestone Number: (2)

Milestone Description: (3)

#### Part A - Milestone Definition

Milestone Type: Program (4)	Tier Structure: (5)	Unit: All (6)
Milestone Owner: (7)	Signature: (8)	Date: (9)
Milestone TCD: (10)	Milestone Success Plan Presentation Date: (11)	
Milestone Definition: Describe the milestone and include any supporting governance. Identify any supporting departments/Directors, if applicable. (12)		

\*Associated with N-MAN-00120-10001-SCH-06, Nuclear Refurbishment Program Milestone Definition Framework  
N-TMP-10056-R010 (Microsoft® 2007)  
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## Appendix E: (Continued)

Internal Use Only D-FORM-10762-R007	
<b>Darlington Refurbishment Program Milestone Definition Template</b>	
<p><b>Requirements to Satisfy the Milestone (Reference N-MAN-00120-10001-SCH-06):</b></p> <ul style="list-style-type: none"> <li>Identify reference to any process, letters, documents, transmittals in support of milestone completion.</li> <li>Indicate how your department will meet <u>each</u> of the requirements of the milestone. Provide details, progress status, work down curves, challenges, etc. Use separate sheets as required.</li> </ul> <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; text-align: center; line-height: 30px; margin-left: 10px;">13</div>	
<p><b>Performance Indicator:</b>  Identify the performance indicators (metrics, WDC, etc) to indicate progress.</p> <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; text-align: center; line-height: 30px; margin-left: 10px;">14</div>	
Milestone Predecessor(s):	Milestone Number: <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; text-align: center; line-height: 30px;">15</div> Or N/A <input type="checkbox"/>
Milestone Successor(s):	Milestone Number: <div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; text-align: center; line-height: 30px;">16</div> Or N/A <input type="checkbox"/>

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D-FORM-10762-R007

### Darlington Refurbishment Program Milestone Definition Template

#### Part B - Milestone Completion

Completion Status – please select one:		
17		
<input type="checkbox"/> Milestone met on or before target	Target Date	Completion Date
<input type="checkbox"/> Milestone met based on associated recovery plan	Recovery Date	Completion Date
<input type="checkbox"/> Milestone removed through approved CCF process		
<i>Please attach Recovery Plan, D-FORM-10763, and/or Change Control Form, N-FORM-11252, if applicable.</i>		
Describe how you met this milestone and list all the deliverables/documents. <i>Indicate how your department met <u>each</u> of the requirements of the Milestone Definition. Provide details, PASSPORT Documents, signed letters etc. Indicate Challenge Process used.</i>		
<div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin-bottom: 10px;">18</div>		

Final Signatures		
19	Approval Level	Signature
		Date Signed
Issued by – Owner		
Recommended to Close by – RPET		
Approved by – Director, Planning & Controls		

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*\*Please refer to N-MAN-00120-10001-SCH-06, Nuclear Refurbishment – Milestone Definition Framework*

ID	Section	What is this?
1	Record Number	The standard record number begins with NK38-ref-09701-xxxxxx - this cannot change. The xxxxxx portion of the record number shall be the Activity ID assigned in the P6 schedule
2	Milestone Number	This shall be the Activity ID assigned in the P6 Schedule
3	Milestone Description	This shall be the Activity Name from the P6 Schedule
4	Milestone Type	Milestone type shall be identified as either Program or AIP Scorecard
5	Tier Structure	This is the milestone tier, as determined in the Milestone Tier Structure Process (Section 3.1 of the manual): Tier 1 - Reportable to EVP Nuclear Refurbishment; Tier 2 - Reportable to SVP Nuclear Refurbishment; Tier 3 - Reportable to SVP Direct Report
6	Unit	This is the Unit the Milestone Definition Form Relates to. The form defaults to "All". If the form only relates to one unit - please specify.
7	Milestone Owner	Please specify the individual and their position
8	Signature	Requires Milestone Owner's signature
9	Date	The date the Milestone Definition Form was signed
10	Milestone TCD	This is the milestone completion date, as established in the P6 Schedule by BL Project Finish
11	Milestone Success Plan Presentation Due Date	This will be the Milestone TCD date minus 3, 6, or 9 months. For example, a milestone with a TCD of November1, 2013, would have a presentation date of August 1, 2013 if three months were subtracted. See section 3.4.2 of the manual.
12	Milestone Definition	Describe the milestone and includes any supporting governance. Identify any supporting departments / directors, if applicable.
13	Milestone Requirements	Identify reference to any process, letters, documents, transmittals in support of milestone completion.

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14	Performance Indicator	Identify the performance indicators (metrics, WDC, etc) to indicate progress.
15	Milestone Predecessor (s)	List any milestone predecessors, if applicable. Ensure to use proper P6 Activity IDs from P6.
16	Milestone Successor (s)	List any milestone successors, if applicable. Ensure to use proper P6 Activity IDs from P6.
17	Milestone Completion	Check off one Status: <b>G</b> - Shows that the milestone was completed on time as indicated by the initial TCD; <b>R</b> - Shows that the milestone was completed on time based on a recovery plan; <b>N</b> - Shows that the milestone was removed through the approved CCF process.
18	Milestone Deliverable Met	Indicate how your department met each of the requirements of the Milestone Definition. Provide details, PASSPORT Documents, signed letters etc. Indicate Challenge Process used.
19	Final Signatures	This form shall be signed by the Owner of the Milestone; Shall be Recommended to Close by the appropriate line RPET Member, and Final approved by the Director, Planning and Controls

Note: This form can also be used for NR AIP Scorecard Definition requirements. For details, please contact P&C Scheduling Departments

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## Appendix F: Instruction to Fill Out D-FORM-10763 (Recovery / Mitigation Plan)



Records File Information:  
Sent to Records for file

Internal Use Only  
D-FORM-10763-R007\*

### Darlington Refurbishment Program Milestone Recovery/Mitigation Plan Template

Record Number: NK38-REF-09701 -R- ①

Recovery / Mitigation Plan for Milestone Number: ②

Milestone Description: ③

To: Director, Planning & Controls	From: ④ (Milestone Owner)	Date: ⑤
Original Milestone Completion Date: ⑥	Date which Milestone will be Complete: ⑦ Recovery date: Mitigation date:	

Cause of Milestone Challenge: ⑧
Course of Action to Recover the Milestone: Include responsible individuals and due dates. ⑨
Determine Effect on Successor Milestones: Quantify impact of all successor milestones. ⑩

Final Signatures			
⑪	Approval Level	Signature	Date Signed
	Issued by - Owner		
	Recommended by - RPET		
	Approved by – Director, Planning & Controls		

\*Associated with N-MAN-00120-10001-SCH-06, Nuclear Refurbishment - Program Milestone Definition Framework  
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Appendix F: (Continued)

*\*Please refer to N-MAN-00120-10001-SCH-06, Nuclear Refurbishment – Milestone Definition Framework*

ID	Section	What is this?
1	Record Number	The standard record number begins with NK38-ref-09701-xxxxxx- this cannot change. The xxxxxx portion of the record number shall be the Activity ID assigned in the P6 Schedule.  Note: The form defaults to include an "R", this differentiates the recovery plan from the milestone definition form.
2	Recovery Plan for Milestone Number	This shall be the Activity ID assigned in the P6 Schedule
3	Milestone Description	This shall be the Activity Name from the P6 Schedule
4	From	Milestone Owner as identified in the initial Milestone Definition form.  Please specify the individual and their position.
5	Date	The date the recovery plans was drawn up.
6	Original Milestone Complete Date	This is the milestone completion date, as identified in the Milestone Definition Form (this is also established in P6 schedule by BL Project Finish.)
7	Milestone Recovery / Mitigation Date	Recovery Date on or before original date. Mitigation Date after original date.
8	Cause of Milestone Challenge	Identify the reason(s) why the milestone due date has been impacted
9	Course of Action to Recover the Milestone	Identify the path forward to complete with a list of actions to recover the milestone. Include responsible individuals and due dates.
10	Effect on Successor Milestone	Quantify the impact of all successor milestones
11	Final Signatures	This form shall be signed by the Owner of the Milestone; Shall be Recommended by the appropriate line RPET Member, and Final approved by the Director, Planning and Controls



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**DARLINGTON REFURBISHMENT PROGRAM MILESTONE & INTEGRATED MASTER SCHEDULE**

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**Darlington Refurbishment Program  
Milestone & Integrated Master Schedule**

**NK38-PLAN-00300-10000-R003**  
2014-09-25

Order Number: N/A  
Other Reference Number:

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Prepared by:

\_\_\_\_\_  
Derek McAuley  
Manager, Scheduling      Date  
Planning & Control  
Nuclear Refurbishment

Concurred by:

\_\_\_\_\_  
Gary Rose      Date  
Director, Planning &  
Project Control  
Nuclear Refurbishment

Approved by:

\_\_\_\_\_  
Dietmar Reiner      Date  
SVP  
Nuclear Refurbishment

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**Revision Summary**

Revision Number	Date	Comments
R000	2010-12-21	Initial Issue
R001	2012-01-31	First Revision - Reflects a 2016 first unit Refurb start date and further development of the program milestones and individual project milestones. See Section 2.0 of this document for further details.
R002	2014-01-31	Second Revision – Reflects no overlapping between Unit 2 and Unit 1 outages; Additional milestones to align with NK38-MAN-09701-10005 NUCLEAR REFURBISHMENT PLANNED OUTAGE MANAGEMENT and based on current status of all project bundles.
R003	2014-09-25	<p><b>(1)</b> The document name is changed to <i>Darlington Refurbishment Program Milestone &amp; Integrated Master Schedule</i>, to better reflect the content.</p> <p><b>(2)</b> Third Revision – Aligns milestone changes in NK38-MAN-09701-10005, <i>Nuclear Refurbishment Planned Outage Management</i>.</p> <p><b>(3)</b> Based on current planning assumptions, the unit refurb outage sequence order has been changed to Unit 2, Unit 3, Unit 1 and Unit 4. Please refer to <i>Darlington Refurbishment – Unit Outage Sequence Update</i> (File: NK38-00531 P, CD#: NK38-CORR-00531-17008).</p> <p><b>(4)</b> Every refurb outage is broken into 4 segments: Lead-in Segment, Removal Segment, Inspections &amp; Installation Segment and Lead-out Segment.</p> <p><b>(5)</b> Several milestone dates are changed, including</p> <ul style="list-style-type: none"> <li>• OP2015 (Initial Work Order Assessment Complete): from 15-Sep-14 to 30-Jan-15 (RO-20.5).</li> <li>• OP2040 (Long Lead and At Risk Materials Identified): from 15-Nov-14 to 15-Feb-15 (RO-20).</li> <li>• OP2070 (U2 Segment 1 Work Package Assessing Complete) to OP2070S1: 15-Sep-15 to 15-Apr-16 (SS-06).</li> <li>• OP2060 (U2 Segment 1 Readiness Assessment Finished) to OP2060S1: 15-Oct-15 to 15-Jul-16 (SS-03).</li> <li>• OP2160 (All U2 Segment 1 Documentation Ready) to OP2160S1: from 15-Oct-15 to 15-Feb-16 (SS-08).</li> <li>• OP2200 (Unit Refurb High Level Permitry Level 1 Plan Completed: from 15-Feb-16 to 15-Dec-15 (RO-10).</li> <li>• OP2260 (U2 Segment 1 Reactor Safety Challenge Meeting) to OP2260S1: from 15-Jul-16 to 15-Sep-16 (SS-01).</li> <li>• OP2100 (U2 Segment 1 Materials Staged and Tools on Site) to OP2100S1: from 15-Jul-16 to 30-Aug-16 (SS-01.5).</li> <li>• OP2230 (U2 Segment 1 Work Permits Prepared &amp; Reviewed and Challenge Meeting held by Operations) to OP2230S1: from RO-03 to SS-03 (15-Jul-16).</li> <li>• OP2240. Change word in title from “Support” to “Strategic Plan” (Radiation Protection Strategic Plan Support, Waste Minimization &amp; Outage Environmental Safety Plan Prepared).</li> </ul> <p><b>(6)</b> New Milestones are added, including</p> <ul style="list-style-type: none"> <li>• OP2290 (Cyclical Scope/Cost/Duration Reconciliation Review): RO-15 (15-Jul-15).</li> <li>• RP290 (Refurb Inspection &amp; Installation Segment Training Readiness) RO+19 (15-</li> </ul>

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		<p>May-18).</p> <ul style="list-style-type: none"> <li>• Created instances of RP200, RP210, RP270 and RP290 and for the other 3 units.</li> <li>• OP2300S1 (U2 Segment 1 At-Risk Materials List Generated): SS-13 (15-Sep-15).</li> <li>• OP2310S1 (All U2 Segment 1 Holds Removed): SS-06.5 (30-Mar-16).</li> <li>• OP2350-S1 (U2 Segment 1 Dose Estimate Complete): SS-03 (15-Jul-16).</li> <li>• OP2200-S1 (U2 Segment 1 Detailed Permitry Level 1 Plan Completed): SS-05.5 (30-Apr-16).</li> <li>• OP2330-S1 (All U2 Segment 1 materials on-site or dispositioned): SS-03 (15-Jul-16).</li> <li>• OP2320-S1 (All U2 Segment 1 Applicable walk-downs complete): SS-00.5 (30-Sep-16).</li> </ul>
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## 1.0 OVERVIEW

In order to sufficiently prepare and efficiently implement the Darlington Nuclear Refurbishment Program, a multi level scheduling approach is applied, including

- Level 0: Program Milestone Schedule
- Level 1: Program Integrated Master Schedule
- Level 2: Program Coordination & Control Schedules
- Level 3: Project Detailed Production Schedules

The Darlington Refurbishment Program Milestone & Integrated Master Schedule (PMIMS, NK38-PLAN-00300-10000) is the preamble of the Program Level 0 Schedule and Program Level 1 Schedule, and it describes

- The Program Milestone Dates and Owners
- The Responsibility Allocation and Control Accounts
- Assumptions
- Alignment with station and planned outages

All Project Bundles and functional groups have Control Accounts (Level 1 Activities) shown on the Program Level 1 Schedule. These Control Accounts are further broken down to Work Packages (Level 2 Activities) in Program Level 2 Schedules.

The Level 1 Activities (Control Accounts) in the Program Level 1 Schedule and Level 2 Activities (Work Packages) in Program Level 2 Schedules are logically tied to relevant Program Milestones, where applicable.

The PMIMS Revision 3 has been developed with current contracting strategies for each project bundle. Once a contract is awarded, an assessment against the Program Milestones will be performed. Program Milestones are re-evaluated when necessary and on an annual basis.

## 2.0 DESCRIPTION

The Darlington Refurbishment Program Integrated Master Schedule Revision 0 (R000) was approved in December 2010, Revision 1 (R001) was approved in January 2012, and Revision 2 (R002) was approved in January 2014.

Revision 3 (R003) is required based on the following changes,

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- The unit refurb outage sequence order identified in the Darlington Life Extension Model shows the unit sequence order being unit 2, unit 1, unit 3 and unit 4. Based on current planning assumptions, a different unit order has been confirmed by OPG and is now Unit 2, Unit 3, Unit 1 and Unit 4. This change has been formally communicated with CNSC. Please refer to **Darlington Refurbishment – Unit Outage Sequence Update** (File: NK38-00531 P, CD#: NK38-CORR-00531-17008);
- This new sequence order has no impact on the planned unit outage dates associated with the Nuclear Refurbishment Program also identified in the Darlington Life Extension Model;
- Every refurb outage is broken into 4 segments: Lead-in Segment, Removal Segment, Inspection & Installation Segment and Lead-out Segment, so that the project teams will focus on the specific segment, and integration can be achieved segment by segment;
- Accordingly, segmentised Outage Preparation Milestones are added and they are documented in NK38-MAN-09701-10005, Nuclear Refurbishment Planned Outage Management.

The PMIMS Revision 3 documents have been updated to reflect these changes and to provide additional details as the planning phase is further developed.

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### 3.0 RESPONSIBILITY ALLOCATION

Following the matrix structure of the Darlington Refurb Program Work, the responsibility allocation is stated as,

Project Bundles	Scope of Work	Responsible	Accountable
<b>R&amp;FR</b>	<ul style="list-style-type: none"> <li>Tooling for R&amp;FR</li> <li>Mock-up &amp; Training for R&amp;FR</li> <li>Retube and Feeder Replacement work</li> </ul>	Project Manager	VP, Refurb Execution
<b>Turbine Generator</b>	<ul style="list-style-type: none"> <li>TG Engineering Services and Equipment Supply work</li> <li>TG Minor Procurement and TG Refurb Construction work</li> <li>TG Inspections and Repairs</li> </ul>	Project Manager	VP, Refurb Execution
<b>Steam Generator</b>	<ul style="list-style-type: none"> <li>SG EPC Contract work, including Primary Side Cleaning, SG Water Lancing, SG Access Port, SG Tube and Divider Inspections and SG Minor Projects</li> <li>SG Inspections and Repairs</li> </ul>	Project Manager	VP, Refurb Execution
<b>Fuel Handling &amp; Defueling Bundle</b>	<ul style="list-style-type: none"> <li>Defueling Preparations</li> <li>Fuel Handling Refurb</li> <li>Fuel Handling Specialised Projects</li> </ul>	Project Manager	VP, Refurb Execution
<b>Balance of Plant</b>	<ul style="list-style-type: none"> <li>BOP Common Systems Refurb</li> <li>BOP Nuclear Systems Refurb</li> <li>BOP Conventional Systems Refurb</li> </ul>	Project Manager	VP, Refurb Execution
<b>Islanding</b>	<ul style="list-style-type: none"> <li>Bulkhead &amp; Containment Isolation</li> <li>Barriers Project</li> <li>Islanding Pre-Outage Modifications</li> <li>Islanding Outage Modifications</li> </ul>	Project Manager	VP, Refurb Execution
<b>Shutdown, Layup and Services</b>	<ul style="list-style-type: none"> <li>Unit Takeover from the Station</li> <li>Unit Shutdown</li> <li>Shutdown Pre-Req. Modifications</li> <li>Shutdown Outage Mods.</li> <li>Unit Layup Services</li> </ul>	Project Manager	VP, Refurb Execution



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<b>Refurb Support Facilities</b>	<ul style="list-style-type: none"> <li>• RSF-Work Control Area (73711)</li> <li>• Radiation Protection Teledosimetry (73712)</li> <li>• Washroom Facility and Turbine Lunch Room (73716)</li> <li>• Shops and Work Areas (73715)</li> <li>• TAB West Elevation Elevator (73713)</li> <li>• Decontamination Shops /Contaminated Shops and Work Areas (73714)</li> <li>• Off-Site Security X-Ray Scanner (73718)</li> <li>• Vestibule, Storage Pad, PB Lay-down Area and Pathways (73716)</li> <li>• Electronic Work Authorization Areas Kiosks (73719)</li> </ul>	Project Manager	VP, Refurb Execution
<b>Facilities and Infrastructure Projects- Inside</b>	<ul style="list-style-type: none"> <li>• D2O Storage Facility (31555)</li> <li>• R&amp;FR Island Support Annex (73810)</li> <li>• Nuclear Waste Processing Facility</li> <li>• R&amp;FR Replacement Facilities</li> <li>• R&amp;FR Command Centre</li> </ul>	Director, Facilities and Infrastructure Projects	VP, Projects & Modifications
<b>Facilities and Infrastructure Projects - Outside</b>	<ul style="list-style-type: none"> <li>• Retube Waste Storage Facility (60162)</li> <li>• West Security &amp; Office Building (73808/73815)</li> <li>• Darlington Energy Complex (73803)</li> <li>• DNGD Maintenance Facility (31717)</li> <li>• Warehouse Facilities (73822)</li> <li>• Contractor Trailer Park (73826)</li> <li>• OSB Refurb (25619)</li> <li>• Facility Services Building (73825)</li> <li>• Facility Support Services – A,B (73823/73824)</li> <li>• Demolition Projects – A,B,C (73891/73892/73893)</li> <li>• Boiler House Replacement (34000)</li> <li>• Information Centre (73804)</li> <li>• GM Office Lease (73814)</li> </ul>	Director, Facilities and Infrastructure Projects	VP, Projects & Modifications
<b>Facilities and Infrastructure Projects - Infrastructure</b>	<ul style="list-style-type: none"> <li>• Water &amp; Sewer Project (73802)</li> <li>• Road &amp; Bridges – DN Operation (73829)</li> <li>• Parking – DN Operation (73828)</li> <li>• Parking – DN Removal (73894)</li> <li>• General Services – DN Operation (73827)</li> <li>• Power &amp; Electrical Distribution (73821)</li> <li>• MTO Holt Road Interchange (73706)</li> <li>• Hepcoe Demolition (73897)</li> <li>• Landscape (73896)</li> <li>• Underground Services Upgrade</li> </ul>	Director, Facilities and Infrastructure Projects	VP, Projects & Modifications
<b>Cyclical Maintenance</b>	<ul style="list-style-type: none"> <li>• Cyclical maintenance work to be performed during 4 Refurb outages</li> </ul>	Manager, NR Operations & Maintenance	Director, NR Operations & Maintenance

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<b>Commissioning &amp; Start-up</b>	<ul style="list-style-type: none"> <li>• Provide test and commissioning guidelines and procedures to contractors</li> <li>• Assist project managers to perform system test and commissioning</li> <li>• Organise systems combined commissioning, unit start up and organize performances test</li> <li>• Unit Handover to the Station</li> </ul>	Director, NR O&M	SVP, Nuclear Refurb
<b>Unit Demobilization</b>	<ul style="list-style-type: none"> <li>• Unit Refurb Outage Demobilization</li> <li>• Contract closeout by units</li> <li>• Site management transferring to successor unit</li> </ul>	VP, Refurb Execution	SVP, Nuclear Refurb
<b>Final Station Demobilization</b>	<ul style="list-style-type: none"> <li>• Post Refurb Programs Identification</li> <li>• Demolition of Temporary Buildings</li> <li>• Landscaping &amp; Rehabilitation</li> <li>• Station Configuration As Built Tech. Docs</li> <li>• Program Final Acceptance</li> </ul>	VP, Refurb Execution	SVP, Nuclear Refurb
<b>Functional Work</b>	Described in NR Program Management Plans	NP Division Directors	SVP, Nuclear Refurb

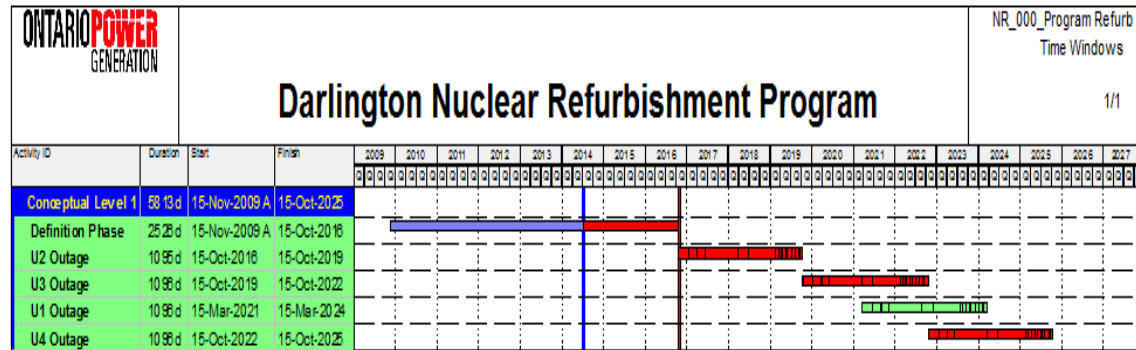
#### 4.0 PROGRAM PHASES

10 Phases were defined for the Darlington Nuclear Refurbishment Program as follows, for financial release purposes.

- Phase 1: Program Initiation Phase, 2007-2008
- Phase 2: Program Approval Phase, 2008-2009
- Phase 3: Preliminary Planning Phase, 2009-2011
- Phase 4: Detailed Engineering & Refurb Scope Definition Phase, 2012-2014
- Phase 5: Outage Preparation Phase, 2014-2015
- Phase 6: Unit 2 Refurb Outage Phase/U2 Release Quality Estimate, 2015-2019
- Phase 7: Unit 3 Refurb Outage Phase/U3 Release Quality Estimate, 2018-2023
- Phase 8: Unit 1 Refurb Outage Phase/U1 Release Quality Estimate, 2020-2024
- Phase 9: Unit 4 Refurb Outage Phase/U4 Release Quality Estimate, 2021-2025
- Phase 10: Program Closure Phase, 2024-2026

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**Note:** this diagram shows only Definition Phase and the 4 Unit Refurb Execution Phases.

## 5.0 PROGRAM MILESTONE DEFINITIONS

As per N-MAN-00120-10001-SCH-06, each individual milestone definition sheet is issued as a record in AssetSuite.

Program Milestone Definitions of PMIMS Revision 3 can be found in PowerSearch and AssetSuite via using the Milestone ID with "NK38-REF-09701-" pre-fix as the record number.

For the Program Milestones and Key Dates, please refer to Appendix B.

## 6.0 ALIGNMENT WITH STATION PLANNED OUTAGES AND OPERATING WORK PROGRAM

### 6.1 Pre-Refurb Work in Station Planned Outages

There are pre-refurb work activities that must be completed in the Darlington planned outages leading up to Refurb. It is the responsibility of the Nuclear Refurb Team to identify these Work Orders and ensure scope rationalization is provided prior to Planned Outage scope freeze. *Planned Outage Management* (N-PROC-MA-0013) will be followed.

### 6.2 Pre-Refurb Work in the On-Line Work Schedule

There is work that can be completed in Darlington's on-line program (IPG). This work is being integrated into the IPG work program, following the *Integrated On-Line Work Schedule* (N-PROC-MA-0022).

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## 7.0 ASSUMPTIONS

The Program Integrated Master Schedule (R003) is based on the following assumptions,

- EPC Contractors will undertake the major work nuclear refurbish work while OPG establishes a team to oversight and support the refurb work.
- OPG will undertake cyclical maintenance work and unit commissioning & start-up.
- There will be no resource demand conflict due to other nuclear stations' refurb program/projects, i.e., the major contractors will have sufficient resources to complete the work for NR Program.
- There will be no further strategic change on the sequence of the four Unit Outages, as described in detail in Section 2.0 and Section 4.0.
- PIMS is developed in a progressive elaboration approach. The Level 1 Activities in the PIMS are originally *instructive version*, and they become *control version* when the relevant work is released and the contractors' detailed schedule is summarised and baselined.

For detailed assumptions and risks of each project bundle, please refer to Nuclear Refurbishment Actions, Issues, Decisions and Key Assumptions Management (N-MAN-0120-10001-RISK-07).

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**Appendix A: Program Integrated Master Schedule before U2 Circuit Breaker Open**

The Program Integrated Master Schedule that contains all Control Accounts (Level 1 Activities) is published on OPG WebPages at the following link and it is monthly updated: <http://catou-ogwspuwdc:9015/webpublishing/nuclear/projects/dr/Pages/CCSchedules.aspx>

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**Appendix B: Program Milestones and Key Dates**

Activity ID	Activity Name	Start	Finish	Owner
<b>Regulatory Key Dates</b>		<b>04-Oct-10 A</b>	<b>4-Jul-22</b>	
<b>UC Regulatory Key Dates</b>		<b>04-Oct-10 A</b>	<b>31-Dec-14</b>	
RG010	Protocol to Manage Interaction on ISR		04-Oct-10 A	VP, Nuclear Services
RG020	CNSC Acceptance of ISR Procedure		30-Dec-10 A	VP, Nuclear Services
RG030	Submission of EA Project Description		28-Apr-11 A	VP, Nuclear Services
RG051	Submission of DNGS License Extension Application		28-Jun-11 A	VP, Nuclear Services
RG040	Submission of Final ISR Report		27-Oct-11 A	VP, Nuclear Services
RG050	Submission of EIS/TSD's		01-Dec-11 A	VP, Nuclear Services
RG060	CNSC Staff Issue Final ISR Report Sufficiency Review		06-Feb-12 A	VP, Nuclear Services
RG085	CNSC EA Hearing		03-Dec-12 A	VP, Nuclear Services
RG080	Current License End Date		28-Feb-13 A	VP, Nuclear Services
RG070	CNSC Decision on EA		14-Mar-13 A	VP, Nuclear Services
RG075	CNSC Approval for NWSF License Renewal		14-Mar-13 A	VP, Nuclear Waste Management
RG100	CNSC Staff Assessment of Final ISR Report		05-Jul-13 A	VP, Nuclear Services
RG110	Submission of IIP & License Renewal Application		22-Nov-13 A	VP, Nuclear Services
RG090	CNSC Certification of RWC Transportation Package Design		23-Jan-14 A	VP, Nuclear Waste Management
RG120	IIP Approval by CNSC		31-Dec-14	VP, Nuclear Services
<b>U2 Regulatory Key Dates</b>		<b>15-Jan-16</b>	<b>15-Jul-16</b>	
RG125	U2 Submit Request for Outage Approvals		15-Jan-16	VP, Nuclear Services
RG130	U2 Outage CNSC Approvals in Place		15-Jul-16	VP, Nuclear Services
<b>U3 Regulatory Key Dates</b>		<b>15-Jan-19</b>	<b>15-Jul-19</b>	
RG153	U3 Submit Request for Outage Approvals		15-Jan-19	VP, Nuclear Services
RG157	U3 Outage CNSC Approvals in Place		15-Jul-19	VP, Nuclear Services
<b>U1 Regulatory Key Dates</b>		<b>15-Jun-20</b>	<b>15-Dec-20</b>	
RG143	U1 Submit Request for Outage Approvals		15-Jun-20	VP, Nuclear Services
RG147	U1 Outage CNSC Approvals in Place		15-Dec-20	VP, Nuclear Services
<b>U4 Regulatory Key Dates</b>		<b>4-Jan-22</b>	<b>4-Jul-22</b>	
RG163	U4 Submit Request for Outage Approvals		15-Jan-22	VP, Nuclear Services
RG167	U4 Outage CNSC Approvals in Place		15-Jul-22	VP, Nuclear Services
<b>Program Release Dates</b>		<b>19-Nov-09 A</b>	<b>15-Oct-21</b>	
RL010	Rel.3: Preliminary Planning Release	19-Nov-09 A		Director, NR P&PC
RL020	Rel.4A: Detailed Planning Release A	17-Nov-11 A		Director, NR P&PC

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Activity ID	Activity Name	Start	Finish	Owner
RL025	Rel.4B: Detailed Planning Release B	15-Nov-12 A		Director, NR P&PC
RL070	Rel.4C: Detailed Planning Release C	14-Nov-13 A		Director, NR P&PC
RL080	Rel.4D: Detailed Planning Release D	13-Nov-14		Director, NR P&PC
RL030	Rel.5/6/RQE: U2 Outage Release	15-Oct-15		Director, NR P&PC
RL040	Rel.7: Unit 3 Outage Release	15-Oct-18		Director, NR P&PC
RL050	Rel.8: Unit 1 Outage Release	15-Mar-20		Director, NR P&PC
RL060	Rel.9: Unit 4 Outage Release	15-Oct-21		Director, NR P&PC
<b>Facilities and Infrastructure MS</b>		<b>15-Apr-16</b>	<b>15-Apr-16</b>	
CP190	All Refurb Related Facilities & Infrastructure Projects Ready for Service		15-Apr-16	VP, Proj.& Mods
<b>Outage Preparation Key Dates</b>		<b>19-Nov-09 A</b>	<b>15-Apr-25</b>	
<b>Unit Common Outage Prep. MS</b>		<b>19-Nov-09 A</b>	<b>15-Jun-16</b>	
RP010	Program Execution Plan (PEP) Approved		19-Nov-09 A	Director, NR P&PC
RP020	R&FR Contract Tech. Spec. Issued		15-Sep-10 A	VP, NR Engineering
RP030	Program Integrated Master Schedule Approved		15-Dec-10 A	Director, NR P&PC
RP039	R&FR Project RFP Issued		22-Feb-11 A	Director, NR P&PC
RP040	Program Scope Identified		12-May-11 A	VP, NR Engineering
RP050	Unit Outage Sequence Duration and Start Date Defined (incl. VBO Pre/Post Outages)		25-May-11 A	VP, NR Execution
RP055	2nd Phase Evolution of Outage Sequence		15-Oct-11 A	VP, NR Execution
RP070	1st Priority Projects RFP's Issued		15-Dec-11 A	Director, NR Supply Chain
RP065	Preliminary Engineering Procedure List Developed		15-Dec-11 A	VP, NR Engineering
RP075	PIMS Revision 2016 Start Issued		15-Feb-12 A	Director, NR P&PC
RP060	R&FR Contract Awarding		01-Mar-12 A	Director, NR Supply Chain
OP2000	U2 Health of Scope < 20		12-Oct-12 A	VP, NR Engineering
RP080	Fuel Channel Annulus Spacer Design Selected		23-Oct-12 A	VP, NR Engineering
OP2005	U2 Level 3 Schedule Developed for Definition Phase		14-Dec-12 A	Director, NR P&PC
RP150	Fuel Channel LCM Project Complete		21-Dec-12 A	VP, NR, Engineering
RP240	Mock-up Installation Starts at DEC		21-May-13 A	VP, NR Execution
RP230	57 DSR's for Engineering Studies Completion/Disposition		31-Oct-13 A	VP, NR Engineering
OP1000	All Units Health of Scope <20		15-Nov-13 A	VP, NR Engineering
RP140	Preliminary Engineering Standards Complete		15-Nov-13 A	VP, NR Engineering
RP250	Mock Ups Site Construction and Assembly Complete		13-Feb-14 A	VP, NR Execution

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Activity ID	Activity Name	Start	Finish	Owner
RP170	R&FR Mock-up Available for Service		31-Mar-14 A	VP, NR Execution
RP280	Blue Ribbon Task Force Scope Recommendations		31-Mar-14 A	VP, NR Execution
RP160	Refurbishment MDR's Complete		15-Aug-14	VP, NR Engineering
RP180	Program Health Review Finished		15-Oct-14	Director, NR P&PC
RP190	R&FR Tooling Available for Service		15-Aug-15	VP, NR Execution
RP130	All Projects Detailed Engineering Finished/U2 Design Mod. Docs Finished		15-Aug-15	VP, NR Engineering
RP260	R&FR Definition Phase Complete/Production Tools Delivered to DEC		15-Jun-16	VP, NR Execution
<b>Unit 2 Outage Prep. MS</b>		<b>15-Apr-14 A</b>	<b>15-Apr-19</b>	
<b>Non-Segmentised Prep. MS</b>		<b>15-Apr-14 A</b>	<b>15-Apr-19</b>	
OP2010	U2 Outage Level 1 Revision A Issued		15-Apr-14 A	NR, Unit Director
OP2020	U2 OMS Work Order Scope Definition Complete		15-Oct-14	VP, NR Execution
OP2120	U2 Refurb Outage Planning Organization Defined		15-Oct-14	NR, Unit Director
OP2130	U2 Refurb Pre-Outage Metrics Prepared		15-Oct-14	Director, NR P&PC
OP2140	U2 Scope Ranked and Approved in OMS		15-Jan-15	NR, Unit Director
OP2015	U2 Initial Work Order Assessment Complete		01-Feb-15	VP, NR Execution
OP2040	U2 Long Lead and At Risk Materials Identified		15-Feb-15	VP, NR Execution
OP2050	U2 Outage Level 1 Revision B Issued		15-Apr-15	NR, Unit Director
OP2290	U2 Cyclical Scope/Cost/Duration Reconciliation Review		15-Jul-15	NR, Unit Director
OP2075	U2 OMS Work Order Scope Freeze		15-Oct-15	NR, Unit Director
OP2170	U2 PC1's Submitted		15-Nov-15	VP, NR Execution
OP2180	U2 Refurb Outage Pre-Requisites Scheduled		15-Dec-15	NR, Unit Director
OP2200	U2 Refurb Outage High Level Permitry Level 1 Plan Completed		15-Dec-15	Director, NR O&M
OP2210	U2 Risk Mitigation Plans Prepared		15-Feb-16	VP, NR Execution
OP2080	U2 Outage Level 1 Revision C Issued		15-Apr-16	NR, Unit Director
OP2110	U2 Outage Level 1 Revision 0 Issued (Control Version)		15-Jul-16	NR, Unit Director
OP2220	U2 Refurb Outage Execution Organization Identified		15-Jul-16	VP, NR Execution
OP2240	U2 Radiation Protection Support, Waste Minimization & Outage Environment Safety Plan Prepared		15-Jul-16	Director, NR O&M
OP2250	U2 Refurb Outage Execution Metrics Prepared		15-Jul-16	VP, NR Execution



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Activity ID	Activity Name	Start	Finish	Owner
OP2270	U2 Refurb Outage Briefing Packages Ready		15-Aug-16	Section Manager, NR Public Affairs
RP200U2	U2 Refurb Training Outage Readiness		01-Oct-16	Director, NR O&M
OP2280	U2 Refurb Outage Pre-Requisites Complete		15-Oct-16	VP, NR Execution
RP270U2	U2 Refurb Training Execution Readiness		15-Apr-17	Director, NR O&M
RP290U2	U2 Refurb Inspection & Installation Training Readiness		15-May-18	Director, NR O&M
RP210U2	U2 Refurb Training Operational Readiness		15-Apr-19	Director, NR O&M
<b>Unit 3 Outage Prep. MS</b>		<b>15-Apr-17</b>	<b>15-Apr-22</b>	
<b>Non-Segmented Prep. MS</b>		<b>15-Apr-17</b>	<b>15-Apr-22</b>	
OP3010	U3 Outage Level 1 Revision A Issued		15-Apr-17	NR, Unit Director
OP3020	U3 OMS Work Order Scope Definition Complete		15-Oct-17	VP, NR Execution
OP3120	U3 Refurb Outage Planning Organization Defined		15-Oct-17	NR, Unit Director
OP3130	U3 Refurb Pre-Outage Metrics Prepared		15-Oct-17	Director, NR P&PC
OP3140	U3 Scope Ranked and Approved in OMS		15-Jan-18	NR, Unit Director
OP3015	U3 Initial Work Order Assessment Complete		01-Feb-18	VP, NR Execution
OP3040	U3 Long Lead and At Risk Materials Identified		15-Feb-18	VP, NR Execution
OP3050	U3 Outage Level 1 Revision B Issued		15-Apr-18	NR, Unit Director
OP3290	U3 Cyclical Scope/Cost/Duration Reconciliation Review		15-Jul-18	NR, Unit Director
OP3055	U3 Project Detailed Engineering Finished (Design Modification Documents Finished)		15-Aug-18	VP, NR Engineering
OP3075	U3 OMS Work Order Scope Freeze		15-Oct-18	NR, Unit Director
OP3170	U3 PC1's Submitted		15-Nov-18	VP, NR Execution
OP3180	U3 Refurb Outage Pre-Requisites Scheduled		15-Dec-18	VP, NR Execution
OP3200	U3 Refurb Outage High Level Permitry Level 1 Plan Completed		15-Dec-18	VP, NR Execution
OP3210	U3 Risk Mitigation Plans Prepared		15-Feb-19	VP, NR Execution
OP3080	U3 Outage Level 1 Revision C Issued		15-Apr-19	NR, Unit Director
OP3110	U3 Outage Level 1 Revision 0 Issued (Control Version)		15-Jul-19	NR, Unit Director
OP3220	U3 Refurb Outage Execution Organization Identified		15-Jul-19	VP, NR Execution
OP3240	U3 Radiation Protection Support, Waste Minimization & Outage Environment Safety Plan Prepared		15-Jul-19	Director, NR O&M
OP3250	U3 Refurb Outage Execution Metrics Prepared		15-Jul-19	VP, NR Execution

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Activity ID	Activity Name	Start	Finish	Owner
OP3270	U3 Refurb Outage Briefing Packages Ready		15-Aug-19	Section Manager, NR Public Affairs
RP200U3	U3 Refurb Training Outage Readiness		01-Oct-19	Director, NR O&M
OP3280	U3 Refurb Outage Pre-Requisites Complete		15-Oct-19	VP, NR Execution
RP270U3	U3 Refurb Training Execution Readiness		15-Apr-20	Director, NR O&M
RP290U3	U3 Refurb Inspection & Installation Training Readiness		15-May-21	Director, NR O&M
RP210U3	U3 Refurb Training Operational Readiness		15-Apr-22	Director, NR O&M
<b>Unit 1 Outage Prep. MS</b>		<b>15-Sep-18</b>	<b>15-Sep-23</b>	
<b>Non-Segmented Prep. MS</b>		<b>15-Sep-18</b>	<b>15-Sep-23</b>	
OP1010	U1 Outage Level 1 Revision A issued		15-Sep-18	NR, Unit Director
OP1020	U1 OMS Work Order Scope Definition Complete		15-Mar-19	VP, NR Execution
OP1120	U1 Refurb Outage Planning Organization Defined		15-Mar-19	NR, Unit Director
OP1130	U1 Refurb Pre-Outage Metrics Prepared		15-Mar-19	Director, NR P&PC
OP1140	U1 Scope Ranked and Approved in OMS		15-Jun-19	NR, Unit Director
OP1015	U1 Initial Work Order Assessment Complete		01-Jul-19	VP, NR Execution
OP1040	U1 Long Lead and At Risk Materials Identified		15-Jul-19	VP, NR Execution
OP1050	U1 Outage Level 1 Revision B Issued		15-Sep-19	NR, Unit Director
OP1290	U1 Cyclical Scope/Cost/Duration Reconciliation Review		15-Dec-19	NR, Unit Director
OP1055	U1 Project Detailed Engineering Finished (Design Modification Documents Finished)		15-Jan-20	VP, NR Engineering
OP1075	U1 OMS Work Order Scope Freeze		15-Mar-20	NR, Unit Director
OP1170	U1 PC1's Submitted		15-Apr-20	VP, NR Execution
OP1180	U1 Refurb Outage Pre-Requisites Scheduled		15-May-20	NR, Unit Director
OP1200	U1 Refurb Outage High Level Permitry Level 1 Plan Completed		15-May-20	Director, NR O&M
OP1210	U1 Risk Mitigation Plans Prepared		15-Jul-20	VP, NR Execution
OP1080	U1 Outage Level 1 Revision C Issued		15-Sep-20	NR, Unit Director
OP1110	U1 Outage Level 1 Revision 0 Issued (Control Version)		15-Dec-20	NR, Unit Director
OP1220	U1 Refurb Outage Execution Organization Identified		15-Dec-20	VP, NR Execution
OP1240	U1 Radiation Protection Support, Waste Minimization & Outage Environment Safety Plan Prepared		15-Dec-20	Director, NR O&M
OP1250	U1 Refurb Outage Execution Metrics Prepared		15-Dec-20	VP, NR Execution

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Activity ID	Activity Name	Start	Finish	Owner
OP1270	U1 Refurb Outage Briefing Packages Ready		15-Jan-21	Section Manager, NR Public Affairs
RP200U1	U1 Refurb Training Outage Readiness		01-Mar-21	Director, NR O&M
OP1280	U1 Refurb Outage Pre-Requisites Complete		15-Mar-21	VP, NR Execution
RP270U1	U1 Refurb Training Execution Readiness		15-Sep-21	Director, NR O&M
RP290U1	U1 Refurb Inspection & Installation Training Readiness		15-Oct-22	Director, NR O&M
RP210U1	U1 Refurb Training Operational Readiness		15-Sep-23	Director, NR O&M
<b>Unit 4 Outage Prep. MS</b>		<b>15-Apr-20</b>	<b>15-Apr-25</b>	
<b>Non-Segmented Prep. MS</b>		<b>15-Apr-20</b>	<b>15-Apr-25</b>	
OP4010	U4 Outage Level 1 Revision A Issued		15-Apr-20	NR, Unit Director
OP4020	U4 OMS Work Order Scope Definition Complete		15-Oct-20	VP, NR Execution
OP4120	U4 Refurb Outage Planning Organization Defined		15-Oct-20	Director, NR P&PC
OP4130	U4 Refurb Pre-Outage Metrics Prepared		15-Oct-20	Director, NR P&PC
OP4140	U4 Scope Ranked and Approved in OMS		15-Jan-21	NR, Unit Director
OP4015	U4 Initial Work Order Assessment Complete		01-Feb-21	VP, NR Execution
OP4040	U4 Long Lead Materials Identified		15-Feb-21	VP, NR Execution
OP4050	U4 Outage Level 1 Revision B Issued		15-Apr-21	NR, Unit Director
OP4290	U4 Cyclical Scope/Cost/Duration Reconciliation Review		15-Jul-21	NR, Unit Director
OP4055	U4 Project Detailed Engineering Finished (Design Modification Documents Finished)		15-Aug-21	VP, NR Engineering
OP4075	U4 OMS Work Order Scope Freeze		15-Oct-21	NR, Unit Director
OP4170	U4 PC1's Submitted		15-Nov-21	VP, NR Execution
OP4180	U4 Refurb Outage Pre-Requisites Scheduled		15-Dec-21	VP, NR Execution
OP4200	U4 Refurb Outage High Level Permitry Level 1 Plan Completed		15-Dec-21	Director, NR O&M
OP4210	U4 Risk Mitigation Plans Prepared		15-Feb-22	VP, NR Execution
OP4080	U4 Outage Level 1 Revision C Issued		15-Apr-22	NR, Unit Director
OP4110	U4 Outage Level 1 Revision 0 Issued (Control Version)		15-Jul-22	NR, Unit Director
OP4220	U4 Refurb Outage Execution Organization Identified		15-Jul-22	VP, NR Execution
OP4240	U4 Radiation Protection Support, Waste Minimization & Outage Environment Safety Plan Prepared		15-Jul-22	Director, NR O&M
OP4250	U4 Refurb Outage Execution Metrics Prepared		15-Jul-22	VP, NR Execution
OP4270	U4 Refurb Outage Briefing Packages Ready		15-Aug-22	Section Manager,

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**DARLINGTON REFURBISHMENT PROGRAM MILESTONE & INTEGRATED MASTER SCHEDULE**

Activity ID	Activity Name	Start	Finish	Owner
				NR Public Affairs
RP200U4	U4 Refurb Training Outage Readiness		01-Oct-22	Director, NR O&M
OP4280	U4 Refurb Outage Pre-Requisites Complete		15-Oct-22	VP, NR Execution
RP270U4	U4 Refurb Training Execution Readiness		15-Apr-23	Director, NR O&M
RP290U4	U4 Refurb Inspection & Installation Training Readiness		15-May-24	Director, NR O&M
RP210U4	U4 Refurb Training Operational Readiness		15-Apr-25	Director, NR O&M
<b>Outage Execution Key Dates</b>		<b>15-Oct-16</b>	<b>15-Oct-25</b>	
<b>Unit 2 Refurb Outage</b>		<b>15-Oct-16</b>	<b>15-Oct-19</b>	
U2010	U2 Circuit Breaker Open	15-Oct-16		VP, NR Execution
	U2 Removal Segment Start	1-Apr-17		VP, NR Execution
	U2 Inspection & Installation Segment Start	1-Jun-18		VP, NR Execution
	U2 Lead Out Segment Start	1-May-19		VP, NR Execution
U2280	U2 Full Power & Handover to DNGS		15-Oct-19	VP, NR Execution
<b>Unit 3 Refurb Outage</b>		<b>15-Oct-19</b>	<b>15-Apr-23</b>	
U3010	U3 Circuit Breaker Open	15-Oct-19		VP, NR Execution
	U3 Removal Segment Start	1-Apr-20		VP, NR Execution
	U3 Inspection & Installation Segment Start	1-Jun-21		VP, NR Execution
	U3 Lead Out Segment Start	1-May-22		VP, NR Execution
U3280	U3 Full Power & Handover to DNGS		15-Oct-22	VP, NR Execution
<b>Unit 1 Refurb Outage</b>		<b>15-Mar-21</b>	<b>15-Sep-24</b>	
U1010	U1 Circuit Breaker Open	15-Mar-21		VP, NR Execution
	U1 Removal Segment Start	1-Sep-21		VP, NR Execution
	U1 Inspection & Installation Segment Start	1-Nov-22		VP, NR Execution
	U1 Lead Out Segment Start	1-Oct-23		VP, NR Execution
U1280	U1 Full Power and Handover to DNGS		15-Mar-24	VP, NR Execution
<b>U4 Unit 4 Refurb Outage</b>		<b>15-Oct-22</b>	<b>15-Apr-26</b>	
U4010	U4 Circuit Breaker Open	15-Oct-22		VP, NR Execution
	U4 Removal Segment Start	1-Apr-23		VP, NR Execution
	U4 Inspection & Installation Segment Start	1-Jun-24		VP, NR Execution
	U4 Lead Out Segment Start	1-May-25		VP, NR Execution
U4280	U4 Full Power & Handover to DNGS		15-Oct-25	VP, NR Execution
<b>Program Closeout Key Dates</b>		<b>30-Jun-26</b>	<b>30-Jun-26</b>	
CL1000	Final Acceptance		30-Jun-26	SVP, Nuclear Refurb

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**Note:**

- (1) Letter A besides dates means *Actual Completion Dates*.
- (2) The segmentised Outage Milestones are Tier 4 milestones that are not listed in the table.

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**Appendix C: Segmentised Reoccurring Milestones Example (Tier 4)**

The table below is a summary of Segment Preparation milestones that are tied to/occur with the start of each of the 4 segments (as defined in the Outage level 1) with Unit 2 Lead-in Segment example titles and Milestone ID's in PMSS -C.

Segment Start – XX Months	Title	Owner	PMSS ID (U2 Segment 1 example)
SS-13	U2 Lead-in Segment At Risk Materials List Generated	VP, NR Execution	OP2300S1
SS-08	All U2 Lead-in Segment Documentation Ready	VP, NR Execution	OP2160S1
SS-06.5	All U2 Lead-in Segment Holds Removed	VP, NR Engineering	OP2310S1
SS-06	U2 Lead-in Segment Work Package Assessment Complete	Unit Director	OP2070S1
SS-05.5	U2 Lead-in Segment Detailed Outage Segment Permitry Level 1 Plan Complete	Director, NR O&M	OP2200S1
SS-03	U2 Lead-in Segment Dose Estimate Complete	Director, NR O&M	OP2350S1
SS-03	U2 Lead-in Segment Readiness Assessment Finished	VP, NR Execution	OP2060S1
SS-03	All U2 Lead-in Segment Materials On-Site or Dispositioned	VP, NR Execution	OP2330S1
SS-03	U2 Lead-in Segment Work Permits Prepared & Reviewed and Challenge Meeting Held by Operations	Director, NR O&M	OP2230S1
SS-01.5	U2 Lead-in Segment Materials Staged and Tools on Site	VP, NR Execution	OP2100S1
SS-01	U2 Lead-in Segment Reactor Safety Challenge Meeting	Director, Nuclear Safety	OP2260S1
SS-00.5	All U2 Lead-in Segment Applicable Walk-downs Complete	VP, NR Execution	OP2320S1

**Note:** Milestones OP2350, OP2230, OP2330 and OP2320 will occur 3 times for Segment 2 and twice for Segment 3. Refer to NK38-MAN-09701-10005 for more details.



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**DARLINGTON REFURBISHMENT: SCHEDULE MANAGEMENT PLAN FOR INTEGRATED LEVEL 3 EXECUTION**

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**Darlington Refurbishment: Schedule  
Management Plan for Integrated Level 3  
Execution**

**N-MAN-00120-10001-SCH-11-R000**  
2014-04-04

Order Number: N/A  
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R000	2014-04-04	Initial issue.

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# **DARLINGTON REFURBISHMENT: SCHEDULE MANAGEMENT PLAN FOR INTEGRATED LEVEL 3 EXECUTION**

## **1.0 INTRODUCTION**

### **1.1 Purpose**

This document describes the Integrated Level 3 Darlington Refurbishment Schedule Management Plan (SM Plan). The purpose of the SM Plan is to provide guidance on how to develop, manage, and control the Integrated Level 3 Execution Schedule throughout the Refurbishment Execution life cycle. This covers the preparation and management of the execution plan from Breaker Open to Breaker Closed, including the integration of readiness activities.

### **1.2 Scope**

The SM Plan identifies the process and procedures used to manage the schedule during the course of the Darlington Refurbishment Outage Execution. In addition to defining the schedule development approach, the plan defines who is responsible for tracking and reporting schedule progress, how schedule updates are received and incorporated, how variances and changes will be addressed, and how to baseline the schedule. The plan describes the project's schedule management tool. The plan also addresses the four execution segments, work types and work groups, taking into account Operation Authority, Nuclear Safety, Permit Strategy and Return to Service requirements.

### **1.3 Level 3 Schedule Development Timeline**

The development of the Integrated Level 3 Execution Schedule will be iterative process with many inputs provided at diffident times. List and timeline of major revisions, deliverables and milestones required before the level 3 execution schedule is fully integrated is provided in Appendix F: Timeline of Critical Inputs Required for Development of IL3E Schedule

### **1.4 Guiding Principles**

Establishing an accurate and realistic schedule is a critical planning step for a project/outage. The schedule is the main planning tool used to understand and communicate the status, interrelationships and dependencies among project activities and deliverables.

Schedule detail must be developed at an appropriate level to allow the project team to coordinate the work and communicate the plan, monitor project progress and cost performance, and use the data to make accurate forecasts, strategize and plan upcoming work.

The Integrated Level 3 Execution Schedule will:

- Be all inclusive of all work to be done during the execution window (all work groups)
- Be prepared and updated by the individual work groups and monitored by the Master Scheduler
- Be hours based
- Be one network (longest path) in a single P6 database
- Be resource loaded (histograms and work list tool) (user defined - examples; SDS qualified CT, Pipefitter Welder, BM Rigger, BM Welder)
- Be coded to roll up to the Level 2
- Be baselined

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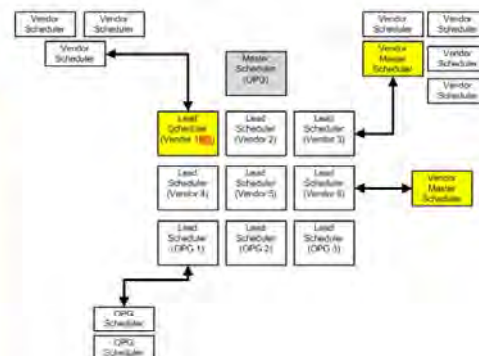
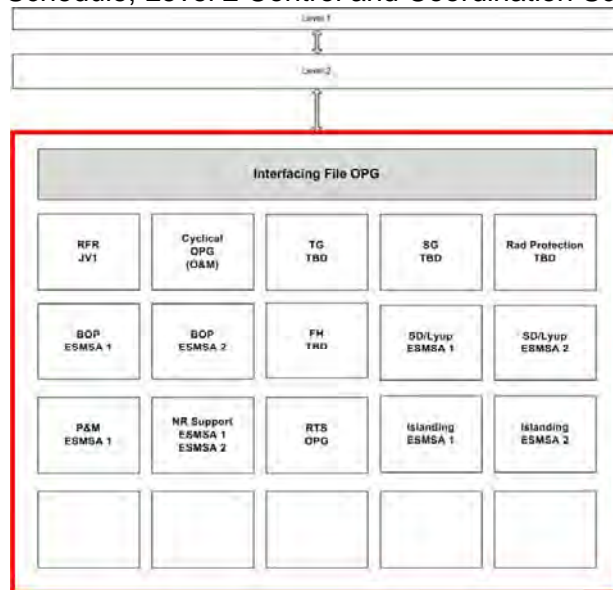
### **DARLINGTON REFURBISHMENT: SCHEDULE MANAGEMENT PLAN FOR INTEGRATED LEVEL 3 EXECUTION**

- Have all integration activities (hand-offs) between work groups logically tied through an interface file under control of the Master Scheduler and subject to schedule change rules
- Contain appropriate detail to support Release Quality Estimate (RQE)
- Show support activities for all work groups (See Task Breakdown Table, Section 5.2)

There will be one P6 scheduling database controlled and managed by OPG. All work groups (OPG and vendor work groups) will work in the same P6 instance

- An OPG Assigned Master Scheduler is responsible to control and manage the unified P6 schedule.
- A Lead Scheduler will be assigned by each work group and will follow schedule process direction from the OPG Master Scheduler
- The work group Lead Scheduler has authority to update and revise his work group's schedule within the protocols specified by the Master Scheduler
- The Master Scheduler takes his direction from the Unit Director and Outage Manager

The structure of the schedule will include Milestones, Level 1 Program Integrated Master Schedule, Level 2 Control and Coordination Schedule and Level 3 Execution schedule



**Methodology:** Owner performing the role of General Contractor to integrate multi prime EPC and Owner directed resources for a multi year project.

**Bundle → Sub Bundle → File / Vendor (commercially independent)** working in owners P6 able to calculate Critical Path @L3 and fully integrated via OPG interfacing file.

**ESMSA Lead Scheduler may direct more than one bundle (commercially independent)**



## 2.0 PARTICIPANTS

### 2.1 Roles and Responsibilities

During the definition phase, OPG's role was that of the Design Authority and Project Manager. The Execution phase adds the role of General Contractor, Owners Engineer, and License Holder / Controlling Authority of a power reactor.

During the execution of the Darlington Refurbishment, OPG's role during execution includes the following:

- Shut down, de-fuel and lay-up the unit

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- Maintain control of the island/plant
- Ensure all aspects of safety are adhered to
- Perform Cyclical ,FIN and Contact Partner Support Work/Rehab
- Construction coordination & integration
- Schedule analysis and optimization
- Configuration control/management
- Commission and restart the unit
- Quality Oversight

Schedule-related responsibilities of staff and stakeholders involved in managing and controlling the project schedule are noted as follows:

#### **Responsibilities:**

- Director Planning and Controls – will approve the project's Schedule Management Plan. Responsible to establish and publish reports and metrics in support of Unit Director and other project stakeholders. Assign the Master Scheduler in order to provide the infrastructure required for the schedule development.
- Unit Director – will approve baseline schedule, and any significant changes through the schedule change control process. The Unit Director is ultimately responsible for the schedule and to complete the project according to the schedule. Accountable for unit scope management process. Accountable for development and implementation of Project Control Center (PCC) command and control processes. Accountable to identify report requirements and interpret/analyze reports and metrics. Accountable to establish and implement readiness review process.
- Outage Manager – Accountable for affirming, documenting and communicating all decisions relating to establishing and executing the critical path. Will be responsible for development of the Schedule. Accountable for identifying risks to the schedule and determining the appropriate risk management strategy. Accountable for work integration. Accountable for unit and segment forecasts. Responsible for managing outage scope. Responsible to implement PCC command & control process. Will review reports and metrics to identify and counteract schedule deviations. Responsible to implement readiness review process.
- Work Control Section Manager and Work Control Team Leaders – will be responsible for developing detailed logic for the execution of assigned outage work windows. Responsible to identify and resolve work integration issues within assigned work scope. Will identify to Project Managers any interfacing logic issues which might impact on a projects cost and/or schedule. Will document system window logic assumptions and assist Outage Manager with decision support information as required to help resolve project interface issues. Will identify risks and establish risk mitigation plans as appropriate.
- Project Manager – will oversee, provide input to the schedule and review schedule status reports provided by the Lead Scheduler. The Project Manager will also evaluate time-risk recommendations from the Lead Scheduler to avoid schedule issues. Accountable for project schedule and cost. Accountable for project readiness.
- Functional Managers – will notify the Unit Director and Lead Scheduler of workload changes that may affect the schedule. The Functional Manager will also review and approve time estimates provided by staff for the schedule.

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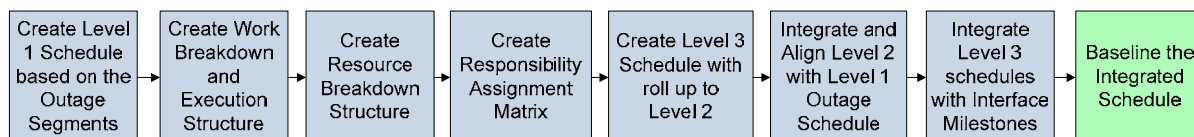
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- Work Group (OPG or Contractors) - Accountable for work quality. Responsible for developing detail schedule. Responsible for work cost. Responsible for work readiness. Responsible for work execution. Responsible to status the work. Will provide accurate time estimates for the beginning and completion of work as well as status reports on the achievement of those times. Will manage their internal activities to the timely accomplishment of the schedule, of which status shall be reported regularly notifying the Unit Director of potential or actual schedule variances. Will ensure resources are utilized efficiently and effectively such that down time is minimized and identify opportunities to utilize resources more effectively to the benefit of the project.
  - Master Scheduler – will report functionally to the Unit Director and will be accountable for the development of the unit and segment schedules. Will provide critical path analysis. Will integrate the work for the segment and unit schedule while managing and controlling the L3 interface file. Will publish reports and metrics on the work. Will raise upwards any integration or scheduling conflicts for resolution. Gives direction to Lead Schedulers on schedule logic and integration. Will maintain the scheduling tool and supporting documentation. The Master Scheduler will make recommendations to the Outage Manager to avert schedule variances that may adversely affect the project critical path, budget or expenditures
  - Lead Scheduler (Work Group) – Will develop unit and segment schedules for the work group. Will provide critical path analysis for the work group. Will integrate the work for the segment and unit schedules for the work group. Will status the schedule activities per work group's direction. Will publish reports and metrics for the work group
- Quality Assurance – will periodically audit scheduling practices to validate compliance with this Schedule Management Plan.

## 3.0 SCHEDULE DEVELOPMENT PROCESS

The schedule development process is comprised of multiple development steps. Each step taken generates a schedule subcomponent that can stand alone to inform the project team of that aspect of the final schedule. When integrated, it forms the basis for the approved working version of the final schedule known as the Baselined Schedule. Figure 1 depicts the order and the individual products generated during the schedule development process.

**Figure 1 - Schedule Development Process**



### 3.1 Create Level 1 Schedule (PIMS-C)

The Level 1 Schedule is a visual representation of anticipated critical activities, milestones, and interfaces across the entire project/outage. Level 1 schedule is the Program Integrated Master Schedule (PIMS) that contains execution windows in the Refurbishment. Each Unit Outage will have its own PIMS. The Unit 2, Level 1 is called PIMS-C. It is developed by OPG during the Definition Phase to provide the project teams and Contractors with the earliest possible view of

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project's most critically timed activities. At this stage, the date for a critical activity may not be known, but the visual representation of the activity among all the activities on the chart will enable the team to conceptualize the relative flow of important events.

The PIMS displays both the project's expected flow of critical activities as well as the vertical integration of related deliverables from other existing or pending contracts. It displays what OPG is responsible for in parallel with the Contractor's responsibilities. It sets a clear expectation early on of critical timing between project deliverables and key events.

See Appendix C: Overview of Unit 2 -Darlington Nuclear Refurbishment Program

PIMS-C will be updated according to the schedules' milestones. With each progressive revision, more knowledge and optimization of the schedule will be incorporated. The nomenclature of the revisions will be Revision 'A' schedule, Revision 'B' schedule, Revision 'C' schedule and Revision 'O'. Revision 'O' will be the final revision before Breaker Open. In support of the Release Quality Estimate, an RQE revision will be issued. This revision will come after Rev B and incorporate the best available input from all stakeholders.

### **3.2 Outage Segments**

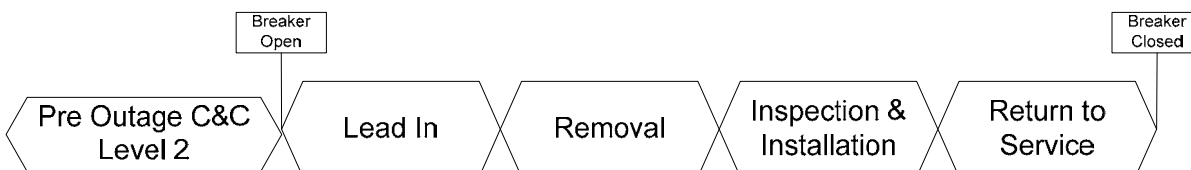
Due to duration of each Refurbishment Outage, there are complexities and data management considerations that are greater than previous outages or projects. In order to manage the volume of data in a logical fashion, Outage segmentations have been established. The segments were developed from the following rule set:

1. Segment needs to be big enough to have its own P6 project
2. Segment needs to be small enough not to threaten P6 capability with respect to the number of activities that can be in a single P6 file
3. Segment needs to be complex enough to warrant its own handling team
4. The end point for a Segment should be a natural logic node which marks the completion of a large number of activities. It may mark a major transition e.g. OPG to vendor, vendor to vendor work program, vendor to OPG. The intent is to minimize the number of activities that are carried from one phase to another in order to limit the number of interfacing milestones to only those required. To the extent possible work will be scheduled within a segment.

The benefits of breaking the Outage into Segments include:

- Maintain schedule integrity while reducing complexity
- Allows Planning & Scheduling Basis change
- Appropriate level of detail
- Strong reporting model
- Reporting frequency
- Establishes Integration Points (work horizon)
- Enables close-out of a P6 node

The segments are Lead in, Removal, Inspection & Installation and Return to Service



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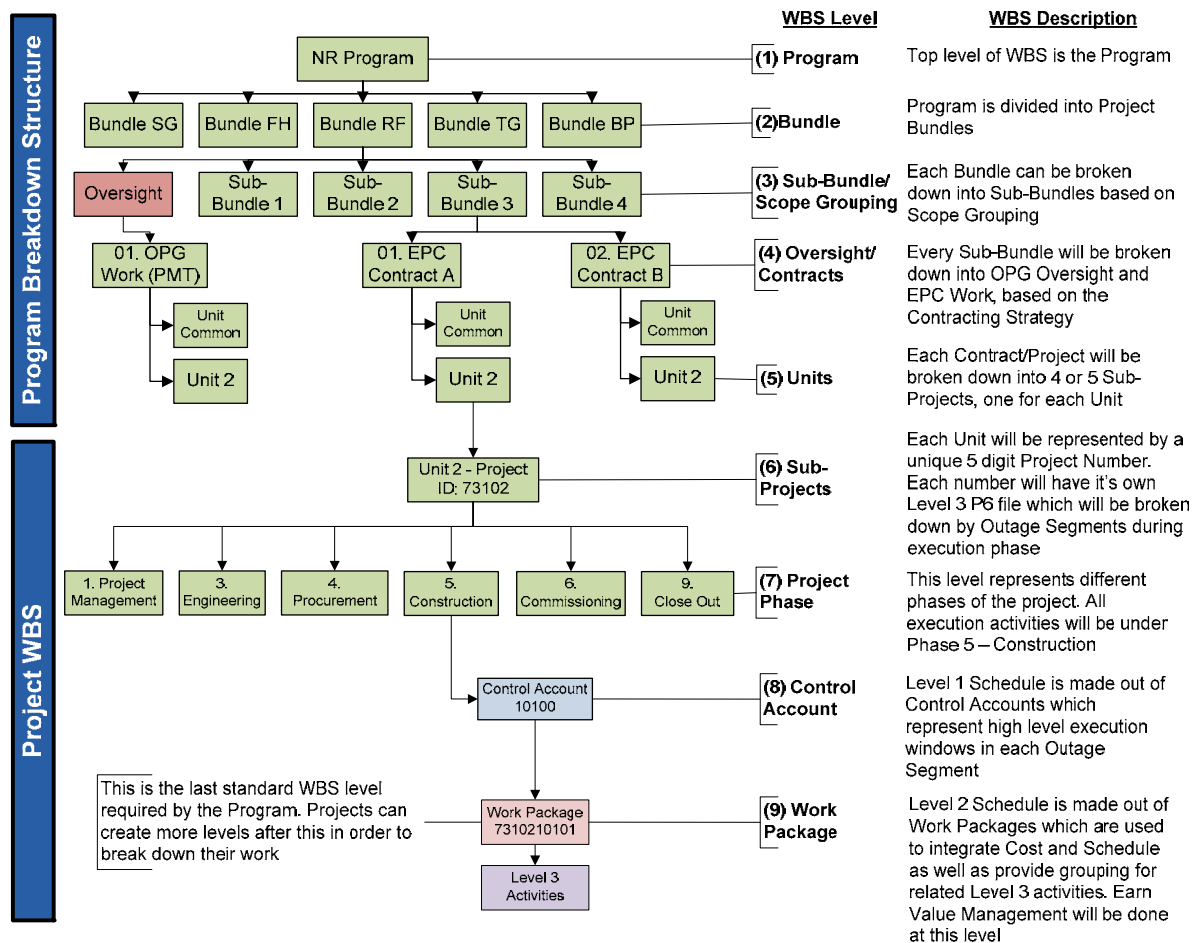
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### 3.3 Create Work Breakdown Structure (WBS)

The Darlington Refurbishment uses a deliverable-oriented work breakdown structure (WBS) to best reflect the scope of project (Reference WBS Guide NK38-GUID-09701-10006). The WBS is created by breaking down the project's main deliverable – e.g. Refurbishment of Unit 2 – into its sub components using a hierarchical -tree format and will be developed in parallel with L1 execution windows and aligned with work sequence. The upper levels of the WBS breakdown the deliverables into Control Accounts while the lower levels of the WBS depict the Work Package and activities and tasks.

Example of how the standard WBS has been implemented is in Appendix D

**Figure 3 – General Work Breakdown Structure**





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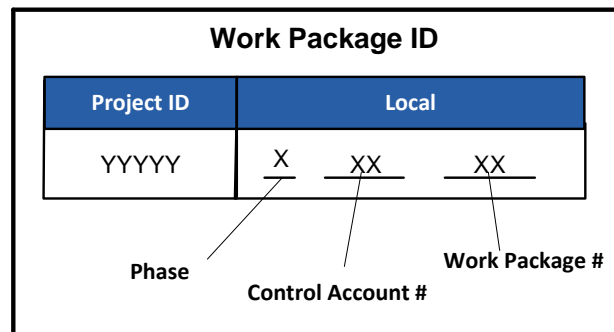
# DARLINGTON REFURBISHMENT: SCHEDULE MANAGEMENT PLAN FOR INTEGRATED LEVEL 3 EXECUTION

## 3.3.1 WBS Element Numbering Methodology

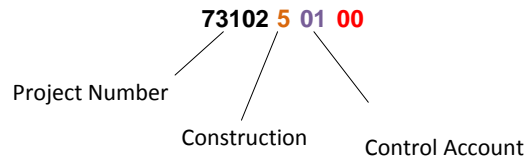
In order to successfully implement the Multi Level Scheduling Model we will utilize the WBS functionality in P6 to allow progress on lower level activities to roll up through the WBS to Work Packages and Control Accounts. To facilitate this structure and to create traceability between the WBS and the schedule and to distinguish between levels, all boxes on the WBS, known as “elements” will be numbered using the methodology shown in Table 1

**Table 1. Element Numbering Methodology**

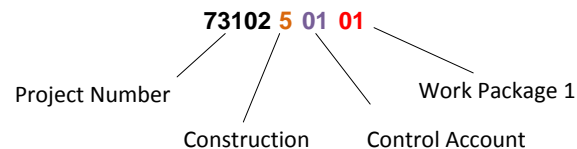
WBS Elements	WBS Path
NR Program	NR
Bundle BOP	NR.BP
Sub-Bundle Nuclear System	NR.BP.NS
EPC Contract 1	NR.BP.NS.01
Unit 2	NR.BP.NS.01.U2
Project 73592	NR.BP.NS.01.U2.73592
Construction	NR.BP.NS.01.U2.73592.5
Control Account 50100	NR.BP.NS.01.U2.73592.5.01
Work Package 50101	NR.BP.NS.01.U2.73592.5.01.01
Level 3 Activities	NR.BP.NS.01.U2.73592.5.01.01....



### Level 1 Schedule: Control Account - Activity ID



### Level 2 Schedule: Work Package - Activity ID



## 3.4 Create Resource Breakdown Structure

The Resource Breakdown Structure will be based on the Crew codes in Asset Suite 7. Crew codes will be used to estimate resources and provide resource demand curves. All level 3 activities will be resource loaded. Labour will be identified in hours. Commodities such as Pressure Tubes or Control Vales can also be included in the RBS. Common critical equipment such as the Turbine Hall Crane will also be included in the RBS in order to identify conflicts in requirements. All tasks identified in the L3 schedule will be estimated to identify resource requirements so that a resource histogram of the work identified in the L3 can be produced. Each contractor will be accountable to produce a resource histogram for Level of Effort work such as work performed in contractor shops and supervision. Total resource histograms will be a sum of the detailed tasks and the LOE estimates.

Full list of resources can be found on SharePoint: [Resource Breakdown Structure](#).

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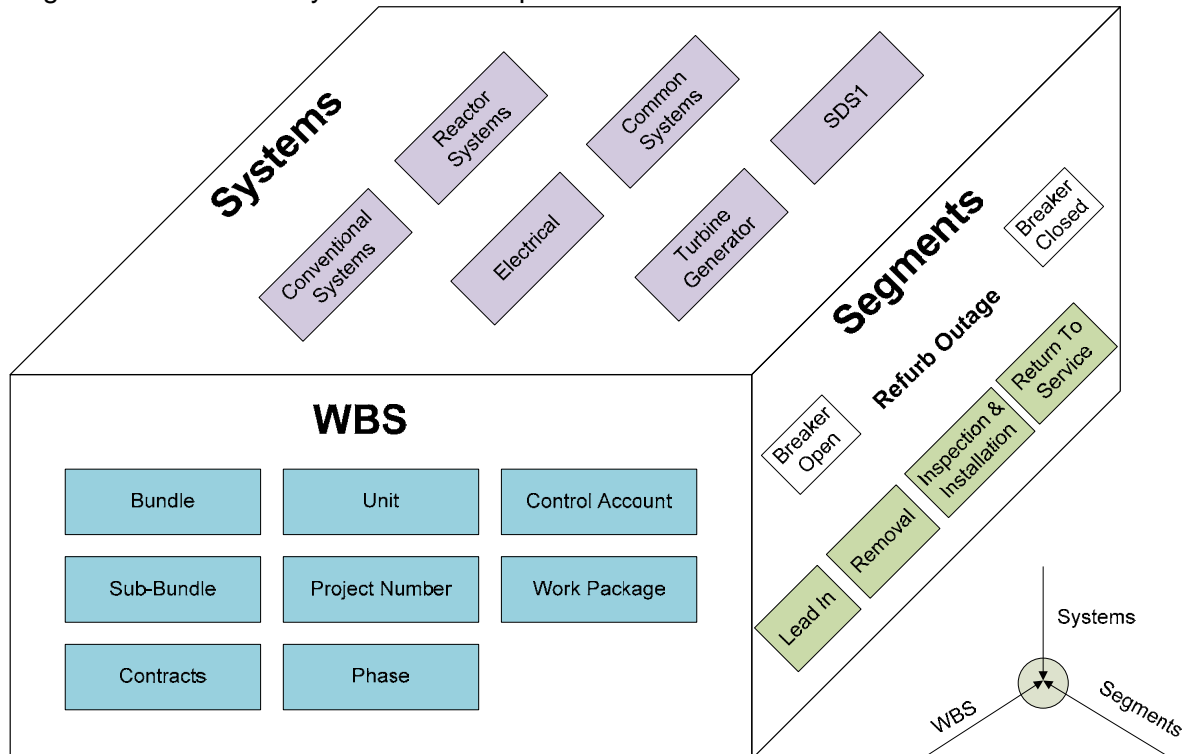
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### 3.5 Create and Integrate Schedule

The WBS serves as the outline structure for the schedule. The Execution Windows serve as identification of the unit condition which allows work to be scheduled safely and integrated. A coding structure in P6 will include a code for each Execution Window within the Outage Segments and all the Systems that are part of the Refurbishment.



The intersection of the WBS, Systems and the Execution Windows allows the schedule to be sorted and viewed by any combinations of these elements.

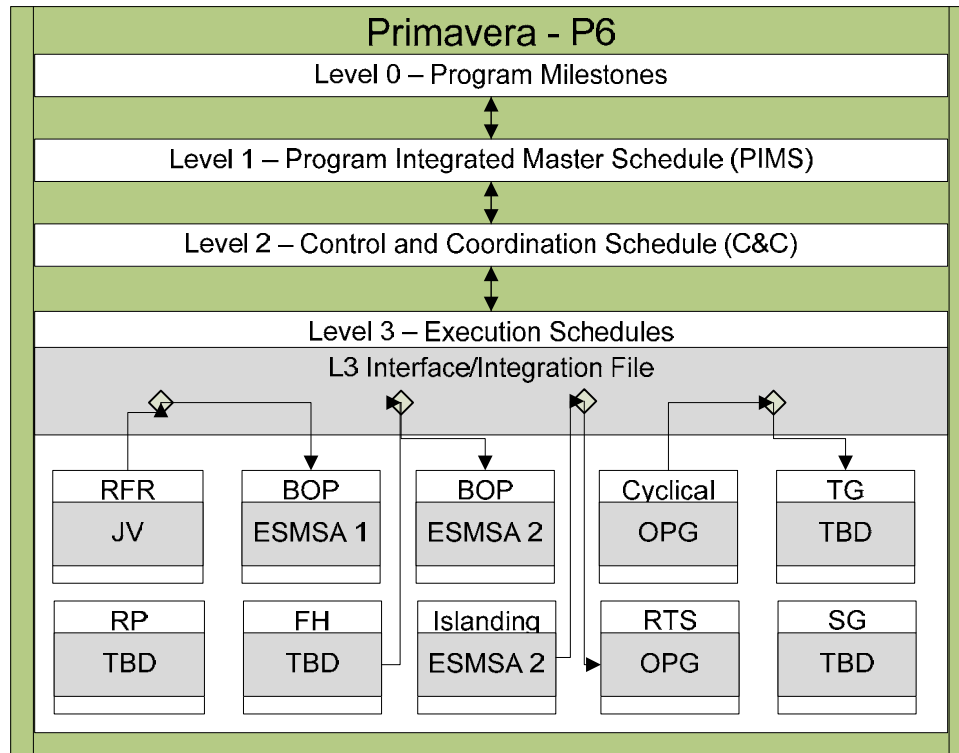
As part of the Multi Level Scheduling Model, NR Refurbishment will have different levels of the schedules that are integrated and aligned with each other using WBS Summaries, Activity Codes and Milestones, as described below:

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#### Level 0 – Program Milestones

- Program Milestones schedule including Program Release Milestones, Regulatory Milestones, Outage Preparation Milestones, and Outage Execution Milestones
- Level 1 execution schedule will be logically tied with Program Milestones

#### Level 1 - Program Integrated Master Schedule (PIMS-C: First Unit Outage)

- Level 1 execution schedule will be broken up by Outage Segments, Systems and RTS Phases/Nodes, following the standard WBS structure
- Master Scheduler will work with the vendor's Scheduling Leads to create the high level Control Accounts, based on the logic and execution windows defined by the Outage Manager
- Each Control Account will be a WBS Summary activity to allow roll ups from the Level 2 and Level 3 schedules
- Each Unit will have a separate PIMS P6 file
- PIMS will go through multiple revisions as more detail information becomes available. Revision '0' will be the final revision before Breaker Open.

#### Level 2 - Control and Coordination Schedule (C&C)

- Each Work Group/Vendor will develop number of Level 2 execution activities called Work Packages
- Work Package will be used to integrate schedule and cost, and for Earn Value Management
- All level 3 activities will roll up to Work Packages using the standard WBS, to allow progress tracking at a higher level
- Change Control is done at the Work Package level
- Level 2 will be used to manage float

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#### Level 3 – Detailed Execution Schedule

- All activities will be developed and updated in a single P6 instance, controlled and managed by OPG
- Activities will be created using standard WBS and broken into Segments and Systems
- Activities will be hourly based, resource loaded, and less than one week in duration. Longer duration activities will require additional monitoring mechanism (e.g. Work-Down Curve)
- All activities will roll up to Level 2 Work Packages using the WBS structure
- Activities will be generated using 2 methods:
  - o Manual Input by the Scheduling Leads
  - o Automatic upload of Work Orders from AS7 where each activity ID will be a Work Order and Task number.
- Each Level 3 P6 file will be owned and managed by a single Work Group/Vendor
- Standard P6 templates will be utilized to communicate the scheduling requirements for similar work across different Work Groups
- Activity Code dictionaries, resource codes and calendars will be established in OPG P6 instance and used by all the work groups
- All activities will be coded with the window segment and the system (SCI)

#### Level 3 Interface/Integration File

- All the integration activities (hand-offs) between Work Groups/Vendors will be logically tied through Interface Milestones
- The Interface Milestones will be created by the Master Scheduler and each Scheduling Lead will create logic ties between the milestones and their activities
- All the interfaces within the same Work Group will have direct ties between L3 activities
- Milestones will be created using standard WBS and broken into Segments and Systems

#### **3.5.1 Date, Sequence, and Link Activities**

There are four types of dependencies (logical relationships) used to create links between schedule tasks. The Finish to Start dependency is more commonly used for scheduling the Darlington Refurbishment.

- **Finish-to-Start (FS):** The initiation of the successor activity depends upon the completion of the predecessor activity.
- **Finish-to-Finish (FF):** The completion of the successor activity depends upon the completion of the predecessor activity.
- **Start-to-Finish (SF):** The completion of the successor activity depends upon the initiation of the predecessor activity.
- **Start-to-Start (SS):** The initiation of the successor activity depends upon the initiation of the predecessor activity.

Tasks are linked together and sequenced to identify the relationships between deliverables, sub-deliverables, activities, tasks, and subtasks. The following rules should be applied when creating task dependencies:

Tasks are linked together and sequenced to identify the relationships between activities. The following rules should be applied when creating task dependencies:

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Tasks are linked together and sequenced to identify the relationships between activities. The following rules should be applied when creating task dependencies:

- All tasks shall have at least one successor and one predecessor so there are no unlinked tasks.
- Start and Finish dates should not be entered when creating new tasks.
- For purposes of modeling the critical path, all dependencies should be linked to a detail task or deliverable and not to a summary task.
- Early dates (the earliest date on which a task can start or finish) are calculated in the forward pass of time analysis.
- Late dates (the latest date on which a task can start or finish) are calculated using backward pass time analysis.
- Constraints will be applied sparingly (only when required) in order to maintain a flexible, realistic schedule.

#### **3.5.2 Risk Estimate Duration**

To identify the time- risk associated with a critical or near critical activity or task, the Darlington Refurbishment and/or contractor staff should apply the Program Evaluation and Review Technique (PERT).

The formula is:  $PERT\ mean = (O + 4ML + P) \text{ divided by } 6$

Where:

O = Optimistic estimate

ML = Most likely estimate

P = Pessimistic estimate

The project team member performing the task will provide variables O, ML, and P to calculate an optimistic, most likely and pessimistic estimate that can be utilized in the Monte Carlo simulation. A schedule for both the most likely and the pessimistic will be maintained and risk mitigation strategies will be documented in the Risk Plan for those tasks on the critical path (Reference Risk Process N-PROC-LE-0017).

#### **3.5.3 Duration Guidelines**

As a general rule, the basis for resource estimation will be in hours. The task duration will also be in hours. Tasks of significant duration should be broken down into shorter duration tasks if possible to permit accurate assessment of work progression or they need to be supplemented with a metric/work down curve to identify status.

Standard resource calendars will be used in P6. All vendors and OPG will use the same suite of calendars.

#### **3.5.4 Validate Schedule**

##### Horizontal Schedule Review

A horizontal schedule review of the sequence of scheduled activities and logic ties is performed to ensure prerequisites or constraints are satisfied, including, but not limited to:

- Shutdown safety (e.g., redundant systems available, appropriate heat sink configurations).

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- Logical constraints (e.g., preparation work complete, isolations).
- Alignment of conventional equipment to support planned electrical evolutions.
- Satisfaction of required plant conditions (e.g., system pressure, temperature, and configuration).
- Confirmation that any operating or functional test (as-found test) required for PM WOs with an operability test required attribute are scheduled prior to the actual PM.

#### Vertical Schedule Review

A vertical slice of activities scheduled to be executed concurrently is reviewed to ensure the following:

- (1) Maintain Shutdown reactor safety (e.g., aggregate work/risk does not impair ability to control power, cool fuel or contain reactivity below an acceptable level).
- (2) Following the publication of Rev C Schedule's we will perform a risk analysis of WOs causing elevated risk.
- (3) Formulate oversight contingency or compensatory actions to mitigate both risk and possible duration extensions.
- (4) System conflicts do not exist that preclude completion of work as planned (e.g., conventional equipment alignments support planned electrical evolutions).
- (5) Sufficient resources are available (e.g., manpower, equipment, location) to complete the schedule as planned. This should include the evaluation of external resource commitments to other outages or projects.

Prior to the Reactor Safety Challenge Meeting an independent schedule review shall be completed to ensure defense in depth has been maintained throughout the outage.

- (1) The review should ensure that shutdown safety is maintained and shutdown risks are minimized.
- (2) The review should be completed by an independent licensed individual that has not been involved in the planning and preparation of the outage (e.g. a Fleet Peer).
- (3) Any outstanding actions from the independent review should be documented and reviewed at the Reactor Safety Challenge meeting.]

### **3.5.5 Integrate Schedules**

An Integrated Level 3 Schedule is created after contract award and prior to Breaker Open. OPG and the Vendor will each prepare their schedules for integration into a single schedule - the Level 3. The Level 3 is the combined list of deliverables and tasks to be completed by OPG and Vendor, logically tied with defined duration. The combined schedule is based on OPG's Project WBS and the Vendor's scope of work.

The following steps are necessary to create the Integrated Multi-Level Scheduling Structure:

1. OPG will define all the Program Milestones based on the committed dates and create Level 0 Schedule
2. Outage Manager will define high level execution windows and system groupings for execution based on the Program Milestones, that will be represented as Control Accounts in Level 1 Schedule
3. Vendor will build a detail Level 3 schedule based on the Program Milestones and Control Accounts defined by OPG. Level 3 schedule will follow the standard WBS and will have all the mandatory activity codes like System, Equipment, Location, Unit, Work Order, MEC/EC Number etc. (See Scheduling Guide for full list of mandatory codes)
4. Vendor will summarize the Level 3 Schedules into Level 2 activities called Work Packages

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5. Master Scheduler will work with the vendors to integrate and align the Level 2 activities within the Control Accounts, refining the structure of Level 1 schedule based on the contractual commitments, constraints, coordination with other work groups and additional information that were not available during the initial planning phase
6. Master Scheduler will work with the vendors to identify and integrate any interfaces between Work Groups using the Level 3 Interface P6 File

The resulting Integrated Level 3 will be reviewed and approved by Unit Director after which it will be baselined.

Appendix E shows how multiple levels of the schedules are integrated together

### **3.6 Baseline Schedule**

Prior to commencing outage work and after OPG's schedule and the Vendor Contractor's schedule are integrated, reviewed, and approved, the schedule will be baselined.

Prior to breaker open, the Integrated Level 3 schedule will be going through multiple revisions as we develop and incorporate additional details. With each revision, we will create a new baseline. The plan is to have 4 major revisions: Revision 'A', 'B', 'C' and Revision 'O'. Revision 'O' will be the final revision before Breaker Open.

In support of the Release Quality Estimate, an RQE revision will be issued. This revision will come after Rev B and incorporate the best available input from all stakeholders.

To baseline the Integrated Level 3 schedule, the Master Scheduler saves the approved version in P6 and stores a copy in the project repository. New baseline dates are uploaded to the BI Reporting Engine, to be reflected on all the standard reports.

After Revision 'O', the baseline will be re-established only upon scope change as approved through the Change Control Process.

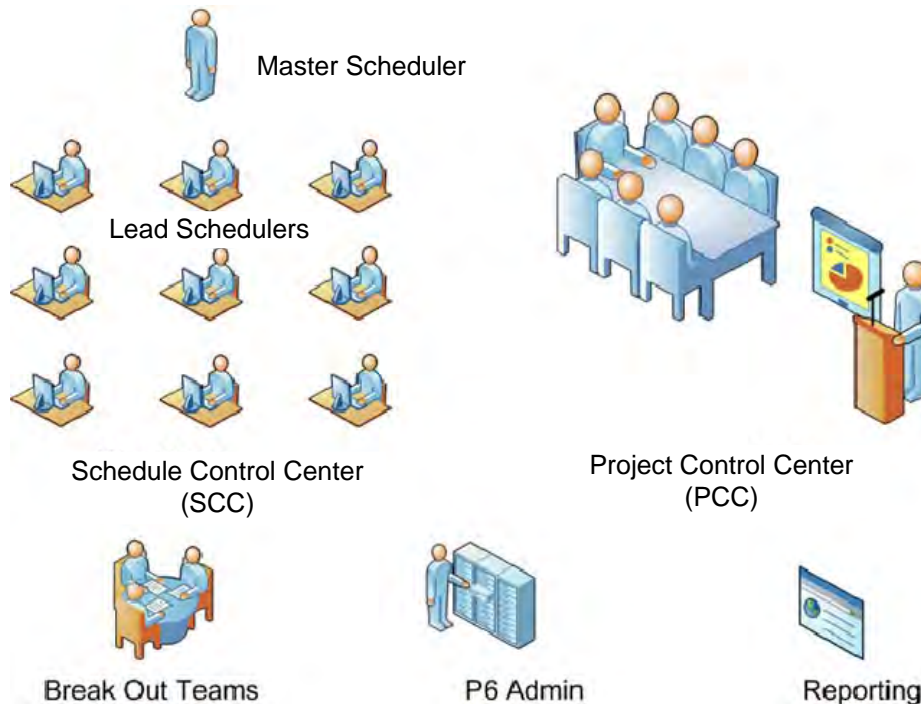
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## 4.0 SCHEDULE CONTROL CENTER (SCC)



To facilitate the collaboration between OPG and the Vendors in order to develop an Integrated Level 3 schedule, we are creating a Schedule Control Center (SCC) Room. This room will be located in a close proximity to the Project Controls Center (PCC), and will be equipped with multiple OPG workstations connected to a single P6 instance.

Each vendor will supply a Lead Scheduler who will be co-located with other vendors in the SCC room. Lead Schedulers will take direction from a Master Scheduler on how to develop and integrate their individual Level 3 schedules.

Everyone will be working in one P6 environment, using one set of standard codes, calendars and resource dictionaries. The environment will be supported by IT and a dedicated P6 administrator, who will managed security and code libraries based on the requirements set by the Master Scheduler.

All the Level 3 schedule updates should be coordinated from the SCC room to ensure the integrity of the integrated schedule and based on the PCC requirements.

SCC room will have Break Out areas for problem solving and meetings. There should also be access to flow sheets, area diagrams and SOW documents for reference.

Access to Asset Suit 7 will be available to the Vendors so they can status the work. The BI solution hosted on the OPG network will provide live reports to monitor schedule development and progress.



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### 5.0 SCHEDULING DEVELOPMENT TOOL

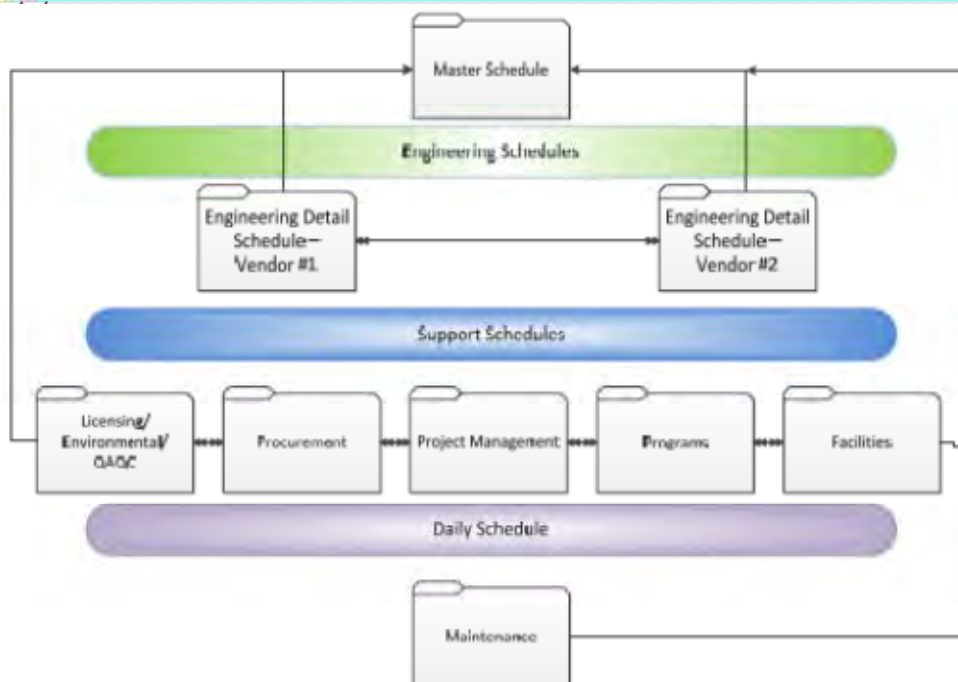
Primavera P6 will be used as the schedule development tool. Activities generated in the schedules will be downloaded from Asset Suit 7 (AS7) or they will be manually created based on the standard P6 templates/fragments.

#### 5.1 Scheduling Development Tool Description

Schedule data is compiled and updated in a scheduling tool to depict the time-sequenced flow of tasks, the actual work progress, and what remains to be completed. P6 is the standard schedule development tool used at OPG. P6 will interface with Work Management Tool (Asset Suit 7), Cost Management Tool (Proliance) and Estimating application (US Cost).

##### EPS Structure

NR	NUCLEAR REFURBISHMENT
NACT	Nuclear Refurbishment Active
PMSS	Level 0: NR Program Milestone Schedule
PIMS	Level 1: NR Program Integrated Master Schedule (Currently for Scenario Analysis)
PCCS	Level 2: NR Program Coordination & Control Schedules (C&C Schedules)
PDPS	Level 3: Nuclear Project Detailed Production Schedules
FUN	Functional Work By Divisions
BUN	Project Bundles Level 3 Schedule
TGB_L3	Turbine Generator Bundle
SGB_L3	Steam Generator Bundle
FHB_L3	Fuel Handling Refurb Bundle
DFB_L3	Defuelling Bundle
FSP_L3	FH Specialised Project Bundle
BOP_L3	BOP Bundle
ISL_L3	Unit Islanding Bundle
SDN_L3	Shutdown, Layup & Services Bundle
RSF_L3	Refurb Additional Facilities Bundle
FIP_L3	Facilities and Infrastructure Project Bundle
CCM_L3	Cyclical Maintenance Project Bundle
CSU_L3	Commissioning, Startup and Handover to Station Bundle (most work by OPG)



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### EPS Structure for OPG and Vendor's schedules

+	ML0	Level 0: Program Milestone Schedule
+	ML1	Level 1: Program Integrated Master Schedule
+	ML2	Level 2: Program Coordination & Control Schedules
-	ML3	Level 3: Project Detailed Production Schedules
-	RFR L3	RFR Level 3 Schedules
-	RFR OPG	RFR OPG Work Level 3 Schedules
-	RFR OPG_U0	RFR OPG Work U0 -- 73105
	73105	RFR OPG Work U0
+	RFR OPG_U2	RFR OPG Work U2 -- 73106
+	RFR OPG_U1	RFR OPG Work U1 -- 73107
+	RFR OPG_U3	RFR OPG Work U3 -- 73108
+	RFR OPG_U4	RFR OPG Work U4 -- 73109
+	RFR SNC_MR	RFR SNC Major Retubing Work
-	RFR SNC_MU	RFR SNC Mockup Project
-	RFR SNC_U0	RFR SNC Mockup U0 -- 73111
	73111	RFR SNC Mockup U0
-	RFR SNC_TL	RFR SNC Tooling Project
-	RFR SNC_U13	RFR SNC Tooling U0 -- 73112
	73112	RFR SNC Tooling U0
+	DFL3	Defueling Level 3 Schedules

## 5.2 Task Breakdown

The development of a Level 3 Schedule that integrates the schedules of numerous contractors including some OPG work groups requires a degree of standardization. An analysis process has been used to determine what user groups will need to be in the schedule and the results are shown in Task Breakdown Table. OPG and contractors are expected to use this table to establish the tasks that will appear in the Level 3 schedule.

### 5.2.1 How to use Task Breakdown Table

What belongs in the schedule? - The table identifies a number of possible tasks (e.g. submit PC1, Prepare permit) in a subject area (e.g. Work Protection). The next three columns are labeled Always, Sometimes, and Never.

Always means always. For reasons that have to do with plant status control, management of critical and near-critical path, resource assignment etc, we have determined that these tasks must be in the schedule and must be shown at level 3.

Never means never. If, for reasons of its own, a contractor wishes to include these activities in its own P6 schedule they are at liberty to do so, but they must be coded so that they are NOT brought into the OPG layouts of P6 in which tasks are being integrated. OPG is conscious of the need to limit the total tasks brought into the project in order to ensure the manageability of project updates, and hence we will not be including "never" tasks in our schedule.

Sometimes has the following interpretation:

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A “sometimes” task may be included in the schedule because contractor’s scheduler needs it there for internal coordination purposes or

A “sometimes” tasks may be brought into the schedule at the request of the OPG Master Scheduler or Work Control Team Leader (WCTL) to facilitate broader scale coordination of work. Normally the requirement to add additional tasks will be identified in Task Analysis Meetings (TAMs) as system window logic is being established.

The next three columns in the table are labeled Direct P6, AS7 and Either. These labels describe how activities get into P6. There are two means available for a contractor to populate the P6 schedule with the tasks as defined above. The first is to directly inject the task into P6. The second is to add the task to the Work Order in Asset Suite 7(AS7) through the use of the assessment functions of that program. Most tasks can be placed into the P6 schedule using either method and contractors are encouraged to use whichever is most effective. A small number of exceptions are identified in table below.

Work Type	Activities	Always	Sometimes	Never	P6	AS7	Either
<b>Work Protection</b>	<b>Submit PC1</b>			X			
	<b>Prepare Permit</b>			X			
	<b>Apply Permit</b>	X				X	
	<b>Walk &amp; Accept permit</b>		X				X
	<b>Apply Lock-out/Tag-out</b>		X				X
	<b>Test device under permit</b>		X				X
	<b>Surrender a permit</b>			X			
	<b>Remove a permit</b>	X					X
	<b>Adjust/Test beyond boundary point</b>	X					X
	<b>Build scaffold</b>	X					X
<b>Scaffolding</b>	<b>Modify a Scaffold</b>		X				X
	<b>Approve Engineered Scaffold</b>			X			
	<b>Remove scaffold</b>	X					
	<b>Manage Scaffold materials</b>			X			
	<b>remove insulation</b>	X					X
<b>Insulation</b>	<b>store insulation</b>			X			
	<b>Dispose of old</b>			X			

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Work Type	Activities	Always	Sometimes	Never	P6	AS7	Either
	insulation						
	Install insulation	X				X	
	manage Insulation materials			X			
Radiation Protection	request rubber area			X			
	establish rubber area	X					X
	remove rubber area	X					X
	perform unique rad survey		X				X
	perform routine rad survey			X			
	Install or remove shielding		X				X
	High Hazard work Oversight	X					X
	provide rad support	X					X
	Perform materials survey for release from station		X				X
	Schedule use of decontamination facilities			X			
	Material Surveys at zone boundaries		X				X
	Radiography	X					X
Trades work	repair/replace	X				X	
	erect a safe work boundary			X			
	electrical disconnect		X				X
	electrical reconnect		X				X
	mechanical disconnect		X				X
	mechanical install		X				X
	calibrate device		X				TBD

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Work Type	Activities	Always	Sometimes	Never	P6	AS7	Either
	Apply/remove grounds		X				X
Hoisting and Rigging	use a crane (or other common service equipment eg loading bay, FMMA equipment, turbine stands)			X			
	maintain or otherwise disable a crane	X					X
	Manage rigging equipment			X			
	Operate Plant devices		X			X	
	Install or remove a TCR		X			X	
Painting/Sealing	Paint or floor seal a room or area		X				
Supply Chain Issues	Order Material			X			
	Schedule Material Required At Site		X				X
	Receipt Inspection			X			
	material from supplier			X			
	Mat'l prepared and delivered (staged)		X				TBD
	remove parts hold			X			
	AFS Declaration	X			X		
Engineering	CCD declaration	X			X		
	Remove Eng Hold			X			
	Approve Eng drawing			X			
	AFS documentation			X			
	OLW review			X			

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Work Type	Activities	Always	Sometimes	Never	P6	AS7	Either
	Review/approve Inspection results		X				X
	Online Wiring			X			
Miscellaneous	Work Outside the Const'n Island (Other units)	X				X	
	Work Outside the Protected Area		X				X
	Security Point Access for Deliveries	TBD	TBD	TBD			
	Equipment Sampling (Chem Lab)		X			X	
	Training			X			

## 6.0 SCHEDULE INPUT MONITORING

### 6.1 Compare Schedule Status to Time Status Reports

Level 3 schedules will be resource loaded with hours for OPG and Vendor work. The total hours loaded at Level 3 activities will be rolled up to Level 2 (Work Package). Total hours will be compared to the estimates done at the Work Package level and all the Actual hours will be collected at this level using financial systems called Tempus and Oncore.

BI (Business Intelligence) Reports will be available to compare plan hours versus actual hours. The SPI and CPI will be calculated at the Work Package level and when issues are identify at Level 2, more detail analysis of Level 3 activities will be initiated. Level 2 and 3 activities will also be monitored against a baseline to identify any work that is not progressing as planned or is ahead of schedule so we can take advantage of the early completion or initiate a recovery plan as required.

### 6.2 Monitor Vendor's Schedule

Schedule health and integrity will be monitored on level 3 schedules developed by all the Work Groups. Standard scheduling templates with minimum number of activities and all the mandatory codes for different work types will be provided. BI reports will be developed to monitor the compliance.

ACUMEN FUSE application will be used to analyze schedule quality and look for issues like missing logic, hard constrains, negative float, number of lags or areas where there is insufficient level of detail, before vendors schedules are integrated within the Program Integrated Master Schedule (PIMS)

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### **DARLINGTON REFURBISHMENT: SCHEDULE MANAGEMENT PLAN FOR INTEGRATED LEVEL 3 EXECUTION**

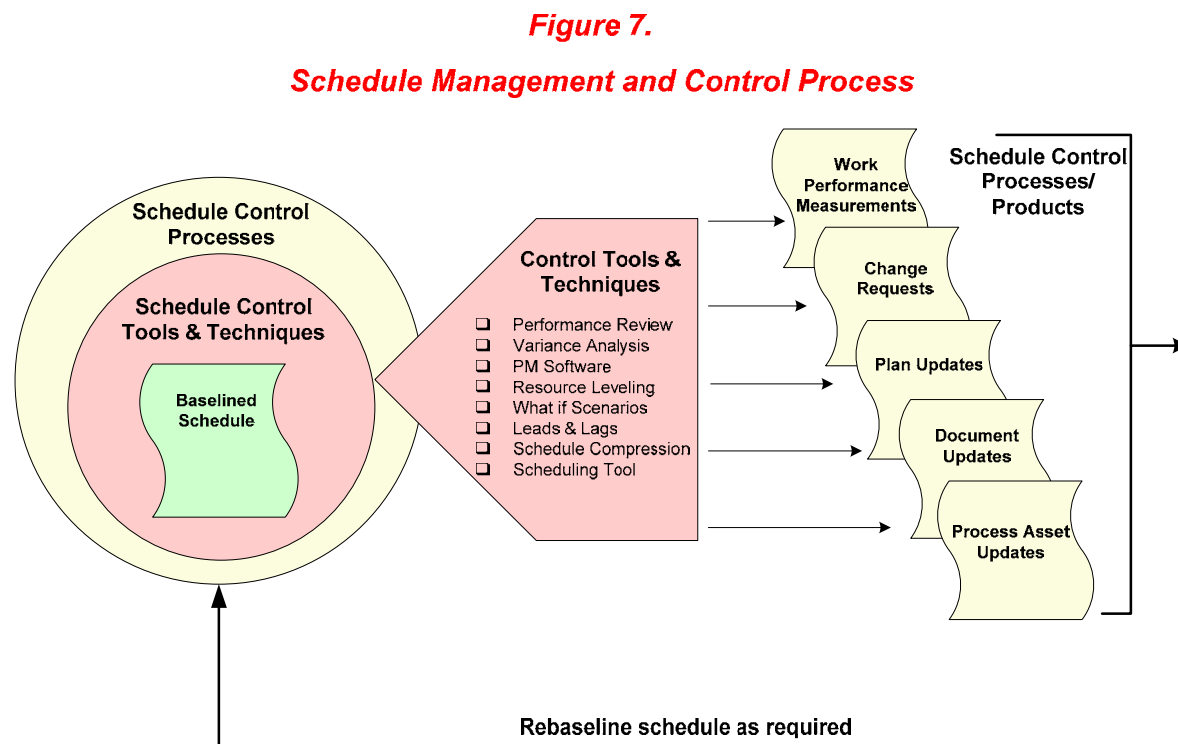
Monitoring vendor's schedules will be ongoing activity and all the issues will be communicated through Master Scheduler to the Lead Schedulers located in the SCC room. It will be Master Scheduler's responsibility to ensure that all the corrective actions have been resolved in a timely manner and that both Outage Manager and Unit Director are aware of the issues.

## **7.0 SCHEDULE MANAGEMENT AND CONTROL**

Schedule management and control begins when the Level 3 is first baselined. This initial baseline establishes the project's scope and sets the expectation for how and when the scope will materialize. Any proposed changes to the scope will drive a schedule change management process. At this point, changes happen only if there is a change in requirements.

Schedule control addresses anticipating or correcting schedule variance. To do this, control tools and techniques are used to detect and forecast serious deviations from the baseline.

Figure 7 depicts a high-level representation of the schedule management and control process used by the Darlington Refurbishment.



As actual completion dates are monitored against the baseline, control tools and techniques are applied to anticipate, avoid, and mitigate time loss as well take advantage of extra time due to early completions.

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### **7.1 Schedule Control Techniques**

Schedule control processes serve to minimize schedule changes. Control techniques are designed to reveal the status of the schedule and suggest corrective action to bring the project back on schedule. A number of techniques will be used on Level 3 schedules developed by OPG and contractors. For a list of Schedule Control Techniques that will be used in the Darlington Refurbishment see Appendix B

Schedule Planning Analysis takes place early in the project when the WBS is formulated. The scheduling team will use P6 to run What-if Scenarios to align the project owner's vision of the project with the likely timeframe for completion. What-if Scenarios will again be run when a new completion date must be determined as a result of a requested change to the WBS during the course of the project...

### **7.2 Schedule Control Products**

Schedule Control Products such as Work Performance Measurement Data, Change Requests, Plan Updates, Process Asset Update, and Project Document Updates will result from applying schedule control techniques.

Planning and Controls (P&C) will facilitate the development of these products but it will be the Bundle/Project Team's responsibility to prepare, review or update the product and take the necessary correct actions, e.g. To submit a Change Request or to review the Performance Reports or to update the Schedule Baseline.

### **7.3 Schedule Change Request Process**

Schedule changes may be driven by unanticipated work, new scope or when forecast is so far from the baseline that all the monitoring tools are no longer providing meaningful information. The change control process will be done at the Work Package level. If schedule analysis reveals an unfavorable impact to Work Package End Date or total resource hours projected, then a work Package Change Control process will be initiated.

Change Control process specifies different thresholds when a proposed change is considered an approved variance, a baseline change or full re-baseline of the schedule. Different levels of approves are required, based on the type of change.

Every change request will be reviewed to evaluate impact on Program Milestones, downstream activities, interfaces with other work groups and resource requirements.

The Master Scheduler monitors the Level 3 by reviewing and incorporating updates on a weekly basis. The Schedule Change Management Process is applied when:

- New tasks or deliverables cause baseline milestones or Work Package End Date to slip
- The project scope is changed
- A new constraint impacts the planned delivery date of the final project deliverable
- A directed change has occurred

### **7.4 Update Schedule**

Level 3 schedules will be updated daily or weekly during the execution phase based on the Outage Segment requirement. Asset Suite 7 tasks will be updated automatically with an interfaces process. Activities created manually will be updated by the Lead Schedulers sitting in the SCC room. Daily updates will include actualizing activities and entering percent complete.



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The Data Date will be moved as required to support the process of generating integrated T-0 schedule.

Based on the daily status updates in Level 3 schedules, the Master Scheduler will analyze the schedule accuracy, float, extra time and overruns with respect to impact on interfaces across work group or execution windows within segments.

#### **7.5 Establish New Schedule Baseline**

Prior to breaker open, the Integrated Level 3 schedule will be going through multiple revisions as we develop and incorporate additional details. With each revision, we will create a new baseline. Revision '0' will be the final revision before Breaker Open and that will be the baseline for execution.

After Breaker Open, in order to change the baseline, work group will have to follow the Change Control Process. Once the change is approved as baseline change and all the impacts on downstream activities have been analyzed, effected baseline will be restored and updated in P6.

Every time a baseline is updated, a copy of the baseline is retained in P6 before any changes are made.

#### **7.6 Archive Schedule Change Support Materials**

A Change Control Form (CCF) is required for any change request. Supporting documentation and analysis is assembled by the project teams and submitted for review to Planning & Controls group. All the information is stored in SharePoint and recorded in Change Control Log. See the Change Control procedure to get the full list of requirements.

### **8.0 SCHEDULE STATUS REPORTING**

NR Refurbishment will use the BI Reporting solution for all the reporting requirements. The BI reports are located on the OPG network in the SharePoint environment. P6 data, including current schedules and the baseline schedules, will be downloaded every night into the BI data warehouse.

All the reports required in the BI will be defined and developed prior to Breaker Open. Existing reports used during outages will be leveraged and new reports will be created based on Refurbishment requirements and industry standards/practices/templates.

#### **8.1 Monthly Project Reports**

Schedule status reporting is accomplished via four monthly reports:

- Project Master Schedule (Gantt Chart)
- Monthly Project Report (Internal and External)
- Sponsor Monthly Project Report
- Contractor Dashboards
- Bundle Dashboards

#### **8.2 Monthly Metrics and Trend Analysis**

Reports that specifically detail the status of the schedule including completion status of tasks, activities, deliverables, and milestones as compared to the baselined plan include:

- Planned vs. Actual Task Completions

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- Estimate to Complete (ETC)
- Critical Path Analysis

#### **8.3 Weekly Metrics and Trend Analysis**

- Weekly CNO Package
- Schedule Adherence Report
- Schedule Variance by Activity
- New tasks added (or deleted) since last reporting period
- Outage Segment Dashboard
- Project Dashboards

#### **8.4 Daily Reports and Metrics**

- Break Plan
- Plan of the day
- T-0 Plan
- List of tasks that were completed or not completed

#### **8.5 Schedule Oversight Reports**

Reports used to analyze current status and identify potential or actual issues include:

- Project Milestone and Deliverables Reports
- Task Lead Oversight Reports
- Oversight Reports
- Tasks with Negative Float Reports
- Contractual Product Status Reports
- Late or At Risk Task Reports

### **9.0 SCHEDULE CLOSING**

P6 production database will be monitored by P6 administrator who will ensure that the number of active activities do not cause any performance issues. Completed schedules representing early phases of the projects/segments will be archived. Historical data will be available through custom solution.

#### **9.1 Closing Reports**

The Schedule Manager will provide input into the final schedule-related reports generated by the IPOC. These reports include:

- Post Implementation Evaluation Report (PIER)
- Federal Closeout Report

#### **9.2 Archive Schedule Data and Tools**

Archived activities will be in another P6 instance available for review and analysis. Custom P6 Viewer that combines information from two separate P6 instances will be available. Archived schedules will also be available in XER format.

BI Data Warehouse will have all archived and active schedules available for reports and metrics.

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**Appendix A: Glossary & Acronyms**

ACRONYM/TERM	DESCRIPTION
Archive	An Archive is a secure repository of Configuration Items often stored offsite for additional security. Archiving is a process of storing Configuration Items in a secure manner. The purpose of archiving is to provide recoverability to a past state. Although the process for creating an archive is similar to that of taking a baseline, the method of storage for both is different. Whereas baselines are maintained in easily accessible media for reference during the project lifecycle, archives are stored on secure media.
Baseline (also: Project Schedule Baseline)	Approved project schedule that serves as the basis for measuring and reporting schedule performance.
Change	Change and clarifications to any configured item including operational requirements and contract requirements.
Change Control	The tracking and management of proposed changes to an item's format, content, version and/or configuration. Change control applies to many different project office functions (e.g. requirements management, project management, quality management, contract management, etc.) as well as contractor delivered products.
Sub-Contractor	The external service provider that will develop, or otherwise supply a service to or component of a project deliverable. (See Vendor)
Deliverable	A work product produced by a contractor or consultant in accordance with the terms of their contract. It is measureable, tangible, verifiable outcome, result, or item that must be produced to complete a project or part of a project.
ETC	Estimated Time to Complete
FSR	Feasibility Study Report
Integrated Level 3	A schedule of tasks to be completed by both the Vendor and OPG staff.
IT	Information Technology
Managers	The Department staff that oversee other department staff and are generally responsible for workload management.
Milestone	Identifiable point in a project or set of activities that represents a reporting requirement or completion of a large or important set of activities.
Vendor	The contractor who has primary responsibility for developing or integrating the given system, or the primary contractor performing work on the system.
Project Management Body of Knowledge (PMBOK)	Information Technology project management supported by a discipline and a formal body of knowledge that defines a project from inception to implementation.

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ACRONYM/TERM	DESCRIPTION
Project Participant	Individuals that are either dedicated project staff or individuals that provide executive level sponsorship and support.
Project Schedule	Time-sequenced plan to accomplish activities or tasks used to direct and control project execution. Usually shown as a milestone chart, Gantt or other bar chart, or tabular listing of dates.
Project Work Breakdown Structure (Project WBS)	The Project WBS is a hierarchical tree diagram that depicts the first three levels of the work breakdown structure beginning with level 1 that shows the project's main deliverable (the final system) followed by level 2 – the major deliverables that make up the level 1 deliverable, followed by level 3 – sub-deliverables to the major deliverables. "Deliverable" may be a contracted deliverable of major work product.
Request for Proposal (RFP)	The RFP used to solicit proposals from the bidding community based on a set of defined requirements. The requirements may be general in nature allowing the bidders to propose a solution and the specific products to be used. The RFP describes the problem requirements, contractual terms, and required format for the proposal responses. The RFP also includes the specific criteria which will be used to evaluate the received proposals. The project works with DGS to ensure the RFP meets all appropriate state guidelines and regulations.
Resource Breakdown Structure (RBS)	A hierarchical structure of resources by resource category and resource type. The RBS may be organized by functional organizations.
Schedule Management	The process of developing, managing, and controlling the project schedule or integrated master schedule.
Stakeholder	(1) Individuals and/or groups who are involved in or may be affected by project activities. (2) The people who have a vested interest in the outcome of the project.
System Implementation	System implementation includes the activities of the project office and Vendor to deploy the new system into the target environment or production. This includes but is not limited to, the installation of equipment, the installation of software, the rollout of new or modified business processes, and the delivery of supporting documentation. Implementation is complete upon system acceptance by the department's maintaining organizations, and when the system is deemed "In production". Since the project may be developed, implemented, and transitioned in iterations, these processes may be repeated and overlap between iterations.
Work Breakdown Structure (WBS)	A deliverable-oriented hierarchical grouping of project elements that organizes and defines the total scope of the project. Each descending level represents and increasingly detailed definition of the project work.

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**Appendix B: Schedule Control Techniques**

<b>Technique</b>	<b>Definition</b>
Performance Reviews	Performance reviews measure, compare, and analyze schedule performance such as actual start and finish dates, percent complete, and remaining duration for the work in progress.
Scenario Analysis	Allows decision makers to explore the implications of several alternative future states thus avoiding the danger of single-point forecasts. Conducted in a nonthreatening group setting, participants express beliefs, challenge assumptions, and alter their viewpoints to ultimately arrive at a strategic direction that is flexible and will remain so as actual events unfold.
Forward-Pass Analysis	Calculation of early start dates and early finish dates for uncompleted portions of all network activities. Determined by working forward through the network logic from the project's end date.
Backward-Pass Analysis	Calculation of late finish dates and late start dates for uncompleted portions of all network activities. Determined by working backward through the network logic from the project's begin date.
Bottom-Up Estimating	Cost, work, or resource estimate derived by first estimating the project's individual elemental tasks at the lower levels of the WBS and then aggregating those estimates at successively higher levels of the WBS. For cost estimates, the project manager typically includes indirect costs, general, and administrative expenses, profit, and any reserves when calculating the total project cost. This form of estimating is more accurate than making one large estimate.
Top-down Estimating	Approximating the size (duration and cost) and risk of a project (or phase) by looking at the project as a whole and comparing it to previously performed similar projects. The comparison may be made directly using "analogous estimating," through an algorithm as in "parametric estimating," or from the memory of estimating experts. Upon establishing an overall estimate for the project, sub-divide the estimate down through the levels of the WBS, for example, development will be 50% of the total, testing will be 25% etc; then sub-divide development and testing into their components and so on.
Critical Path Method	Predicts project duration by analyzing the sequence of activities (network path) that has the least amount of scheduling flexibility (i.e. float). Early dates are calculated by a forward pass using a specified start date. Late dates are calculated by a backward pass starting from a specified completion dated (usually forward pass's calculated early finish date for the project.)
Monte Carlo Simulation	A technique in which the project team leader or project team computes and/or quantifies the complete and total project cost and/or project schedule a number of times through the use of input values that have been selected at random through the careful utilization of probability distributions or potential costs and/or potential durations. The purpose of utilization of the Monte Carlo analysis is for the sake of calculating a defined distribution scenario of possible total costs associated with the project as well as a range or possible completion dates of the project.
Resource Histogram	Vertical bar chart used to show resource consumption and availability by time period. Also called, resource loading chart.
Resource Leveling	1) Practicing a form of network analysis in which scheduling decisions (start and finish dates) are driven by resource management issues such as limited

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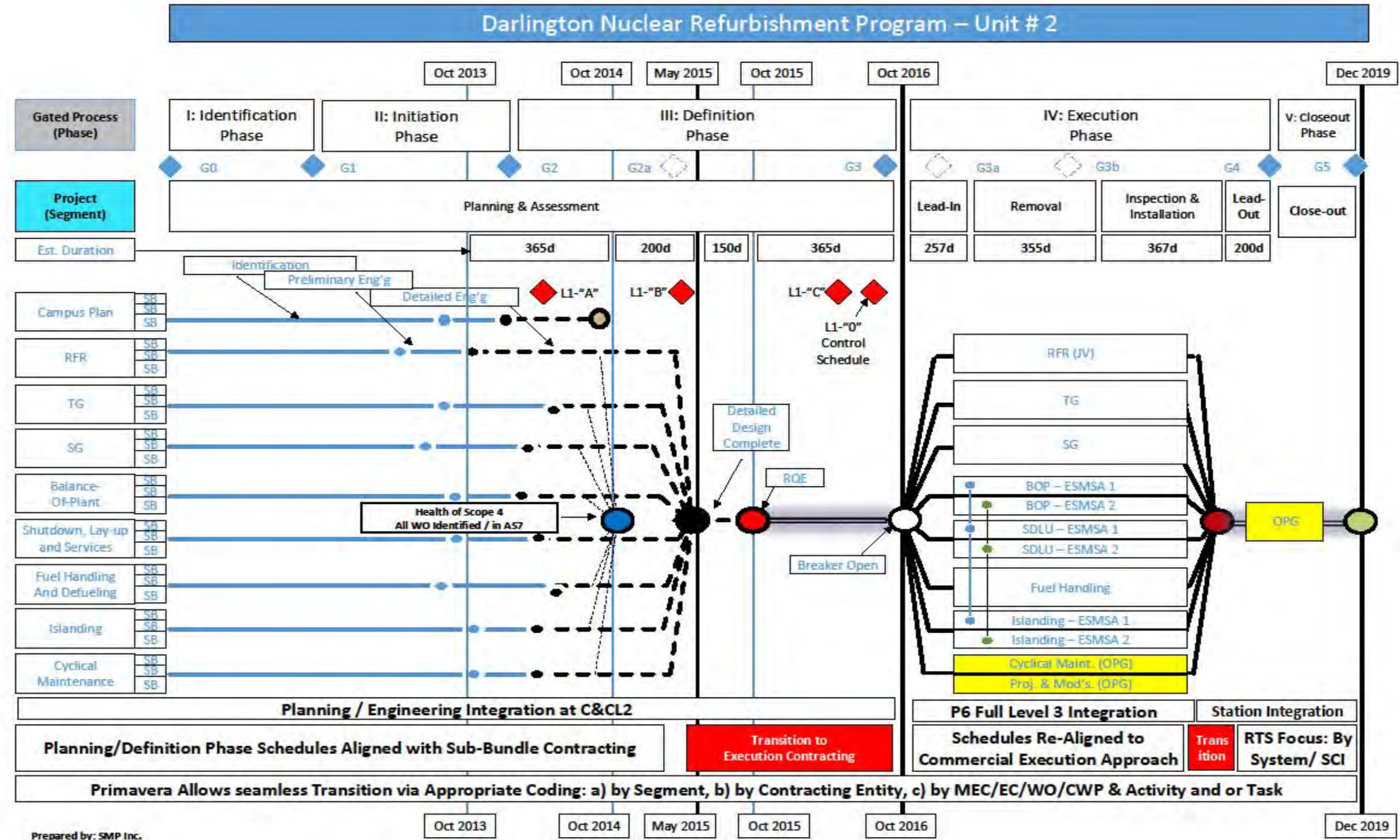
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Technique	Definition
	resource availability or changes in resource levels.  2) Evening out the peaks and valleys of resource requirements so that a fixed amount of resources can be used over time.  3) Ensuring that a resource is maximized but not used beyond its limitations.
Variance Analysis	The goal is to determine the causes of a variance (that is to say, the difference between an expected result and an actual result).
Schedule Compression	Shortening of the schedule without reducing the project scope. Often requires an increase in project cost.
Crashing	Taking action to decrease the total project duration by adding resources (human and material) to the project schedule without altering the sequence of activities. The objective is to obtain the maximum duration compression for the least cost.
Fast Tracking	Compressing the project schedule by overlapping activities normally performed in sequence, such as Design and Build/Construction.
Free Float & Total Float (or Slack)	Free float is the amount of time an activity can be delayed without delaying the early start of any immediately succeeding activities. Also called, secondary float. Total float is the amount of time an activity from its early start without delaying the project end date. Derived by subtracting the early start from the late start or the early finish from the late finish and may change as the project progresses and as changes are made to the project plan. Also called slack, float, and path float.
Adjust Leads and Lags	Lead: A modification of a logical relationship that allows an acceleration of the successor activity such as when a task has a finish-to-start dependency with a ten-day lead, the successor activity can start ten days before the predecessor activity has finished. Lag: A modification of a logical relationship that directs a delay in the successor activity such as when a task has a finish-to-start dependency with a ten-day lag, the successor activity cannot start ten days after the predecessor activity has finished. Adjusting leads and lags is used to find ways to bring project activities that are behind into alignment with the plan.

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Appendix C: Unit 2 -Darlington Nuclear Refurbishment Program



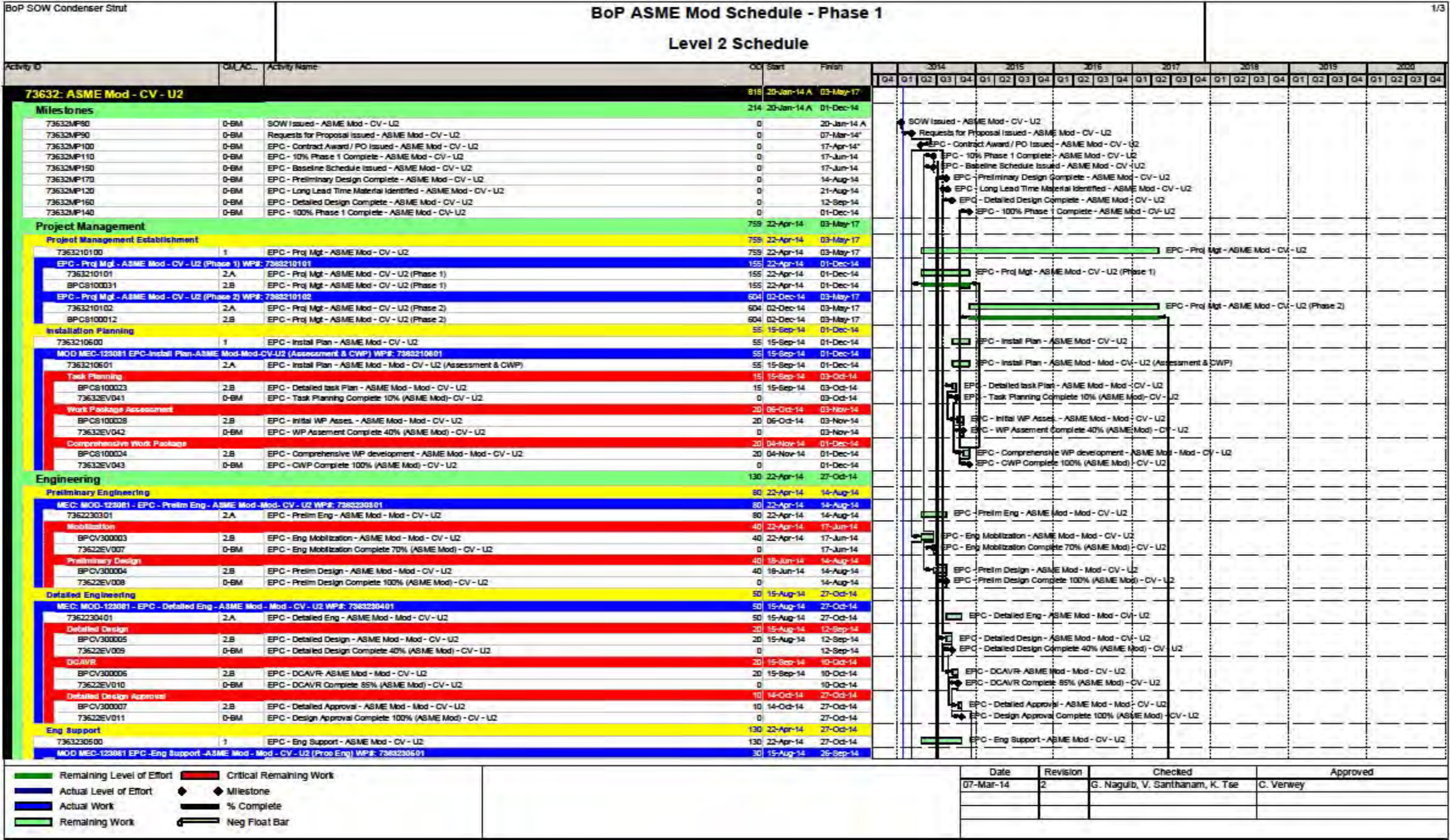


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Appendix D: Implementation of Work Breakdown Structure (WBS)



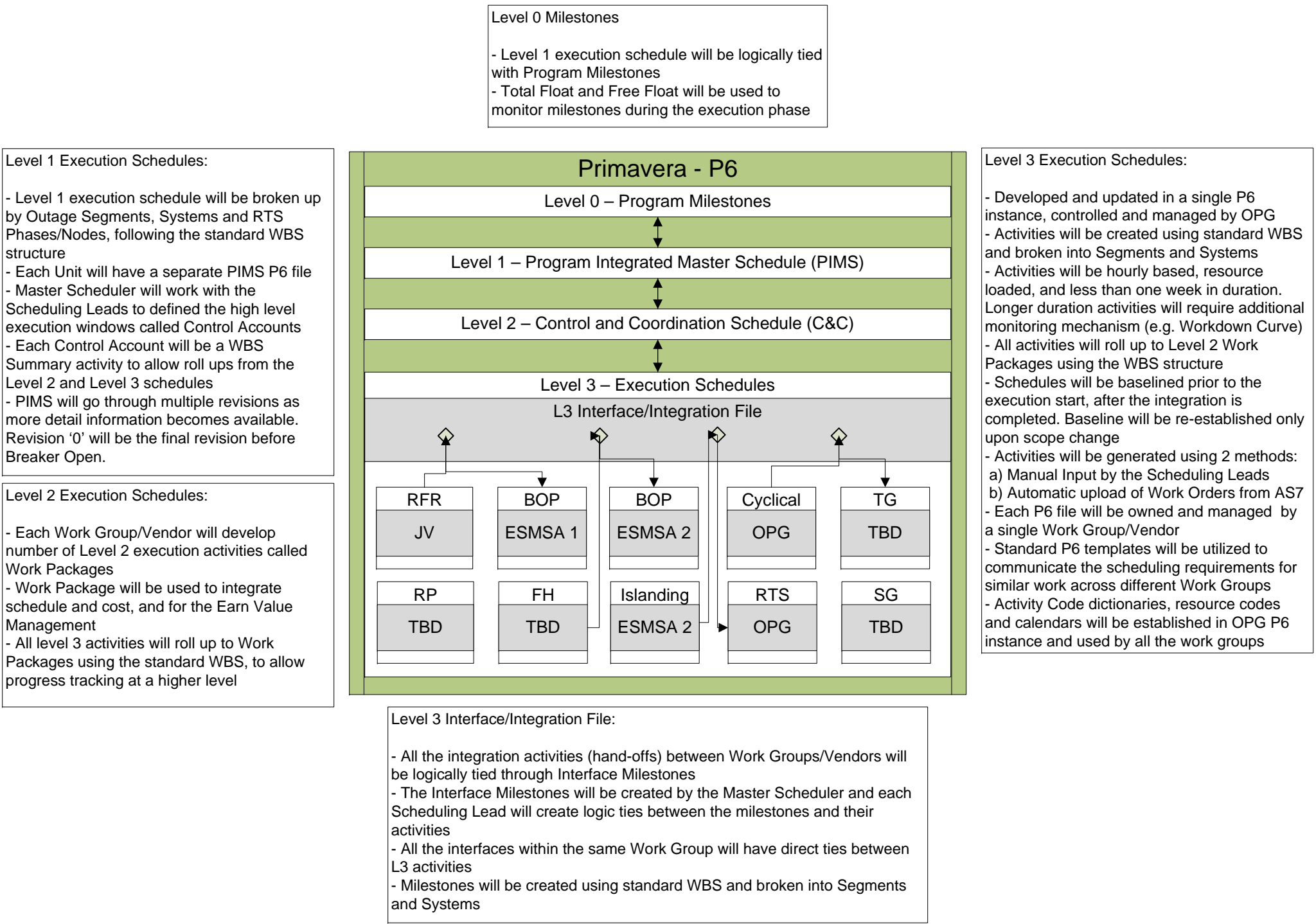


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## Appendix E: Integrated Multi-Level Scheduling Structure

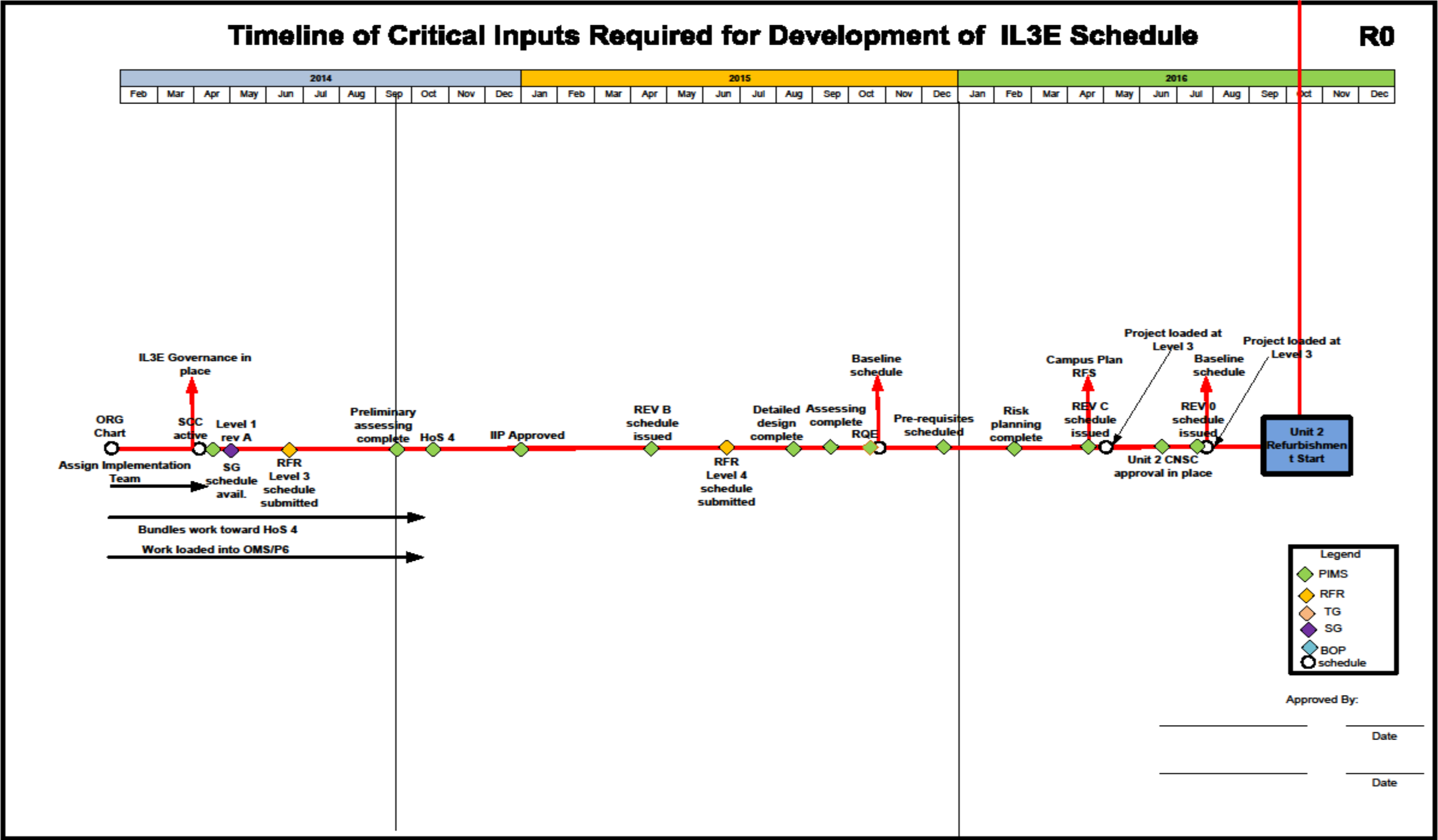


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Appendix F: Timeline of Critical Inputs Required for Development of IL3E Schedule



# ONTARIOPOWER GENERATION

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**NUCLEAR REFURBISHMENT COST ESTIMATE**

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## NUCLEAR REFURBISHMENT COST ESTIMATE

**N-MAN-00120-10001-EST-01-R001**  
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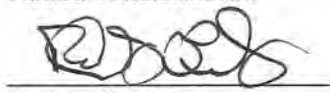
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## 1.0 OVERVIEW

This document is written under the authority of Nuclear Projects Cost Estimating N-MAN-00120-10001-EST. It provides an overview of the requirements and processes to be followed when planning, developing, reviewing, approving Class IV and Class V cost estimates for projects of Nuclear Refurbishment (NR), and obtaining an accurate and realistic assessment of the likely cost of a project.

This manual establishes the practice in which NR will align with other OPG organizations, recognized industry standards, and common practices as recommended by industry groups such as the Association of the Advancement of Cost Engineering International ("AACEI"). This manual aligns the development of project estimates and its requirements to each phase (or gate) of a project as documented in Nuclear Projects - Gated Process N-MAN-00120-10001-GRB.

This manual details the Gate 0/Gate 1, Class IV and Class V estimating requirements and the support group estimates required.

Gate 2/Gate3, Class II and Class III will be prepared by the EPC Vendors. For estimating requirements see N-MAN-00120-10001-EST-03 – Nuclear Refurbishment – Estimate Oversight, Review and Validation.

Compliance to this manual is mandatory for all projects executed or funded by Nuclear Refurbishment program, with exception to projects executed by Projects and Mods.

## 2.0 ROLES AND RESPONSIBILITIES (per Appendix "C")

### 2.1 Definition – Project Estimator

The Project Estimator is the group, the individual, or the 3<sup>rd</sup> Party Estimator who prepare the estimate to the defined scope of work per Nuclear Refurbishment project requirements.

### 2.2 NR Execution – Project Management

- Identify deliverables and requirements in P6 for estimating support, 6 months before the estimate is due for Gate 0 and Gate 1, or 3 months before the estimate review and validation is due for Gate 2, 3 and onwards.
- Validate the accuracy of approved scope description (in DSR, CCA, AR, etc) and its original inputs to the approved scope description.
- Provide the Project Estimator with validated project scope documents, contract strategy, engineering design report and details, etc as needed for the progression of the gate, per agreed work breakdown structure (WBS). The detailed project documents and engineering information are listed in the Appendix A: Estimate Input Checklist per Estimate Classification and NR Project Gates.
- Coordinate and act as SPOC among engineering, reactor safety, supply chain, operation and maintenance, to provide project information to support estimating.

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- Ensure the scope, strategy clarification and alignment is reached between the estimators and project management team, and reflected in Basis of Estimate (BoE) for final approval.
- Develop WBS and the WBS dictionary, and lead its approval in accordance with NR WBS standard.
- Communicate information and decisions relative to construction labour agreements, shift plan, labour strategy, allowance, etc.
- Support estimate's development, revision and approval to meet key milestone, project schedule, and gate requirements.
- Further define the estimate template with Project Estimators per the level of details in estimate
- Review cost presentations for project direct cost, project indirect and overhead cost.
- Review and approve the estimate for Gate 0 &1, or estimate review/validation report for Gate 2, 3 and onwards.

### 2.3 NR Planning and Controls - Estimating

- Provide the manuals and task instructions to estimator, CSA, engineers, and project managers etc. to support project estimating.
- Prepare program level estimates to meet program needs, and consolidate the projects' estimates to support Release Quality Estimate as defined in NK38-PLAN-09701-10235.
- Validate and approve the required estimate accuracy based on Gate requirements as defined in Nuclear Refurbishment Gated Process N-MAN-00120-10001-GRB, jointly with NR Execution- Project Management.
- Ensure the estimate is developed, revised and approved to meet key milestones, project schedule, and gate requirements.
- Assign the Project Estimator to develop the Class IV, Class V estimate per the requirements from NR execution - project management.
- Coordinate use of third-party estimating service, where required and/or applicable, including periodic reviews of their performance and estimating standards.
- The primary role is to develop/approve estimates to support projects for Gate 0 and 1. (As identified in N-MAN-00120-10001-EST03 the primary role is shifted to provide oversight to EPC Vendors, validate and review their estimates to support Gate 2, 3 and onwards, as the EPC contractors are further involved with project development).
- To support Gate 0 and 1, prepare estimate package with BoE (Basis of Estimate), for Gate Review Board as described in Nuclear Refurbishment Gated Process N-MAN-00120-10001-GRB, or Program Scope Review Board ("PSRB") per N-MAN-00120-10001-SCOPE-05: Darlington Refurbishment Program – Scope Review Instruction. (To support Gate 2, 3 and onwards, provide oversight to EPC Vendors, review and validate estimates and BoE prepared by the EPC Vendors, for the scope fullness and properness for the estimating data and methodology – as detailed in N-MAN-00120-10001-EST03 and EST-04).
- Utilize estimating tools for preparing estimate, and provide access to estimate tools and database to project members as needed.
- Develop estimate benchmarking analysis as needed.



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- Keep audit ready records of relevant information regarding each estimate prepared or reviewed.

### 2.4 NR Planning and Controls – Costing and Scheduling

- Provide the Project Estimator with incurred cost of activities already executed for the project.
- Provide the Project Estimator with an updated schedule of activities and key milestones.
- Understand all details of the estimate report and be prepared to use it for budget preparation.
- Working with the Project Estimator, cost and schedule analyst will update the schedule with the appropriate resources, identify resource histograms and analyze peaks and valleys. Also, the cost and schedule analyst will develop the cashflow based on estimate cost.

### 2.5 NR Planning and Controls - Risk Management:

- Provide updated risk register for estimating.
- Lead structured analysis of project estimate for risk/contingency evaluation per N-MAN-00120-10001-RISK-05: Nuclear Refurbishment - Contingency Development and Management.

### 2.6 Major Nuclear Projects Controllership

- Provide escalation factors, capitalized interest calculation methods and standard OPG labour rates to project estimating team.
- Provide guidance and assistance in calculation of NR project/program escalation and capitalized interest.
- Provide guidance to project team for the eligibility of project indirects and overhead cost in the estimate.
- Provide overall finance guidance and support for reviewing total project cost estimate, as required.
- Verify Capital vs. O&M cost for NR Project/Program.

## 3.0 ESTIMATE TYPES

Estimates may be required for a variety of reasons. The typical requirement for the estimates is to support project progression and the gated process.

The estimates can also further facilitate other functional groups and its deliverables as follows:

- Estimate can be used to support annual business planning for NR program funding request (Program Releases, RQE).

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- Estimate can be used to facilitate the preparation of DRAS and its NPV calculation to support the scope progression and final scope approval from SRB.
- Estimate can be used to facilitate the procurement or contracting processes, to set up baseline budget for vendor quotation or bidding.
- Estimate review reports will be used to support NR Execution – Project Management and others for bid evaluation, vendor selection or negotiation.
- Estimate can be further processed for budgeting, and cashflow preparation by the NR Project Controls – Costing and Scheduling

## 4.0 ESTIMATING PROCESSES

There are four major phases in developing an estimate. They are estimate planning, estimate developing, estimate reviewing, and estimate approving. These estimating processes will be repeatedly implemented to support each Gate per gated process N-MAN-00120-10001-GRB. The detailed estimating activities for each phase and gated processes are in Appendix C: Estimating activities and gated processes.

### 4.1 Estimate Planning

NR Planning and Controls – Estimating determines the AACEi classification, timeline, and deliverables of an estimate. They also determines who will be accountable to produce the estimate and when the estimate will be conducted, and how the estimate will be prepared and presented. Also, it will plan the level of accuracy and classification that the estimate is required based on the project gate per N-MAN-00120-10001-GRB: Nuclear Projects - Gated Process.

NR Planning and Controls – Estimating decides which group or individual will estimate different parts of the project scope. It shall decide whether to do the estimate internally in OPG vs. Externally (via 3<sup>rd</sup> party estimator).

NR Planning and Controls – Estimating develops brief schedule for estimate delivery or review dates, based on different pieces of project scope progress, and stage of project (gate) with concurrence of the project manager. Estimating milestones must be in accordance with the overall NR Program Master Integrated Schedule (“PIMS”).

NR Planning and Controls – Estimating approves the level of accuracy for estimate based on available project information and engineering progress. This is to ensure that the estimate requirement is aligned with stage of project (gate).

NR Planning and Controls – Estimating verifies the grouping of major scope items via WBS definition, to facilitate estimate development and review.

Unique estimate ID to each estimate will be provided by NR Planning and Controls - Estimating Team to track and record the estimate and its revision.

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### 4.2 Estimate Developing

Following the Nuclear Projects - Gated Process (N-MAN-00120-10001-GRB), each project will provide required project plans and procedures to support the estimate preparation. Detailed list of documents that NR Execution – Project Management needs to provide to the estimators are listed in Appendix A: Estimate Input Checklist per Estimate Classification and NR Project Gates

The Project Estimator will prepare the estimate to the defined scope of work per Nuclear Refurbishment project requirements. The Project Estimator is assigned by NR Planning and Controls – Estimating to support each NR project and the Gated process.

To support the Gate 0 and Gate 1 effort, the Project Estimator will:

- Achieve and document scope clarification and ensure there is alignment with project execution – project management team, via estimate developmental or clarification meetings.
- Prepare estimate and develop the Estimate Basis in parallel, and clearly outline any deviation or exclusions in estimate.
- Prepare estimate breakdown based on approved project WBS and Code of Accounts NK38-REF-09701-0389661.
- Prepare estimate based on the agreed project estimating template (Appendix B: Sample estimate templates).
- Use estimating tools and databases as directed by NR Planning and Controls- Estimating to prepare the estimate. The estimate shall be structured in consideration of data migration to P6 or other project control tools.
- Ensure estimate and estimate class input into NR project scope control database.
- Develop backups for the estimate calculation details for reviews or audits.

For support to Gate 2, 3 and onwards, the requirements are identified in N-MAN-00120-10001-EST03

#### 4.2.1 Estimate Basis Freeze

Generally, all the estimate basis or project information supporting the estimate or estimate review/validation will be frozen 1 month before the estimate due date. Only minor project changes or information updates that are received by the estimator 2 weeks before the estimate due date, will be incorporated into the estimate and estimate review and validation.

#### 4.2.2 Basis of Estimate

The Project Estimator shall prepare the Basis of Estimate (as detailed in N-MAN-00120-10001-EST04) in parallel with the development of the estimate.

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### 4.2.3 Estimate Allowance and Contingency

The definitions for allowance and contingency, and the contingency calculation methods for estimate are laid out in N-MAN-00120-10001-RISK-05: Nuclear Refurbishment - Contingency Development and Management.

NR Project Risk Management group shall undertake a structured analysis of the project estimate to establish program level contingency and management reserves.

### 4.2.4 Estimate Escalation and Interest

Project escalation and capitalized interest will be calculated at the project level with support from Major Nuclear Projects Controllership, once the project estimate is developed.

### 4.2.5 Estimate Report Package

As a minimum, this report will include the following documents:

- Basis of estimate
- Cost estimate details
- Cost estimate summary (incl. indirect cost estimate) by Code of Account per WBS and project release gate-
- Estimate key quantities and validation report
- Location and difficulty factors applied in the estimate

### 4.2.6 Estimate Revision

Estimate shall be revised to reflect approved major changes (scope, government policies, working conditions, etc) per project requirement or Refurbishment Program requirement and direction.

Estimates shall be revised when the project or Refurbishment program proceeds to the next gate in accordance with Nuclear Projects - Gated Process (N-MAN-00120-10001-GRB).

## 4.3 Estimate Reviewing

Estimate reviews are intended to ensure that project objectives are met. Estimate reviews validate technical details of the scope of work and verify that the correct processes have been followed during estimate development.

Depending on project's complexity, an estimate may require one or more reviews.

- Scope Review and Quantity Check: The quantity review assesses estimate detail to confirm that it has been completely and correctly quantified per the scope document. The project team reviews scope and quantity details for each direct cost account. This is a key review that requires agreement and alignment on the total package by all attendees.

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- Project Team Review: This review achieves project team agreement on the estimate basis, scope, and overall completeness of the project. The Project Estimator organizes and leads the review challenge meeting. The quorum can include the Project Manager, Project Engineer/Lead, Construction Coordinator, Cost and Schedule Analyst, and Section Manager Project Planning.

### 4.3.1 Estimate Benchmarking

The Project Estimator shall prepare the Estimate Review Report, which summarizes and compares several key benchmark ratios and factors versus historical (and sometimes estimated) values from similar projects. The key benchmark criteria shall be discussed and agreed between Project Estimator and project team. The goal is to ensure that key metrics from the estimate are in line with the same metrics from similar projects. If there is a large discrepancy, it must be explainable by the particular circumstances of the estimated project versus the similar completed projects. Also, the lessons learned on similar types of estimate shall be reviewed.

### 4.3.2 Estimate Reconciliation

When it is not the first estimate, or not the first gate for the project, reconciliation between current estimate and previously published estimate is required. It will compare the variance in quantities and cost for labour, material, and equipment by Code of Accounts or WBS. It is to show the estimate development from previous approved estimate (or BCS).

### 4.4 Estimate Approving

Responsible manager of NR Program Estimating Team and NR project's responsible project manager shall be the first to approve estimates for his/her responsible scope of work.

Depending on the size of project scope and estimate cost, the manager, director, and VP from the responsible execution department or business units may be required to approve the estimate.

## 5.0 ESTIMATE CLASSES AND NR PROJECT GATES

The Association for the Advancement of Cost Engineering International ("AACEi") has developed an estimate classification standard, which defines the estimate "quality" based on the input information used. The AACEi classification system has been adopted for this standard to provide a more uniform basis for decision makers to assess the level of confidence that they can place in an estimate based on a documented level of project definition.

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Table 1, Estimate Classifications and NR Project Gates, which provides detailed information about the AACEi classes of estimates, their intended purpose, the level of definition requirements and the methodology used to prepare them. It also illustrates the estimate classification corresponds to each Gate of Nuclear Refurbishment Project per N-MAN-00120-10001-GRB: Nuclear Projects – Gated Process.

Details for determination of Estimate Classification is defined in N-MAN-00120-10001-EST-02 – Nuclear Refurbishment Estimate Classification Requirement and Assignment.

**Table 1: Estimate Classifications, Preparation and NR Project Gates**

OPG Nuclear Refurbishment Project Gate per N-MAN-00120-10001-GRB	Business Proposal G0	Identification Phase G1	Initiation Phase G2	Definition Phase G3
AACEi Estimate Class	Class 5	Class 5	Class 4	Class 3
Project Phase	<b>Business Proposal</b>	<b>Identification</b>	<b>Initiation</b>	<b>Definition</b>
<b>Purpose</b>	Initial evaluation - Feasibility of proposed projects Identification Phase Funding Concurred	Evaluation/screening of proposed alternates. Initiation Phase Funding Concurred	Preliminary project budgets or Benefit Cost Assessment based on preferred alternative Definition Phase Funding Concurred	Provide basis for BCS Authorization and cost control. Set scope and cost baseline. Execution/Close-out Phase Funding Concurred
<b>OPG NR Project Target Estimate Accuracy (Without contingency)</b>	Minus 50% To Plus 100%	Minus 50% To Plus 100%	Minus 30% To Plus 50%	Minus 20% To Plus 30 %
<b>Level of Project Definition</b>	Between 0 to 1% of total engineering	Between 1 to 2% of total engineering	Between 1 to 15% of total engineering	Varies from 10% to 40% of total engineering
<b>Method</b>  (Reference AACEi Recommended Practices 17R-97, 18R-97 and 19R-97 for more details on methodologies and their uses)	Ratio from existing units, sales estimates, or published costs.  <u>Example Methods</u> Capacity Factored Parametric Estimating Method Analogous Estimating Method Expert Judgment Analogy	Factored estimate based on appropriate equipment sizes, general features and dimensions.  <u>Example Methods</u> Capacity Factored Parametric Estimating Method Analogous Estimating Method Expert Judgment Analogy	Factored estimate based on equipment sizes, soil and site data, site work, buildings, structures, piping, mechanical and electrical information. Allowances where required for non-quantifiable requirements.  <u>Example Methods</u> Equipment Factored Parametric Estimating Method	Some factoring, some quantity takeoff from preliminary equipment arrangements and architectural drawings and information. Vendor quotes for major equipment. Other owner's costs included. Allowances where required.  <u>Example Methods</u> Semi-Detailed Unit costs with Assembly level line items

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### 6.0 ESTIMATING TOOLS

Estimating tool or database will be used for estimating preparation and record tracking/keeping, as defined by NR Planning and Controls – Estimating group. NR will provide access with defined security profile to the estimator. All the estimating detailed data is required to be stored in the defined estimating tool or database. The standardized estimating reports will be generated in the tool or database.

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## **7.0 RECORDS AND REFERENCES**

### **7.1 Records**

Copies of approved estimates produced during each project phase shall be filed according to N-MAN-00120-10001-PC-03: Nuclear Refurbishment Records and Document Management Manual.

### **7.2 References**

HY-HD-STD-006: Standard for Project Estimates

N-MAN-00120-10001-PC-03: Nuclear Refurbishment Records and Document Management Manual

N-MAN-00120-10001-SCOPE-05: Darlington Refurbishment Program – Scope Review Instruction

N-MAN-00120-10001-GRB: Nuclear Projects – Gated Process

N-MAN-00120-10001-SCH-05: Darlington Refurbishment Program – Project Work Breakdown Structure Guide

N-MAN-00120-10001-RISK-05: Nuclear Refurbishment - Contingency Development and Management

NK38-REF-09701-0389661: Darlington Nuclear Refurbishment Project - Code Of Accounts

N-MAN-00120-10001-EST-02: Nuclear Refurbishment Estimate Classification Requirement and Assignment

N-MAN-00120-10001-EST03: Nuclear Refurbishment – Estimate Oversight, Review and Validation

N-MAN-00120-10001-EST04: Nuclear Refurbishment – Basis of Estimate and Documentation

NK38-PLAN-09701-10235: Nuclear Refurbishment Project RQE Cost Estimate Plan

Skills & Knowledge of Cost Engineering, 5th Edition, AACEi, and various recommended best practices of AACEi

A Guide to the Project Management Body of Knowledge (PMBOK Guide) – Fourth Edition



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## 8.0 DEFINITIONS AND ACRONYMS

### 8.1 Definitions

**AACEi** – the Association of the Advancement of Cost Engineering International is the largest organization serving cost management professionals. It is the recognized technical authority in cost and schedule management for programs, projects, products, assets, and services.

**Allowances** - are included in estimates for items that are known, but for which the requirements are undefined. An allowance is a cost assumption which must be made because of incomplete information, quantities or design.

**Analogous Estimating** - An estimating technique that uses the values of parameters, such as scope, cost, budget, and duration or measures of scale such as size, weight, and complexity from a previous, similar activity as the basis for estimating the same parameter or measure for a future activity.

**Basis of Estimate** – Required component of the cost estimate, as recommended by AACE International. This document defines the scope of the project and ultimately becomes the basis for change management. A well-written BOE will clearly and concisely state the purpose of the estimate being prepared, the project scope, pricing basis, allowances, assumptions, exclusions, cost risks and opportunities, and any deviations from standard practices.

**Contingency** - the amount of money or time needed above the estimate to reduce the risk of project overruns of project objectives to a level acceptable to the organization (Project Management Institute Project Management Body of Knowledge). Refer to N-MAN-00120-10001-RISK-05: Nuclear Refurbishment - Contingency Development and Management.

**Code of Accounts** – a numbering system used to uniquely identify each element of the work breakdown structure, and to monitor project costs by categories. It is a coded index which methodically structured to support cost management (estimating, accounting, reporting), planning and scheduling.

**Estimate Classification** – maps the phases and stages of project cost estimating together with a generic maturity and quality matrix. The level of project definition determines the estimate class.

**Factored Estimate** - is an estimate prepared through the use of factoring costs from capacity, cost or some other measure of a known parameter, i.e. and estimate based on the cost of a similar facility of a different size (capacity).

**Indirect Costs** - (1) in construction, all costs which do not become a final part of the installation, but which are required for the orderly completion of the installation and may include, but are not limited to, field administration, direct supervision, capital tools, startup costs, contractor's fees, insurance, taxes, etc;(2) In manufacturing, costs not

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directly assignable to the end product or process, such as overhead and general purpose labor, or costs of outside operations, such as transportation and distribution. Indirect manufacturing cost sometimes includes insurance, property taxes, maintenance, depreciation, packaging, warehousing and loading. In government contracts, indirect cost is often calculated as a fixed percent of direct payroll cost.

**Monte Carlo Method** - a simulation technique, by which approximate evaluations are obtained in the solution of mathematical expressions, so as to determine the range or optimum value. The technique consists of simulating an experiment to determine some probabilistic property of a system or population of objects or events by use of random sampling applied to the components of the system, objects, or events.

**Overhead** - a cost or expense inherent in the performing of an operation, ie, engineering, construction, operating or manufacturing, which cannot be charged to or identified with a part of the work, product or asset and, therefore, must be allocated on some arbitrary base believed to be equitable, or handled as a business expense independent of the volume of production. Plant overhead is also called factory expense.

**Parametric Estimating Method** - In estimating practice, describes estimating algorithms or cost estimating relationships that are highly probabilistic in nature (i.e., the parameters or quantification inputs to the algorithm tend to be abstractions of the scope). Typical parametric algorithms include, but are not limited to, factoring techniques, gross unit costs, and cost models (i.e., algorithms intended to replicate the cost performance of a process of system). Parametric estimates can be as accurate as definitive estimates.

**Take-Off** - is a specific type of quantification that is a measurement and listing of quantities of materials from drawings in order to support the estimate costing process and/or to support the material procurement process.

## 8.2 Acronyms

AACEi	-The Association of the Advancement of Cost Engineering International
AISC	- Asset Investment Screening Committee [this doesn't appear in the document]
BCA	- Business Case Assessment
BCS	- Business Case Summary
BOE	- Basis of Estimate
BOM	- Bill of Material
COA	- Code of Account
COMS	- Constructability, Operability, Maintainability, and Safety screening
CSA	- Cost and Schedule Analyst
ECC	- Engineering Change Control [this doesn't appear in the document]
EPC	- Engineer, Procure and Construct
MNP	- Major Nuclear Projects
NR	- Nuclear Refurbishment
NRP	- Nuclear Refurbishment Program
OAR	- Organizational Authority Register

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PIMS	- Program Integrated Master Schedule
PSRB	- Program Scope Review Board
SCM	- Supply Chain Management
SOW	- Scope of Work
SPOC	- Single Point of Contact
WBS	- Work Breakdown Structure

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**Appendix A : Estimate Input Checklist (Guideline) per Estimate Classification and NR  
Project Gates**

	Gate 0 Class 5	Gate 1 Class 5	Gate 2 Class 4	Gate 3 Class 3
<b>General Project Data:</b>				
Project Scope of Work	D	P	A	A
Project Management Plan	D	P	A	A
Contracting Strategy	D	P	A	A
Risk Analysis Report	D	P	A	A
DRAS Forms	D	P	C	A
Project Master Schedule	D	P	C	A
Work Breakdown Structure	D	P	A	A
Code of Accounts	D	P	A	A
ALARA Plan			P	A
System Health Reports		P	A	A
Cursory field walk down		P	C	C
COMS Report			P	A
MRs and POs for long lead material		D	P	A
RFPs for major contracts	D	D	P	A
Contractor's estimate or bid			P	A
<b>Engineering Deliverables:</b>				
Design Scoping Check List	D	C	A	A
Design Agency Interface Agreement	D	C	A	A
Modification Outline		P	A	A
Master EC		P	A	A
Design Plan and Design Requirements		P	A	A
Design ECs/Project ECs			D	P
Engineering studies/reports	D	P	A	A
BOM			D	P
Plot Plans			P	A
Equipment List			P	A
Electrical Single- Line Drawings			P	A
Specifications and Datasheets			P	A
General Equipment Arrangement Drawings			P	A
Spare Parts Listings			D	P
Mechanical Discipline Drawings			D	P
Electrical Discipline Drawings			D	P
I/C system Discipline Drawings			D	P
Civil/Structural/Site Discipline Drawings			D	P

Legend:

- D : Drafted
- P: Preliminary
- C: Complete
- A: Approved

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## NUCLEAR REFURBISHMENT COST ESTIMATE

### Appendix B : Sample Estimate Summary Template -Construction and Procurement

Project ID:							Date:	October 20, 2010
Project Title:		Nuclear Refurbishment Project						
Project Area:							Estimator:	
WBS:							Estimate #:	
Estimate Type:							in CAD\$K	
Cost Category	Quantity	Manhours	Labour Cost	Material Cost	Equipment Cost	Total Cost	Notes	
Civil & Earthworks								
Concrete & Foundations								
Structural Steel								
Mechanical Equipment								
Piping								
Electrical Equipment								
Electrical Bulks								
Instrumentation & Controls								
Protective Coatings								
Scaffolding								
Buildings and Facilities								
Commissioning								
<b>Total Direct Field Cost</b>								
OPG Construction Indirects								
EPC Contractor's Construction Indirects (Support) & Overhead								
Contractor Profit & Fee								
<b>Total Construction Indirect</b>								
<b>Total Field Cost</b>								
OPG Engineering								
EP Engineering								
Licensing								
<b>Total Engineering Services</b>								
Spare Parts								
Freight								
Insurance and Bonds								
Legal Fee and Tax								
<b>Total Supplementary Cost</b>								
OPG Project Management Cost (PM, PC, SM, etc)								
EP Project Management Cost								
OPG Project Support Cost/Overhead								
Allowance (design allowance)								
Interest								
Escalation								
Contingency								
<b>Total Project Cost</b>								
Management Reserve								
<b>Total Program Cost</b>								

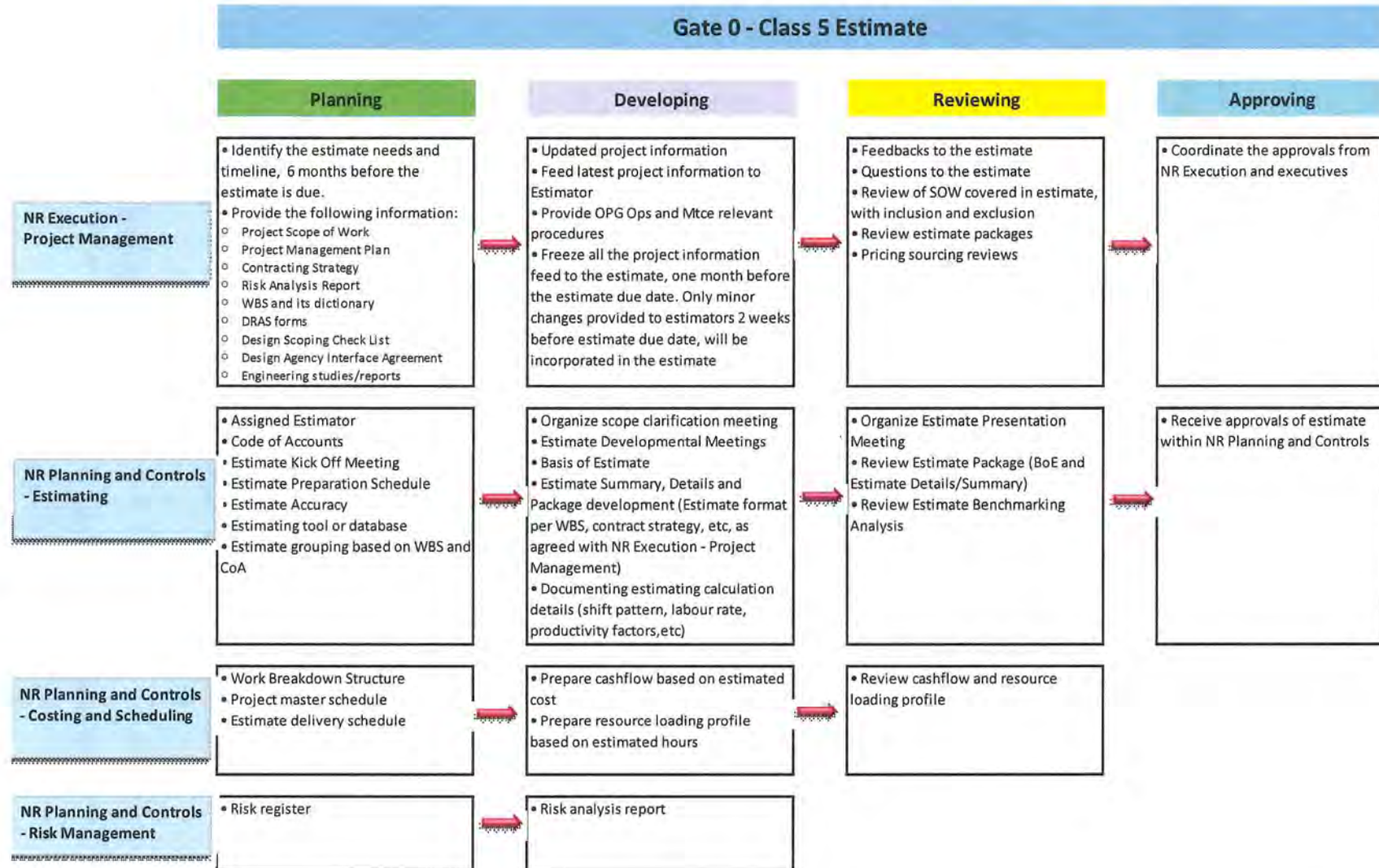
NOTE: Cost category will be based on selected appropriate code of accounts for known scope and level of estimate.

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**NUCLEAR REFURBISHMENT COST ESTIMATE**

**Appendix C: Estimating Activities Supporting Gated Process**

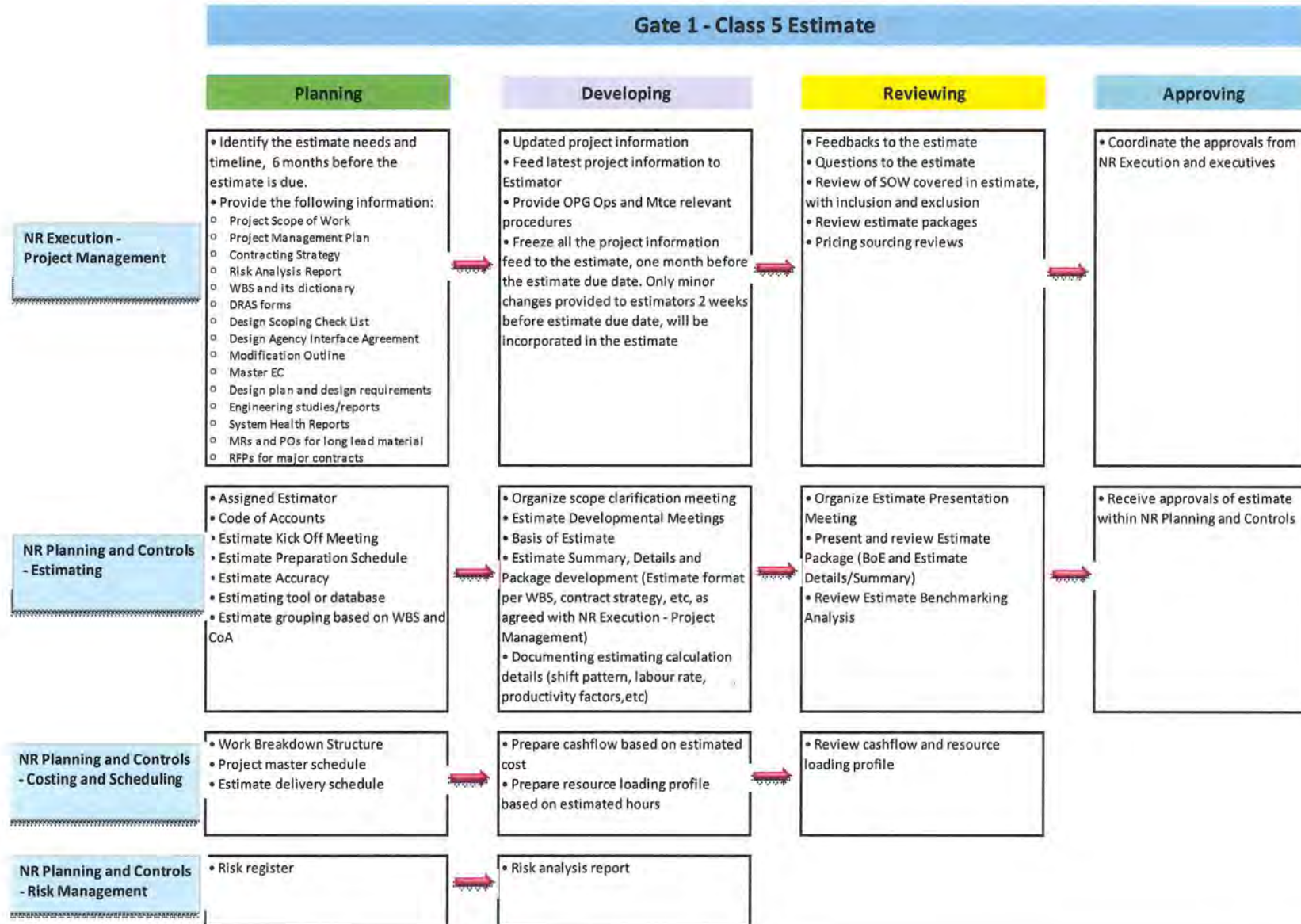




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**NUCLEAR REFURBISHMENT COST ESTIMATE**

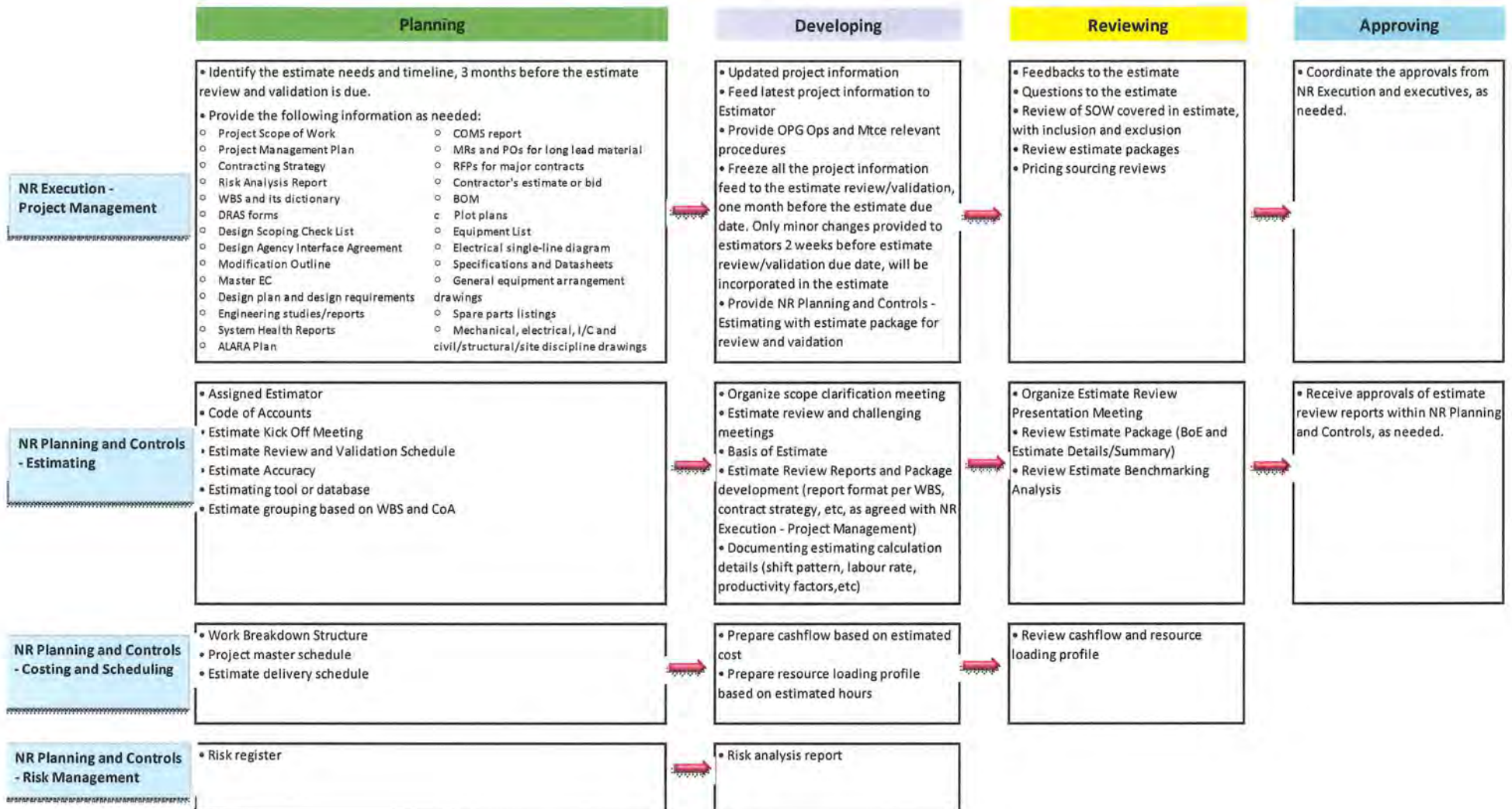


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**NUCLEAR REFURBISHMENT COST ESTIMATE**

## Gate 2 - Class 4 Estimate







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**DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL**

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**Darlington Nuclear Refurbishment  
Program-Scope Control**

**NK38-INS-09701-10001-R006**  
2014-10-22

Order Number: N/A  
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### Revision Summary

Revision Number	Date	Comments
R006	2014-10-22	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to incorporate the processes for Darlington Station owned non-IIP DSRs, and PSRB transition.</p> <ul style="list-style-type: none"> <li>• Addition of Section 2.1, 2.2, 2.3 for PSRB transition</li> <li>• Addition of HoS N/A.1, N/A.2, N/A.3, N/A.4</li> <li>• Removed HoS 4</li> <li>• Clarification of HoS 05 and 10</li> <li>• Rewording of HoS 4.1, 4.2 4.3, 4.4, 3 and 90</li> <li>• Rewording of 4.17.4: Requirement to Progress HoS</li> <li>• Updated diagram in section 4.1</li> <li>• Section 4.3 : DSR (Not Refurb) and Non-IIP</li> </ul>
R005	2013-12-10	<p>Revised and issued by Nuclear Refurbishment, Work Control to reflect current practices and incorporate DCR 0120354. This is an intent revision. Due to extensive changes, revision bars are not used.</p> <p>ISR flag in 3.2 – scope categorization paragraph and any other mentions in the body of this document have been removed.</p> <p>Section 4.6 PSRB, clarified role of PSRB secretary from “whom will ensure that all decisions are recorded within a scope database.” to “whom will ensure that all decisions are implemented in a timely manner.”</p> <p>The following has been added:</p> <ul style="list-style-type: none"> <li>• HoS 03, 04.1, 04.2, 04.3 and 04.4</li> <li>• Appendix B, questions concerning parts</li> <li>• Appendix K, attached a copy of the mentioned memo</li> <li>• GAR/IIP tracking</li> <li>• Migration of a draft DSR to the live database</li> <li>• Intent vs. non-intent changes</li> <li>• DSR status</li> <li>• DSR type</li> <li>• Initiating work requests from DSR line items</li> </ul>
R004	2012-12-12	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to Incorporate the requirement for Cost Benefit Analysis to accompany any new proposed scope post May 11, 2011 Major Scope Freeze Milestone, add the Life Cycle of a DSR, Screening and Funding committee quorum clarification. Scope Change Section added. Document numbers updated to align with Business Transformation initiative 2012.</p>
R003	2012-04-30	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to Incorporate revised Appendix A, Appendix B, added Appendix C (Scope Decision Matrix), added Appendix H (Scope Hierarchy) Added Appendix J (Scope Decision Matrix Summary Table), and references to the Integrated Safety Review (ISR) and DRAS processes. Incorporated NK38-GUIDE-09701-10012 Guide to Scope Health Definition Planning into this instruction section 7.</p>
R002	2010-12-23	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls to Incorporate Screening and Funding Committees additions and governance alignment changes.</p>
R001	2010-06-30	<p>Revised and issued by Nuclear Refurbishment, Planning and Controls</p>
R000	2009-04-29	<p>Initial Issue.</p>

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## 1.0 BACKGROUND

The Program Scope Review Board (PSRB) reviews and approves proposed additions or deletions of major program level scope for refurbishment of the Darlington Nuclear Generating Station (DNGS) as described in the Darlington Refurbishment Program – Program Scope Review Board - Terms of Reference (NK38-PLAN-09701-10003), DNGS Refurbishment Project Reference Plan – Scope Definition (NK38-PLAN-01060-10003) and in accordance with the Darlington Refurbishment Program Charter (D-PCH-09701-10000).

The process of identification of Program scope and the management of scope changes is described in this instruction and applies to all phases of the Darlington Refurbishment Program. This will ensure that the proposed additions and/or deletions have undergone a thorough assessment based on the return on investment, impacts on plant safety, reliability, project schedule and cost, program resourcing, regulatory requirements and environmental impacts. Refurbishment scope is maintained in the Darlington Scope Request (DSR) database.

Scope in the Darlington Refurbishment Program will support the Darlington Refurbishment Principle Program Objectives:

- (a) Confirm feasibility of refurbishing DNGS reactors
- (b) Plan and execute all work required to refurbish the Darlington units
- (c) Ensure the scope of the refurbishment outages will enable economic operations of each unit for an additional 30 years post-refurbishment.

Refer to Program Structure and Summary Management Plan, NK38-PLAN-09701-10067 Sht: 0001, for an overview of the Program and NK38-PLAN-09701-10067 Sht: 0002, Refurbishment Program Scope Management Plan, identifies how the program scope will be defined, managed and controlled throughout the Darlington Refurbishment program.

## 2.0 DIRECTION

This instruction applies to all staff performing or supporting the identification and definition of scope related to the Darlington Refurbishment Program. This instruction describes the process for submission and approval of scope additions by the Darlington Refurbishment Program Scope Review Board (NK38-PLAN-09701-10003). Scope changes and deletions will also follow the process outlined in this instruction.

Rigorous identification and control of the Darlington Refurbishment Outage Program scope and execution is essential to successful completion of the refurbishment on budget and on schedule and shall be based on the following principles:

- Project safety and defense-in-depth is maintained

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- Established Dose Targets are not exceeded
- Appropriate Program and Project work is completed
- Project schedule is not extended unnecessarily and recovery plans are developed as required
- The Program costs do not unnecessarily exceed budget
- Planning and integration with key work management areas of the company (outage and online Darlington schedules)
- Reasonable contingencies are in place for unforeseen circumstances that may arise, i.e. discovery work, during the Darlington Refurbishment Program
- Identify, prioritize, track and mitigate risks associated with the project.

For the purpose of supporting this scope control instruction, the Refurbishment Program scope will include core scope and non-core scope. Scope categories are chosen by the scope initiator and confirmed by the technical screening and funding committees and approved by the PSRB. Scope categories are used to ensure the correct work is accepted into scope with clear justification to support the Program Objectives. Once scope is accepted into the Program, the scope must still follow the Gate Review Board approval process for funding and scope management, in accordance with Nuclear Projects – Gated Process (N-MAN-00120-10001-GRB). Refer to Appendix G of this document for a flowchart of Refurbishment Scope Review Process.

### 2.1 Transition to Ad-Hoc PSRB Meetings

As of May 2014, the quarterly PSRB and Funding Committee Review will be replaced with Ad-Hoc meetings. The NR Project Planning and Controls will have the responsibility in scheduling the need-based PSRB and setting up the agenda.

## 3.0 SCOPING PRINCIPLES

### 3.1 Darlington Refurbishment Objectives

The goal of the refurbishment project is to extend the service life of the units by an additional 30 years of post-refurbishment operations. Refurbishment will involve an outage for replacement of life-limiting components, as well as maintenance or replacement of other components which can be most effectively done during the refurbishment outage period.

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### 3.1.1 Primary Objectives

- Successful refurbishment of Darlington Station Life Limiting Components in order to allow Darlington to operate for 30 years beyond the current predicted end of service life.
- The Refurbishment Project will return the unit in better condition than which it was received.
- A successful refurbishment project requires delivery of all core and approved non-core scope within the timeline and budget established in the Release Quality Estimate and as documented in the project Business Case Summary (BCS).
- Project cost and schedule as well as post-refurbishment performance goals are met with quality, because they will come under extreme scrutiny due to the high profile nature of this project and its impact on OPG's reputation.
- Where scope is approved by PSRB, NR (Nuclear Refurbishment) may recommend inclusion of scope to pre-refurbishment station outage.
- The Refurbishment Program must ensure that all scope is known and is executable.

### 3.1.2 Secondary Objectives

- Refurbishment will assess the scope and overall economics of the program, with consideration of the following:
  - Hardened Backlog
  - 10 Year Investment Program
  - Minor Modification Program
  - Margin Management Plan
  - System Health and Lifecycle management plans
  - System Available for Service (SAFS)/Ready for Service (RFS) process with respect to plant status and operational burdens.
  - Outage Improvement Initiatives
- Support the station vision by delivering value enhancing station improvements (non-core scope).

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- The amount of non-core scope executed during the refurbishment outage will be based on priority of work, and cost benefit assessment. This scope will be optimized to minimize the risk to the refurbishment critical path schedule, and overall project costs.
- All non-core scope must meet strict financial hurdle rules prior to consideration i.e. 9.5% discount rate and 6 year payback (per memo from Chief Financial Officer). Refer to Appendix K for a copy of the memo.

## 3.2 Scope Categorization

All scope is categorized as core scope (CS) or non-core scope (NCS). All core scope will be linked back to the program objectives and non-core scope will be categorized to control and monitor types of scope added and deleted from the Program. Refer to Appendix D of this document for a chart of all scope categories and their description.

### 3.2.1 Core Scope

Consists of work that must be done to achieve the Primary Objective. Core scope will determine the critical path for the refurbishment outage and sets the lower boundary for the cost estimate. Refer to Appendix E of this document for a brief summary of the current document major components of core scope. Core scope includes:

- **Regulatory scope** – Scope that supports station license and regulatory requirements (not optional), as agreed with the regulator and documented in the Integrated Improvement Projects based on Environmental Assessment, Integrated Safety Review and other activities such as Global Assessment which do not require Economic Assessment.
- **Station Life Limiting Components** – modification, repair, or replacement of station life limiting components that must be replaced in order to support the primary objective to allow DNGS to operate for 30 years beyond the current predicted end of service life. This includes items which have an asset class tied to station life and can only be done in a drained and defuelled state. Examples include: Calandria Tubes, Pressure Tubes and Feeders.
- **Component Upgrades** – work to upgrade components, which have a high station priority that can only be done during an extended refurbishment outage with units in a drained/defueled state. Examples include LISS (Liquid Injection Shutdown System) nozzle inspections & repairs, Shutoff Rod guide tubes, and Calandria vessel inspections and repairs.
- **Programmatic work** – Typically performed online or in a normal station outage that must be done in the refurbishment period in order to maintain station licence, including mandatory preventive maintenance, inspections, etc.
- **Prerequisite Scope** – Inspections to determine refurbishment scope and Modifications/upgrades that must be done before refurbishment starts to meet



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production requirements to enable a successful refurbishment. This includes islanding modifications and fueling machine upgrades.

- **Facilities & Infrastructure Plan** – construction of facilities and improvements to the infrastructure to support the refurbishment. See Scope Exclusions (3.2.4) below for exceptions.

### 3.2.2 Non-Core Scope

Consists of work that will be performed in the refurbishment period if it has no impact on the projects Core Scope critical path, does not add risk to the successful completion of core scope, and where cost or resource efficiencies and station priority warrant the work to be executed in the refurbishment period. A Business Case Assessment Summary (BCS) or Decision Record Analysis Summary (DRAS; N-FORM-11390) demonstrating the economic advantage; including risk management and/or reliability improvement, and priority of completing this work during, pre-, during or post-refurbishment will be required to gain approval.

Non-Core scope may include:

- **Safety Improvement Opportunities** – Safety or Environmental improvements beyond standard that provide benefits to the station in terms of increased reliability and/or lower operating costs some of which is documented in the Integrated Safety Review and Safety Factors Reports.
- **Station Improvement Opportunities** – Station improvements that provide benefits to the station in terms of increased reliability and/or lower operating costs, and where it is economically beneficial to OPG to perform the work in the refurbishment period.

### 3.2.3 Facilities & Infrastructure

Facilities & Infrastructure and Campus Plan projects, to support post-refurbishment operations will be funded by the Darlington Refurbishment program. The Darlington Site Infrastructure Co-ordination Committee will prioritize projects to be executed within this funding envelope.

### 3.2.4 Scope Exclusions

The following items are specifically excluded from the scope of Darlington Refurbishment Project:

- Operations and Maintenance work required to be performed to maintain the plant outside of the refurbishment outage window.
- Tritium removal facility improvements, upgrades, or replacements.
- Spare components, either capital or inventory (Other than per ECC (Engineering Change Control) )

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- New Maintenance Facility

## 4.0 PROCESS

Management of the Refurbishment Outage and the complexity over a long period of time will be a key factor in the success of the overall Program. The PSRB will approve the selection of only the correct scope to achieve success of the Program on schedule and within budget.

The Scope Management Process for the Darlington Refurbishment Program is graphically represented in Appendix A. This diagram represents (primarily) the Program Scope Review Board process and the Major Scope decision process. Approval of the further evolution of Major Scope is approved by the Gate Review Board (As per the Gated Process, N-MAN-00120-10001-GRB).

All work requested to be included in the scope of the Darlington Refurbishment Program must be initiated in the Darlington Scope Request database. Scope will originate from several areas of the Program, including the Environmental Assessment and Integrated Safety Review actions, Plant Condition Assessment, including Aging Management recommendations (through Component Condition Assessment's), infrastructure projects, Station Work Management requirements and Station Improvement Initiatives. Considering each scope origin, the scope request information originates in different forms and must be requested in a common format for the Program to control the scope. The Darlington Scope Request database for the Refurbishment Program will be the format in which DSR Line Items are submitted.

Once requested in the database, the scope will be processed accordingly through the database for consideration in the technical screening and funding committees and at one of the PSRB meetings.

Post Major Scope Milestone completion (May 2011) all proposed non-core scope will require a cost benefit analysis (i.e. BCS or DRAS) and project schedule impact review accompanying the DSR. Refer to Developing and Documenting Business Cases (OPG-STD-0076) for BCS process and Nuclear Refurbishment Actions, Issues, Decisions, and Key Assumptions Management (N-MAN-00120-10001-RISK-07) for DRAS process.

### 4.1 DSR life cycle

The DSR will go through a number of transitions from creation to reconciliation against a Work Order at 24 months before each unit's outage, and to close out as illustrated in the diagram below. A DSR starts as a high level thought and progresses from identification stage to the definition stage; depending on how well the scope is known and understood.

There will be five closeout reports, one per unit, as well as a final close out at the end of the project. The DSR managed in the DSR database is the currency of scope control until 24 months prior to the Refurbishment Outage (RO-24) at which time the

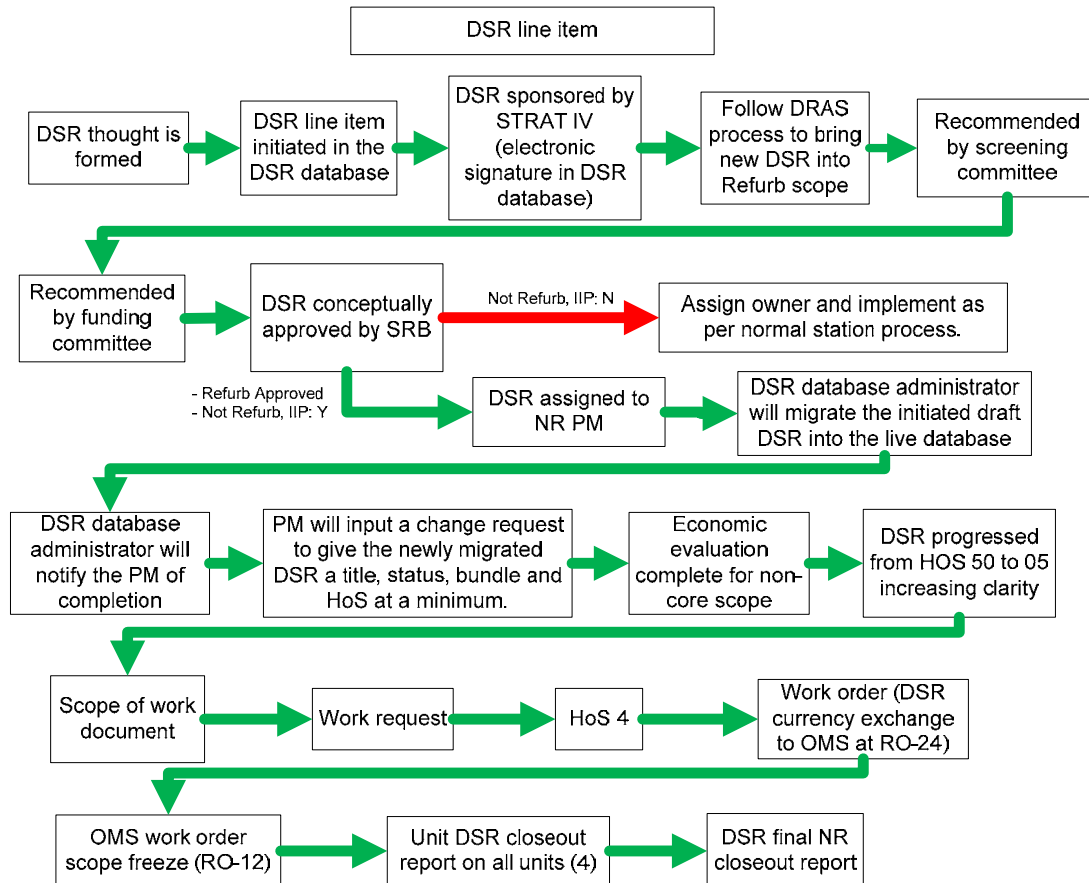
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currency will change to Work Orders managed in the Outage Management System (OMS). The reconciliation report will be complete by the RO-12 (Unit OMS Work Order Scope Freeze Milestone).



## 4.2 DSR database

The term DSR refers to a Darlington Scope Request line item. The DSR database is the source of scope control for the Darlington Nuclear Refurbishment Project. It is available on the project management section of the Darlington Refurbishment web page.

Refurbishment scope is maintained in the DSR data base. Scope management will be integrated into the Refurbishment program information management system through various processes; examples include schedules, contracts, scope of work documents, budgets and business plans. Scope information management shall follow approved OPG, Nuclear and Refurbishment governance, including, but not limited to, N-PROG-AS-0006, Records and Document Control.

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### 4.2.1 DSR initiation

It is intended for anyone to be able to initiate a DSR. To initiate a DSR, open DSR database and follow on screen instructions; if unsure, STOP and ask the DSR database administrator for help. During the DSR creation, the scope initiator will be required to categorize the scope (outlined in Appendix D) and select a DSR type (outlined in Appendix J).

All scope requested in the Darlington Scope Request database must be supported by a Stratum Level 4 sponsor. The sponsor's electronic signature will be required at the time of scope request prior to review at any of the scope review boards. Post Major Scope Milestone completion (May 2011) all new proposed scope will require a cost benefit analysis (i.e. BCS or DRAS) and project schedule impact review accompanying the DSR. After PSRB approval, the DSR database administrator will migrate the initiated draft DSR into the live database and send out an email notification to the PMs (Project Managers) of completion.

If a new DSR is created through an administrative DRAS (does not change scope; i.e. part of an approved DSR is moved to a new DSR with an approved status) and does not require PSRB approval, the signed and issued DRAS can be brought to the DSR database administrator to have the new DSR migrated to the live database.

The PM will need to input a change request to give the newly migrated DSR (at minimum) a title, status, bundle and health. The PM must also review and update any effected work orders.

### 4.3 Scope hierarchy

The scope hierarchy is a method of ranking the DSR line items in the DSR database to establish priority using Scope Type, Risk Rank, Prerequisite Indicator and Economic Valuation. The Scope Hierarchy is further detailed in Appendix H.

### 4.4 Technical Screening Committee

After major scope has been requested and sponsored in the DSR database, a Technical Screening Committee will review the requests. The committee will review a specific list of requirements including Core and None Core designations to ensure the scope request is adequately prepared for the PSRB. The technical screening committee will be led by the Vice President (VP), Nuclear Refurbishment Engineering.

The committee will make technical acceptance recommendations on specific scope items to the Refurbishment Funding Committee and the PSRB.

The Screening Committee Chair and Quorum is as follows:

**Chair:** Vice President, Nuclear Refurbishment Engineering

**Quorum Required (Voting Members):**  
Vice President, Nuclear Refurbishment Engineering

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Director, Operations and Maintenance, Darlington  
Director, Operations and Maintenance, Nuclear Refurbishment  
Director, Engineering, Darlington

Technical Screening Committee meetings require all quorum members or empowered delegates present.

See Appendix C for decision matrix to be used as a guideline by the Technical Screening Committee to make technical acceptance recommendations.

### 4.5 Funding Committee

After Major Scope has been requested and sponsored in the DSR database, and the Technical Screening Committee has recommended the proposed scope addition the Funding Committee will make funding stream recommendations. The Funding Committee will be led by the Director, Nuclear Refurbishment Planning and Controls.

The Funding committee will make funding recommendations on specific scope items to the PSRB.

The Funding Committee Chair and Quorum is as follows:

**Chair:** Director, Nuclear Refurbishment Planning and Controls

**Quorum Required** (*Voting Members*):

Director, Nuclear Refurbishment Planning and Controls  
Director, Business Support, Darlington  
Director, Asset Planning and Integration  
Controller, Nuclear Refurbishment

The Funding Committee meetings require all quorum members or empowered delegates present.

See Appendix F for funding matrix to be used as a guideline by the Funding Committee to make decisions.

### 4.6 Program Scope Review Board

The PSRB shall be a senior cross-functional board with representation from the site and supporting business units. The review board shall consist of voting members and nonvoting members. Non-voting members are scope sponsors or advisors in the Board. All scope presented at the PSRB should be supported by at least one sponsor among the Board membership. This is to ensure that there is support for the scope that is requested and knowledge of the scope that is requested at each meeting. The PSRB voting members will strive to arrive at a consensus for all scope requests. The Director of Planning and Control, Nuclear Refurbishment shall be the Chairperson of the PSRB and will designate a secretary to the PSRB whom will ensure that all

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decisions are implemented in a timely manner. Required quorum for PSRB meetings shall be all of the voting members. In the event of the unavailability of the individual specified below, the Board member may delegate the meeting attendance to an empowered delegate.

The Program Scope Review Board Chair, Quorum and non-voting members are as follows:

**Chair:** Director, Planning and Controls, Nuclear Refurbishment

**Quorum Required** (*Voting Members*):

SVP or Deputy VP, Darlington Nuclear  
SVP, Nuclear Refurbishment  
SVP, Nuclear Engineering and Chief Nuclear Engineer

**Non-Voting Members of the PSRB** (*Sponsors & Advisors*):

VP, Engineering, Nuclear Refurbishment  
VP, Execution, Nuclear Refurbishment  
VP, Corporate Business and Investment Planning  
VP, Science & Tech, or Director, Eng Services  
Director, Operations & Maintenance, Darlington Nuclear  
Director, Operations & Maintenance, Nuclear Refurbishment  
Director, Engineering, Darlington Nuclear  
Director, Engineering, Nuclear Refurbishment  
Director, Work Management, Darlington Nuclear  
Director, Planning and Control, Nuclear Refurbishment  
Director, Investment Management, Nuclear Finance  
Director, Commercial Projects and Facilities  
Director, Business Support Director, Darlington Nuclear

**Note:** The VP, Science and Technology and Director, Engineering Services shall be responsible for scope recommendations within their respective areas of responsibility and attend as appropriate.

In order to record a decision at the PSRB, consensus must be reached between the three (3) Voting Members. This applies to scope approvals and rejections. The PSRB Voting Members will strive to meet the meeting objective of reaching consensus on all scope items during the meeting or by requesting additional information to be provided by the scope sponsors and initiators, in order to support a decision.

## 4.7 Scope Challenge

The scope is challenged a number of times throughout the scoping process. It is challenged at the Technical Screening Committee meeting, financially at the Funding Committee meeting and finally as part of the PSRB, requested scope will be scrutinized to determine whether it must be completed in the Refurbishment Outage and whether it adversely affects the refurbishment outage(s) cost and schedule.

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For each scope request, the PSRB will utilize a list of questions that will challenge the scope initiator to support justification. These questions will address necessity, business need, risk and impact on cost and schedule (Appendix B). Appendix C shows a Scope Flow Decision Matrix which also will be used to validate and challenge the scope. Following approval of Major Scope by the PSRB for inclusion in refurbishment (Refurb) scope, the scope is formally added to the DSR database as Approved. If scope has not been approved, rejection justification will be formally recorded and the scope will be set to "Not Refurb" in the database indicating that it is not part of the refurbishment project and will follow Darlington's normal processes for evaluation.

### **Scope Challenge Meeting** (Prior to Gate 1 and 3 of the Gated Process N-MAN-00120-10001-GRB)

As per N-MAN-00120-10001-GRB, Nuclear Projects Gated Process there is a requirement for a Review of Scope to reassess and confirm need. This is accomplished through a Scope Challenge Meeting. The meeting is chaired and led by the Project Manager who owns the work being proposed to progress the project through the next decision Gate. For each DSR, the PM will utilize the Scope Decision Matrix (Appendix C) to justify / challenge the scope. The PM will complete the summary table in Appendix I and present to the Scope Challenge meeting Quorum for challenge of content and methodology. The completed table confirming recommendations will be submitted with the documents for the Gate Review Board Meeting (N-MAN-00120-10001-GRB). A DRAS will be completed as required and presented at next PSRB.

The Scope Challenge Meeting members are as follows:

**Presenter / Chair:** Project Manager, Nuclear Refurbishment Execution

**Quorum:** Vice President, Nuclear Refurbishment Engineering  
Director, Operations and Maintenance, Nuclear Refurbishment  
Director, Project & Controls, Nuclear Refurbishment

**Advisors:** Director, Nuclear Safety, Nuclear Refurbishment  
Director, Engineering, Nuclear Refurbishment

## 4.8 DSR Changes

If the DSR has not been through Gate 1 of the Gated Process (N-MAN-00120-10001-GRB), i.e. funding not yet allocated for this project, changes are requested through the change control form (change request) within the DSR database. Contact DSR Database Administrator for assistance.

If one of the PM's has been to Gate 1 for the DSR requesting funding, then a Change Control Form (N-FORM-11252) must be completed and approved prior to any DSR database changes.

DSR Change process:

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- For scope changes, DRAS completed by Project Manager and approved by PSRB
- If at or past (funding) gate 1, complete N-FORM-11252 prior to any DSR database changes
- Change control form Initiated in DSR database by an individual
- Change control form concurred (electronically signed) by Project Manager and appropriate stakeholders.
- For intent changes, the change control form also needs to be approved by System Engineering Manager, Nuclear Refurbishment.
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.
- Review and update any affected work orders in Asset Suite.

**Note:** At this time, the DSR Database Administrator is a WCTL (Work Control Team Leader) working for the NR Outage Manager.

### **4.9 Decision Record and Analysis Summary (DRAS)**

Decision records are critical in maintaining an auditable trail of the NR Program changes, including changes in strategy, regulatory interactions, technology, resource, scope, etc. These important decisions should be validated by the appropriate authority to ensure alignment across all NR organizations. Refer to N-MAN-00120-10001-RISK-07, Nuclear Refurbishment Actions, Issues, Decisions, and Key Assumptions Management for full DRAS process. If a DRAS affects DSRs, then the follow the steps in section 4.8, DSR change process.

### **4.10 DSR Database change request**

Changes to an approved DSR (before gate 1) are requested using the change control form in the DSR database with supporting document (i.e. DRAS), for auditable trail. DSR change control form is an electronic form found in the DSR database in the DSR menu, called "Request change to DSR info". When the form opens up, select the correct DSR and enter your proposed changes in the blue fields on the right of the original DSR. The specific approval is dependent on what is being changed, i.e. intent or non-intent.

This electronic method of change control which allows an individual to propose a change which will then be approved by the Project Manager. The time, date, and LAN ID associated with the change are all recorded in the DSR database.

#### **4.10.1 Intent Change process**

Changes in Scope, context or title of a DSR are considered intent changes.



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- For scope changes, DRAS completed by Project Manager and approved by PSRB
- Change control form completed (quoting DRAS number) in DSR database by the Project Manager, Nuclear Refurbishment
- Change control form concurred (electronically signed) by Engineering Project Manager, Nuclear Refurbishment
- For intent changes, the change control form also needs to be approved by System Engineering Manager, Nuclear Refurbishment.
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.
- Review and update any affected work orders in Asset Suite.

#### **4.10.2 Non-Intent Change process**

Fixing spelling errors or splitting one DSR into multiple DSRs (which doesn't change scope or context) are considered a non-intent change and does not require engineering approval.

- Change control form completed in DSR database by the Project Manager, Nuclear Refurbishment
- Change control form concurred (electronically signed) by appropriate stakeholders.
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.

**Note:** If unsure, default to intent change or contact DSR database administrator.

#### **4.11 DSR Ownership Change**

- Change control form completed in DSR database by Sending Project Manager, Nuclear Refurbishment
- Change control form concurred (electronically signed) by Receiving Project Manager, Nuclear Refurbishment
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.

**Note:** If one of the PM's has been to Gate 1 for the DSR requesting funding, then a Change Control Form (N-FORM-11252) must be completed and approved prior to any DSR database changes.

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### **4.12 DSR GAR (Global Assessment Report) and IIP (Integrated Implementation Plan) Tracking**

NR Engineering is responsible to identify DSRs committed in the GAR/IIP. NR Engineering will input change requests and the DSR database administrator will ensure the changes reflect approved documentation. All work orders generated from IIP identified DSR line items will require regulatory tracking in AssetSuite.

### **4.13 DSR (Not Refurb) and Non-IIP**

Darlington Generation Station is responsible to use the current station processes to monitor, track and close the work per the following governances and processes.

- N-PROC-MP-0060: Aging Management Process
- N-PROC-MA-0024: System Performance Monitoring
- N-GUID-01510-10001: Site Component Health and Engineering Program Health Reporting Process
- N-PROC-MA-0097: Equipment Reliability Implementation

### **4.14 DSR status**

DSR Status	Description
Approved	PSRB approved scope for the Darlington Refurbishment Project.
Cancelled	Work that will not be completed by the station or Refurbishment organization.
Closed	All work, actions and reports have been completed.
Not Refurb	DSR is not part of the refurbishment project and will follow Darlington's normal processes for evaluation.
Not Required	Contingency work that has been analyzed and determined to be not required, usually due to a report, analysis or inspection results.
Superseded	The DSR's scope is covered by another existing or new DSR. Superseded to station AR, ASIC project, PM, etc for Non-IIP Station owned DSR.

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### **4.15 Initiating work requests from DSR items**

Detailed work orders will be required during the Detailed Planning phase. D-GUID-09701-10013, Initiating Work Request for DSR Items, helps establish the correct nomenclature and sufficient level of detail used when initiating the work request.

When Unit, SCI, Device, Scope of Work and Unit condition information is known, the DSR line item is ready to initiate a work request, as per N-PROC-MA-0008, Work Initiation and Prioritization.

### **4.16 Work Requests to Work orders**

Work Control SPOC reviews submitted work requests for N-PROC-MA-0008 compliancy, assigns appropriate attributes/tags and approves the work request to a work order.

### **4.17 Health of Scope (HoS)**

#### **4.17.1 Background**

The Darlington Nuclear Refurbishment scoping strategy includes a Health of Scope grouping number representative of the work required to progress a DSR from the identification stage to the definition stage. Each DSR in the DSR database has been categorized with a Health of Scope number identifying how well the scope is known and understood. A unit suffix has been added to HoS 04 and the newly created HoS N/A. Therefore each unit will need to be dispositioned for every DSR. This will enable a better history of the DSR when doing the DSR closure report for each unit. The target is to get Health of Scope to 04.X (work orders have been input on X unit) or N/A.X (work orders will not be input on X unit). This will enable the work to have sufficient clarity that it can enter into the Work Management processes (ECC, work order etc.) at RO-24 (OMS Work Order Scope Definition Complete Milestone).

#### **4.17.2 Health of Scope number definitions:**

HOS	Definition
0	New items which have not been assigned a Health of Scope by the Project Manager. The expectation is that the HoS is assigned within 2 weeks after the PSRB approval.
03	No further work required on DSR.
N/A.1	This DSR line item will not generate work orders on Unit 1 and does not require any other work orders to support Unit 1's Refurb Outage.
N/A.2	This DSR line item will not generate work orders on Unit 2 and does not require any other work orders to support Unit 2's Refurb Outage.
N/A.3	This DSR line item will not generate work orders on Unit 3 and does not require any other work orders to support Unit 3's Refurb Outage.
N/A.4	This DSR line item will not generate work orders on Unit 4 and does not require any other work orders to support Unit 4's Refurb Outage.

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04.1	All Work Orders that this DSR requires on Unit 1 and to support Unit 1's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
04.2	All Work Orders that this DSR requires on Unit 2 and to support Unit 2's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
04.3	All Work Orders that this DSR requires on Unit 3 and to support Unit 3's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
04.4	All Work Orders that this DSR requires on Unit 4 and to support Unit 4's Refurb Outage have been input (with N-PROC-MA-0008 and D-GUID-09701-10013 compliance).
05	DSR is adequately known such that it is ready for Work Order to be input on all Units (Scope of work and unit condition known).
10	Work is known at the component / MEL level (unit, SCI and Device known).
20	Work is known at the system or project level but not component
30	Actions to implement selected, may be a component strategy across many systems. Options developed and preferred selected at system level (potentially many systems).
40	Analyze the completed report to determine actions / path forward. Required assessments or analysis have been completed and issue, priority, constraints and success criteria are understood.
50	Further assessment is required to build a report for analysis to understand the identified issue before the scoping process can begin. At this point the extent, the impacts, the significance, nor the potential resulting actions are known
60	Pure engineering or procedures with no likely field work (i.e. provide CNSC with a report, update procedure, etc). Activities identified as pure engineering or requiring documentation update will be planned by the responsible functional organizations and will be scheduled in the functional organization schedule ensuring that the deliverables meet the timelines identified in the overall Project Integrated Master Schedule.
90	DSR recommended to be removed from NR scope and will not be executed in Nuclear Refurbishment. DSR will be removed from NR scope, pending PSRB approval. The expectation is that the Project Manager who owns the Scope Health 90 item will have the DRAS completed and approved 14 days prior to the next SRB and communicated to the NR Outage Manger for inclusion and scope removal approval at the next SRB.

Note: Any required unit 0 work will be tagged with the unit requiring the implementation.

### 4.17.3 HoS change process

- Change request initiated in DSR database
- Change request approved by the Project Manager, Nuclear Refurbishment
- Change request concurred (electronically signed) by appropriate stakeholders
- DSR Database Administrator reviews the change request for appropriate approvals and updates the DSR database.
- Review and update any affected work orders in Asset Suite.

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**Note:** HOS 90 scope removals approved by SRB at next scheduled meeting.

### 4.17.4 Requirements to Progress HoS

This section identifies deliverables required to take a DSR from the Identification phase to Definition phase at a system level through identifying examples of deliverables for each category.

#### **Health of Scope 50 to 40**

Review the scope for the need to prepare an assessment for further analysis. Deliverables to move DSR to 40 may include:

- Nuclear Safety Assessments/Analysis
- Detailed system assessments
- Code gap analysis
- Reliability assessments
- Life Cycle Management plan
- Material/fatigue analysis

To obtain these deliverables an in-house resource may be assigned or a contracting strategy developed and an outside vendor used. The assessments, plans, analysis should end in recommendations that lead to a better understanding of the issue identified in the DSR. At this point the DSR is considered to be HoS 40.

#### **Health of Scope 40 to 30 or 20 if only 1 System or Project**

Review results of the assessments and identify if DSR requires a modification to the plant, maintenance on a system (i.e. repair, replace) inspection or test. Identify options and select preferred to resolve the DSR issue. Steps to progress to 30 may include the following:

- New DSR presented to PSRB for approval
- Prepare and process DRAS form N-FORM-11390 as per N-PROC-LE-0008 if required to either progress DSR or close the item.
- Prepare EDM (Engineering Decision Making Meeting) materials and hold EDM if required to progress complex scope issues as per N-GUID-01900-10001, if EDM agrees with potential scope then generate ECR (Engineering Change Request)
- Prepare Project Gate documents as per N-MAN-00120-10001-GRB.

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- Prepare Conceptual Study/Report as required identifying potential options to address the problem/needs statement. May be prepared by Refurbishment, OSS (Owner Support Services) or EPC (Engineer, Procure, Construct) vendors.
- Generate inspection requirements or plans to support planning of recommended testing or inspections

Additional assessment or analysis may be required to further define the options where the initial assessment cannot conclusively recommend a path forward to resolve the DSR. In this case the DSR Health of Scope is returned to 50 for further assessment.

#### **Health of Scope 30 to 20**

Work scope should be defined at a system level. Inspections and Conceptual studies may define a need for further scope to be added into the project, contingencies should be planned for by this time and high risk contingency items should progress through the gated process as required if the inspection work cannot be done until a later date. Activities to progress to 20 may include:

- Options developed and preferred selected at system level.
- Prepare Project Gate documents as per N-MAN-00120-10001-GRB

#### **Health of Scope 20**

Work is known at the system or project level but not component. Initiation Phase complete, the following activities can begin:

- Generate a project charter or needs statement for potential modifications to be implemented outside of the Darlington Refurbishment organization.
- Identify non-modification work recommended in the assessments and contact Nuclear Refurbishment WCTLs to input work request for the work, if DSR item issue can be resolved through execution on non-modification work the DSR item can be reclassified as 5 in the Health of Scope
- Develop Preliminary Design Requirements for potential modifications where scope has been adequately defined
- Definition Phase begins. System or project scope is defined. ECR can be generated (ECR identifying problem statement for potential modifications as per N-PROC-MP-0090)
- Sufficient information available to begin to prepare preliminary and detailed design scope of work for EPC RFP (Request for Proposal)
- Long lead items identified

#### **Health of Scope 20 to 05**

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Unit, SCI, Device, Scope of Work and Unit condition is known for the DSR and is ready to initiate work requests, as per N-PROC-MA-0008, Work Initiation and Prioritization. Detailed work orders will be required during the Detailed Planning phase. D-GUID-09701-10013, Initiating Work Request for DSR Items, helps establish the correct nomenclature and sufficient level of detail used when initiating a work request from a DSR. It is expected that once ECR's are approved, conceptual design options are identified and preliminary design requirements are prepared. The EPC contracts can then be issued where the contractor will further define the work and ensure that work order planning is completed. Work will be managed via the Gated Process (N-MAN-00120-10001-GRB).

### **Health of Scope 05 to 03 or 04.X or N/A.X**

Work have been input for unit X (04.X) or work orders will not be input for unit X (N/A.X). This requires each unit to be dispositioned for every DSR, which creates a better history for DSR closure reports. If there is no work required for DSR, it can go to HoS 03.

## **4.18 Scheduling**

Darlington Refurbishment Project Managers are accountable to identify the deliverables required to progress DSRs through the Scope Health Definition levels to Health of Scope 03 or 04.X or N/A.X. P6 schedule activities will be created for the deliverables that progress a DSR to HOS 03 or 04.X or N/A.X. The Project Managers will update and maintain the health of scope rating of the DSR in the DSR database.

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## 5.0 DSR DATABASE DEFINITIONS

<b>Acct_Org</b>	Accountable Organization
<b>Add_Info</b>	Additional information
<b>APP_ISR</b>	Indicates that the DSR is included in the Integrated Safety Review (ISR)
<b>Bundle</b>	Work Grouped by Project Manager area of responsibility (i.e. Balance of Plant [BOP], Fuel Handling [FH]) translates to Complex code on the work order.
<b>CCA</b>	Component Condition Assessment Number
<b>CONTINGENCY</b>	Contingency Flag
<b>Cost_Element</b>	Category from original Darlington Refurbishment Business Case to which the cost is allocated
<b>Cost_Estimate</b>	Cost estimate
<b>Description</b>	Description of work encompassed by the DSR (usually from CCA)
<b>DSR</b>	DSR related to the Line item
<b>DSR_Init</b>	DSR initiator (LAN ID)
<b>Dsr_Line</b>	DSR Line Item Number
<b>Ex_Owner</b>	Execution Owner by name
<b>Fog</b>	Functional Outage Grouping
<b>FUN_STR</b>	Funding Stream i.e. Station funded or Refurb funded, etc.
<b>Gate</b>	Last Gate of the Gate Review Process the DSR has passed through
<b>Grouping</b>	Health of Scope indicator
<b>Economic Evaluation</b>	Indicator of completion of the economic evaluation (Y=yes economic evaluation completed, N=no economic evaluation not completed, Not Required= economic evaluation not required; i.e. HOS 60 DSRs and Core Scope DSRs)
<b>Hierarchy</b>	Priority Ranking of DSRs
<b>Inspection</b>	Indicator that an inspection is required
<b>Item</b>	DSR Line item number
<b>Meet_Date</b>	SRB meeting date
<b>Not_Refurb_Reason</b>	Reason for the scope being rejected by PSRB and not included in the Refurbishment of Darlington
<b>Prereq_Type</b>	Categories for Prerequisite work. (The scope bucket may be non Pre-req but have some pre outage Work Orders)
<b>Priority</b>	Not Used at This Time
<b>PSRB_Sponsor</b>	Manager level or higher who sponsors the scope for consideration by PSRB



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<b>Risk_Rank</b>	Risk Ranking per Risk Governance (N-MAN-00120-10001-RISK)
<b>SCI</b>	System Component Identification number
<b>Scope_Owner</b>	Nuclear Refurbishment Project Manager who owns the scope Execution and Planning
<b>Scope_Bucket</b>	Darlington Refurb Window for Execution of the Scope (i.e. Pre-req means work execution is completed prior to Refurb)
<b>SCOPE_TYPE</b>	Scope type (Refer to Appendix D)
<b>Status</b>	DSR Status, Refer to section 4.13 of this document.
<b>SUB_Bundle</b>	Smaller work grouping of a Bundle (i.e. Safety Systems is a sub bundle of BOP)
<b>TEC_REC1</b>	Technical Screening Committee Recommendation
<b>Title</b>	DSR Title
<b>Type</b>	Work type, i.e. regulatory, campus plan, technical, etc.
<b>Unit</b>	Darlington Unit
<b>WBS</b>	Work Breakdown Structure ID

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### 6.0 ACRONYMS

BCS	Business Case Summary
CCA	Component Condition Assessment
CCF	Change Control Form
CS	Core Scope
DNGS	Darlington Nuclear Generating Station
DRAS	Decision Record Analysis Summary
DSR	Darlington Scope Request Line Item
EA	Environmental Assessment
ECC	Engineering Change Control
ECR	Engineering Change Request
EDM	Engineering Decision Making Meeting
EPC	Engineering, Procure, Construct
GAR	Global Assessment Report
HOS	Health of Scope
IIP	Integrated Implementation Plan
LISS	Liquid Injection Shutdown System
MEL	Master Equipment List
NCS	Non-Core Scope
NR	Nuclear Refurbishment
OM&A	Operations, Maintenance and Administration
OMS	Outage Management System
OSS	Owner Support Services
PM	Preventative Maintenance or Project Manager
PSRB	Program Scope Review Board
Refurb	Refurbishment
RFP	Request for Proposal
RFS	Ready for Service
RO	Refurbishment Outage
SAFS	System Available for service
SVP	Senior Vice President
VP	Vice President
WCTL	Work Control Team Leader

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## 7.0 REFERENCES

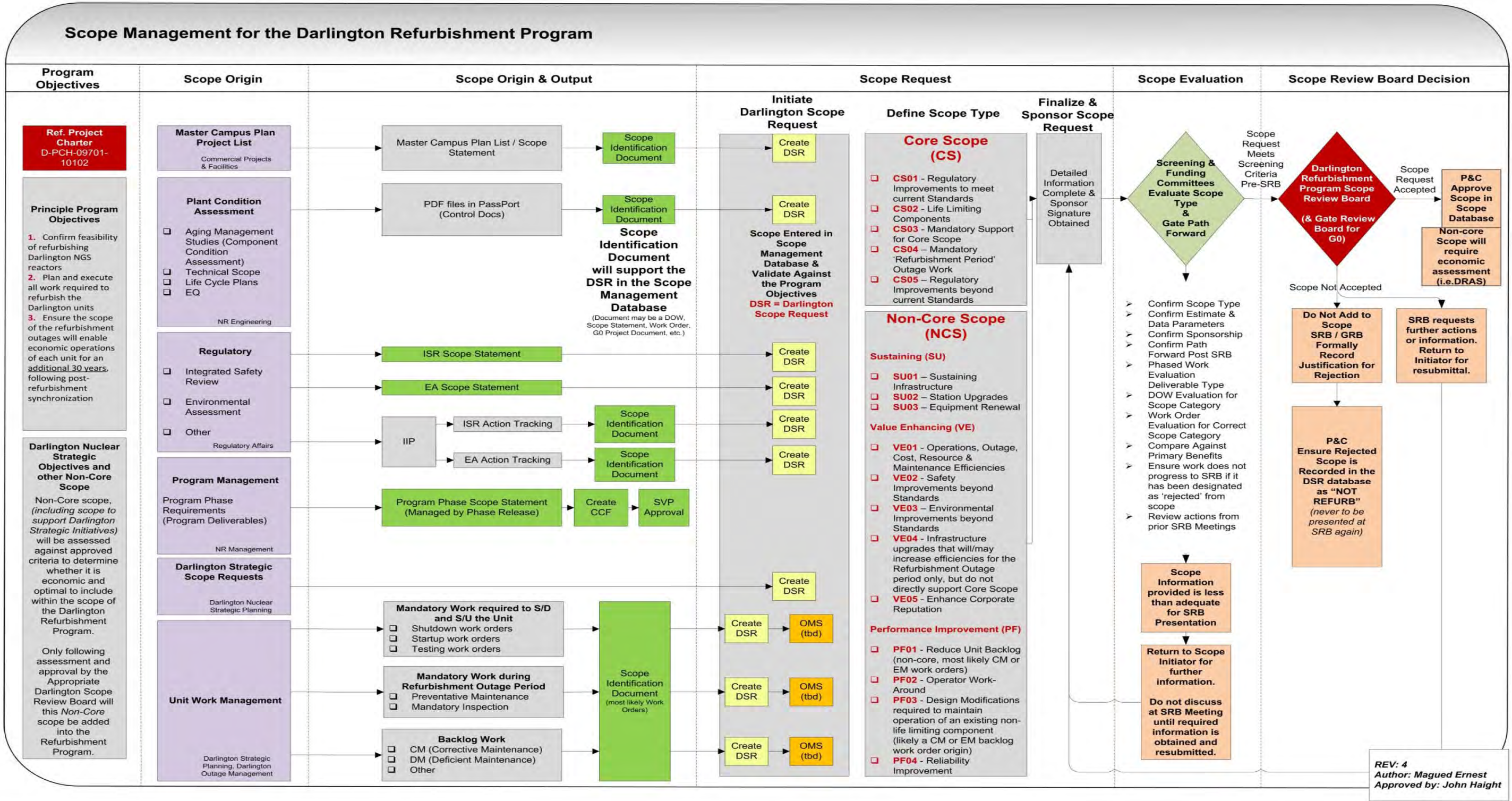
- [R-1] Darlington NGS Refurbishment Project Reference Plan – Scope Definition (NK38-PLAN-01060-10003)
- [R-2] Darlington Refurbishment Program – Program Scope Review Board – Terms of Reference (NK38-PLAN-09701-10003)
- [R-3] Darlington Refurbishment Planning activities Project Charter (D-PCH-09701-10000)
- [R-4] Developing and Documenting Business Cases (OPG-STD-0076)
- [R-5] Nuclear Refurbishment – Darlington (N-PROG-LE-0002)
- [R-6] Nuclear Projects gated Process (N-MAN-00120-10001-SHT-GRB)
- [R-7] Nuclear Refurbishment Actions, Issues, Decisions, and Key Assumptions Management (N-MAN-00120-10001-RISK-07)
- [R-8] Decision Record and Analysis Summary form (N-FORM-11390)
- [R-9] Nuclear Refurbishment Change Control Form (N-FORM-11252)
- [R-10] Refurbishment Program Structure and Summary Management Plan (NK38-PLAN-09701-10067-SHT-0001)
- [R-11] Refurbishment Program Scope Management Plan (NK38-PLAN-09701-10067-SHT-0002)
- [R-12] Initiating Work Request for DSR Items (D-GUID-09701-10013)
- [R-13] Work Initiation, Approval, and Prioritization (N-PROC-MA-0008)
- [R-14] Records and Document Control (N-PROG-AS-0006)
- [R-15] Modification Process (N-PROC-MP-0090)
- [R-16] Engineering Decision Making (N-GUID-01900-10001)
- [R-17] NR Planned Outage Management (NK38-MAN-09701-10005)

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Appendix A: Darlington Refurbishment Outage Scope Management Process



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## DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL

### Appendix B: Darlington Refurbishment Program Scope Categories and Standard Scope Justification Questions

#### B.1.0 CORE SCOPE

Core Scope directly supports the Program Objectives to ensure the success of Refurbishment.

Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>CS01</b>	Regulatory Improvements to meet current Standards	<ul style="list-style-type: none"> <li>Scope that is not optional in order to support the Station License and Regulatory Requirements.</li> </ul>	Q. What is the required regulatory commitment date? Is it required to be completed during the Refurbishment Outages?	<ul style="list-style-type: none"> <li>Environmental Assessment and IIP Actions.</li> <li>Integrated Safety Review and IIP Actions.</li> </ul>
			Q. Are there any technical alternatives for this particular regulatory requirement (i.e. can it be met in any other way? Is there another solution?)	
<b>CS02</b>	Life Limiting Components	<ul style="list-style-type: none"> <li>Major component modification, repair or replacement that cannot survive operation for an additional 30 years (post-synchronization for each unit) – note the exception below.</li> </ul> <p><i>** Note: Components which are assessed to be able to operate effectively for a significant time post-refurbishment, but would then need extensive repairs or replacement, are not to be included in the proposed refurbishment scope, unless they would have a detrimental impact on unit reliability, safety or if they could only be repaired or replaced under refurbishment outage plant condition (i.e. De-</i></p>	Q. Is the proposed scope supported by a life cycle management plan?	<p>Major life limiting components are identified as:</p> <ul style="list-style-type: none"> <li>Replacement of pressure tubes</li> <li>Replacement of calandria tubes</li> <li>Replacement of Feeders</li> <li>Balance of Plant System components (supported by Plant Condition Assessment)</li> </ul>
			Q. Is it considered necessary (component would otherwise be not fit for service)?	
			Q. Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
			Q. Is the work only feasible in the drained and defueled state achieved in the refurbishment outage?	
			Q. Is the work date-sensitive?	
			Q. Can the work be completed while the unit is online?	
			Q. Can the work be completed during a regularly scheduled maintenance outage before or after the Refurbishment Outage? If so, what is the impact on that maintenance outage?	

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
		<i>fuelled/dewatered). These recommendations will be made through the review of Technical Scope documentation (Plant Condition Assessments).</i>	<p><b>Q.</b> Has the alternative of doing the work during the pre-refurbishment period been considered/assessed? Provide clear rationale why not feasible; i.e. discuss drawbacks, major risks.</p> <p><b>Q.</b> Is the equipment assessed to operate for a significant time post-refurbishment?</p> <p><b>Q.</b> Does the proposed solution impact on refurbishment outage schedule?</p> <p><b>Q.</b> Is it more economical to complete the work when scheduled in the refurbishment outage (rather than before or after)? If so, provide economic rationale.</p>	
<b>CS03</b>	Mandatory Support for Core Scope	<ul style="list-style-type: none"> <li>Must do in order to support execution of Core Scope.</li> </ul>	<p><b>Q.</b> Would the refurbishment core scope still be possible to execute without this scope / infrastructure?</p> <p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</p> <p><b>Q.</b> Are the parts:</p> <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	<ul style="list-style-type: none"> <li>Program Management deliverables (non-construction work): Program and Project Management, QA, Supply Chain, Op&amp; Commissioning Management, Health and Safety Management.</li> <li>Required Pre-Outage Inspections (to support definition of Core Scope) - Station Outage or Online work management required.</li> <li>Islanding activities for each unit outage.</li> <li>Infrastructure Master Campus Plan listed work that is mandatory only to support Core Scope (i.e. Retube Control Centre) and absolutely must be executed. The Core Scope could not be executed without this Infrastructure in place (with or without efficiencies).</li> <li>All work required to</li> </ul>

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
				shut down, start-up and test the unit for the Refurbishment Outage.
<b>CS04</b>	Mandatory 'Construction Period' Outage Work	<ul style="list-style-type: none"> <li>Preventative Maintenance Work that would normally be executed during the time period during the Refurbishment Outage</li> <li>Mandatory Inspections that would normally be executed during the time period during the Refurbishment Outage.</li> </ul>	<b>Q.</b> Is the proposed scope Preventative Maintenance included in the PM strategy document for each unit? If not, why is it being requested now?	<ul style="list-style-type: none"> <li>PM for oil change on auxiliary boiler feed pump</li> <li>PM for electrical breaker testing</li> <li>FAC program inspections on service water pipe work</li> <li>Mandatory RV testing/calibrations</li> </ul>
			<b>Q.</b> Is the inspection considered mandatory? Why (what is the supporting mandating documentation)?	
			<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>CS05</b>	Regulatory Improvements beyond current Standards	<ul style="list-style-type: none"> <li>Regulatory suggested improvements that are not required as per current codes and standards.</li> </ul>	<b>Q.</b> Are there any technical alternatives for this particular regulatory requirement (i.e. can it be met in any other way? Is there another solution?)	<ul style="list-style-type: none"> <li>Improvements To EPS Availability</li> <li>Emergency Heat Sink for Accidents</li> </ul>
			<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	



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### B.2.0 NON -CORE SCOPE (NCS)

#### B.2.1 Sustaining (SU) - Non - Core Scope

Sustaining Scope is not mandatory to execute the Refurbishment Outage and achieve the Program Objectives. It may provide long term benefits to the Darlington Site and stations outside the primary Program Objectives. All Non-core Scope requires economic justification (i.e. DRAS).

Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>SU01</b>	Sustaining Infrastructure	<ul style="list-style-type: none"> <li>Infrastructure upgrades required to sustain an additional 30 years of operations.</li> <li>Work is listed as part of the Darlington Master Campus Plan and the Darlington Program Campus Plan Scope Statement</li> <li>Is not part of, nor does it directly support core scope.</li> </ul>	Q. Can the work be executed after Refurbishment is complete without impacting ongoing plant operations?	<ul style="list-style-type: none"> <li>Salt Shed</li> <li>Heavy Vehicle Storage Building</li> <li>Boiler House</li> <li>Lakeshore Garage</li> <li>Gas Bottle Storage</li> </ul>
			Q. What is the economic benefit to refurbishment or to the continued operation of DNGS for an additional 30 years?	
			Q. What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			Q. Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>SU02</b>	Station Upgrades	<ul style="list-style-type: none"> <li>Non-infrastructure station upgrades required to sustain an additional 30 years of operations.</li> <li>Is not part of, nor does it directly support core scope.</li> </ul>	Q. Can the work be executed after Refurbishment is complete without impacting ongoing plant operations?	<ul style="list-style-type: none"> <li>New or improvements to permanent stairway, lifting device, floor grating, access hatches.</li> <li>Logistics improvements to loading bays, cafeteria, walkways</li> </ul>
			Q. What is the economic benefit to refurbishment or to the continued operation of DNGS for an additional 30 years?	
			Q. What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			Q. Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>SU03</b>	Equipment Renewal	<ul style="list-style-type: none"> <li>One time replacement at current end of component life</li> </ul>	Q. Would the refurbishment core scope still be possible to execute without this scope / infrastructure?	<ul style="list-style-type: none"> <li>Steam Turbines and Turbine Auxiliaries: Main Lube Oil Pump</li> </ul>

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Category	Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
	(Nominal 30 years). <ul style="list-style-type: none"> <li>Replacement of obsolete components</li> <li>Inspections to determine equipment condition not part of normal PM program.</li> </ul>	<p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</p> <p><b>Q.</b> Are the parts:</p> <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	<ul style="list-style-type: none"> <li>Main Condensate System: LP Heaters</li> <li>Fuel Handling Inverters Replacement</li> <li>Turbine Control Upgrade</li> </ul>

### B.2.2 Value Enhancing (VE) - Non - Core Scope

Value Enhancing Scope is not mandatory to execute the Refurbishment Outage. There may be significant advantages to the station or to OPG by executing some value enhancing scope. It will primarily have an impact on the post-refurbishment time period. Value Enhancing scope would optimize (primarily) the cost efficiencies post-refurbishment and may help the Station meet efficiency targets (these are not Refurbishment targets). Value Enhancing scope could also provide cost or resource efficiencies during Refurbishment, but are not absolutely essential in completing the work. All Non-core Scope requires economic justification (i.e. DRAS).

Category	Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>VE01</b>	Operations, Outage, Cost, Resource & Maintenance Efficiencies	<ul style="list-style-type: none"> <li>Scope can be proven to add value to the station operations in future by improving maintenance methods, saving costs on outages, optimizing resources or improving operations.</li> </ul>	<ul style="list-style-type: none"> <li>Outage Heat Sink modification expected to reduce outage durations post-refurbishment.</li> <li>Modification to enable a valve to be replaced with a new design instead of repairing a valve.</li> <li>Modification to allow specified maintenance to be completed at-power rather than during an outage condition.</li> <li>Technically required work which is known to extend outage duration or incur greater dose in regular outages and makes an economic case to include in the Refurbishment Program.</li> </ul>
		<p><b>Q.</b> Has a clear explanation been provided as to why the expected impacts/ savings (e.g. OM&amp;A costs, planned outage time, forced loss rate, operator work around, dose reduction, etc) are defensible and attributable to this specific scope of work?</p>	
		<p><b>Q.</b> Has a review been done to ensure that the expected savings/impacts of this scope of work have not already been included in other proposed work scope?</p>	
		<p><b>Q.</b> Have all major stakeholders (and potentially an independent 3rd party) validated the expected savings/ impacts?</p>	
		<p><b>Q.</b> Have all potential post-project implementation costs been included?</p>	
		<p><b>Q.</b> Have required infrastructure and support work costs been included?</p>	
		<p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do</p>	

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
			in Refurb rather than later?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>VE02</b>	Safety Improvements beyond Standards	<ul style="list-style-type: none"> <li>Station or Refurbishment suggested improvements that are not required as per current codes and standards.</li> </ul>	<b>Q.</b> Has the improvement been requested by a group in the Station or an external stakeholder?	<ul style="list-style-type: none"> <li>Installation of a new railing, signage, overhead door or ergonomic enhancement is currently not in place and is in compliance with safety standards and not in violation of any OPG standards.</li> </ul>
			<b>Q.</b> Is there a time constraint for this improvement? If so, what is it? What are the reasons for the constraint?	
			<b>Q.</b> Why should this improvement be considered for execution during refurbishment? Can it be done before Refurbishment?	
			<b>Q.</b> What are the benefits to executing this during the refurbishment outage?	
			<b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>VE03</b>	Environmental Improvements beyond Standards	<ul style="list-style-type: none"> <li>Station or Refurbishment suggested improvements that are not required as per current codes and standards.</li> </ul>	<b>Q.</b> Has the improvement been requested by a group in the Station or an external environmental stakeholder?	<ul style="list-style-type: none"> <li>Installation of a new oil dyke around equipment that was not previously in place and is currently in compliance with environmental laws and not in violation of any OPG standards.</li> </ul>
			<b>Q.</b> Is there a time constraint for this improvement? If so, what is it? What are the reasons for the constraint?	
			<b>Q.</b> Why should this improvement be considered for execution during refurbishment? Can it be done before Refurbishment?	
			<b>Q.</b> What are the benefits to executing this during the refurbishment outage?	

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>VE04</b>	Infrastructure upgrades that are expected to increase efficiencies for the <u>Refurbish</u> Outage period only, but do not directly support Core Scope.	<ul style="list-style-type: none"> <li>Scope that can improve efficiencies during the refurbishment such as improved resource effectiveness, reduction of delays, improved site transportation/logistics.</li> </ul>	<b>Q.</b> What are the economic benefits to executing the work during the refurbishment outage? What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?	<ul style="list-style-type: none"> <li>Increased security monitors or security equipment to make entrance to the station more efficient</li> <li>Moving existing facilities closer to the work face to decrease travel time for trades or management staff</li> </ul>
			<b>Q.</b> How can the station benefit from this work post-refurbishment?	
			<b>Q.</b> Are the parts: <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	
<b>VE05</b>	Enhance Corporate Reputation	<ul style="list-style-type: none"> <li>Proposed scope that will/may enhance OPG's or Darlington Refurbishment Program's corporate reputation with Clarington, Ontario or other groups.</li> </ul>	<b>Q.</b> Is the scope directly related to Refurbishment? (Is this something where funding would normally be obtained through another business unit as part of that unit's core business?)	<ul style="list-style-type: none"> <li>Modification to improve environmental emissions</li> <li>Modification to reduce sound emissions from the station</li> <li>Public Affairs communications (billboards, additional temporary communication stations in the community).</li> </ul>
			<b>Q.</b> How will the scope improve OPG's corporate reputation?	
			<b>Q.</b> Why should this scope be part of the Refurbishment program (and not part of Darlington Nuclear's ongoing operations?)	
			<b>Q.</b> What external groups does this impact (i.e. is there a group that is specifically interested in this initiative?).	
			<b>Q.</b> Is there a strategy in place to communicate this improvement, should it be added to scope?	

### B.2.3 Performance Improvement (PF) - Non - Core Scope

Performance Improvement Scope is non-core scope that supports the reduction of Unit backlog work orders or supports System Health targets beyond the condition at unit turnover to the Refurbishment Program management team. All Non-core Scope requires economic justification (i.e. DRAS).

Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
<b>PF01</b>	Reduce Unit Backlog (non-core, most likely CM or	<ul style="list-style-type: none"> <li>Non-core work that will help reduce backlogs on Darlington Units.</li> </ul>	<b>Q.</b> Does this work exceed the condition in which Refurbishment received the unit from Operations?	<ul style="list-style-type: none"> <li>Valve that has been in disrepair for many years (through many outages). Parts have</li> </ul>

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
	EM work orders)	<ul style="list-style-type: none"><li>Work may be required for unit start-up (i.e. you need the CM or EM equipment fixed to perform start-up of the unit). This may be mandatory to execute for unit condition, but is still not core scope.</li></ul>	<div><div>Q. Does this work contribute to the backlog reduction for the unit?</div><div>Q. Has the unit been started before (after a previous outage) with this condition present? Were there significant conventional safety, nuclear safety, maintenance or operations issues?</div><div>Q. What is the impact on the refurbishment outage schedule?</div><div>Q. What is the impact on the outage cost? What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</div><div>Q. Are the parts:<ul style="list-style-type: none"><li>Available (for purchase or spares on hand)?</li><li>Obsolete?</li><li>Long lead items?</li></ul></div></div>	<div>not been available and this has not been a high priority and does not significantly impact the operation of the system.</div> <ul style="list-style-type: none"><li>Switch that breaks upon commissioning of a system that previously had no work performed on it during the refurbishment outage, but must be repaired or replaced in order to start up the unit/system.</li></ul>
PF02	Operator Work-Around (non-core)	<ul style="list-style-type: none"><li>Non-core work that will remove a requirement for an Operator Work Around. Work <u>may</u> be mandatory for start-up, but is still not core scope.</li></ul>	<div><div>Q. Can this work be executed pre-Refurbishment?</div><div>Q. What is the impact to Operations and the unit if the work is not completed in Refurbishment?</div></div>	<ul style="list-style-type: none"><li>PNGS B example: moderator spool piece for refill was removed years ago during moderator commissioning and not reinstalled. Ops cannot use refill header from S&amp;I tanks to refill moderator, uses a hose under a jumper. Increases refill duration. Mod could be done while unit is operating.</li></ul>
PF03	Design Modifications (non-core) required to maintain operation of an existing non-life limiting component (likely a CM or EM backlog work order	<ul style="list-style-type: none"><li>Proposed modification may be required to continue operations of a system or component, but is not core scope and does not contribute in the greater '30 year' life span of the equipment or system.</li><li>May be required for Unit start-up if it is</li></ul>	<div><div>Q. Is this a requirement for unit start-up?</div><div>Q. If the request is before the scope freeze date; can the work be completed pre-Refurbishment?</div><div>Q. The work does not support core scope and was not identified by Aging Management or Life Cycle Plans as a requirement for an additional 30 years of</div></div>	<ul style="list-style-type: none"><li>Modification to install a balancing weight on a fan due to unacceptable vibrations at system start-up/commissioning – it is minimal work to fix a balance issue, but is not a 30 year fix. May actually be required for start-up, but is not related to core scope</li></ul>

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
	origin).	emergent.	<p>operation. Provide justification for this modification and the near-term benefits to the station.</p> <p><b>Q.</b> Is there a better alternative that will contribute to a longer life-span of the equipment?</p> <p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</p> <p><b>Q.</b> Are the parts:</p> <ul style="list-style-type: none"> <li>Available (for purchase or spares on hand)?</li> <li>Obsolete?</li> <li>Long lead items?</li> </ul>	and does not guarantee that equipment or mod will last for the life of the station.
<b>PF04</b>	Reliability Improvement	<ul style="list-style-type: none"> <li>Proposed scope has high likelihood of improving unit reliability and contributes to reducing unit forced loss rate and optimizing unit capacity factor.</li> <li>Has caused an Equipment Reliability Reset (see criteria below): <ol style="list-style-type: none"> <li>Causes of Reactor Trip, Stepback or Setback</li> <li>Causes a Turbine or Generator Trip</li> <li>Results in a Unit Transient &gt; 5%</li> <li>Results in &gt; 250 Mwhr Forced Loss</li> <li>Categorized as a Reactivity Management Event (Categories 1&amp;2 per N-STD-OP-0009)</li> <li>Results in a Unit/Station entering = 24 Hr Shutdown Clock per AIM</li> <li>Categorized as an Event Reset</li> </ol> </li> </ul>	<p><b>Q.</b> Can this scope be performed online or in an outage prior to or post-refurbishment?</p> <p><b>Q.</b> What is the priority on this improvement for the station? Is it likely to contribute to another ER reset or has an investigation shown otherwise?</p> <p><b>Q.</b> Has this reliability issue occurred more than once at Darlington or other stations? What is the probability of reoccurrence?</p> <p><b>Q.</b> Does the cost of the proposed scope outweigh the cost of MW loss of generation? Has an economic assessment been completed?</p> <p><b>Q.</b> What is the Cost of parts and labour? Is it economically beneficial to do in Refurb rather than later?</p>	<ul style="list-style-type: none"> <li>Unit 5 East F/M stuck on channel E-06. East B-ram will not retract to allow for separation of the second pair. 48 hour shutdown clock initiated June 2, 2009 @ 21:06. WR #00685020.</li> <li>5-71210-P2 tripped. Field investigation reported that the power supply 5-53200-CB7D tripped on a ground fault resulting in &gt;6MW loss in output.</li> </ul>

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Category		Description of Scope Type	Questions for Scope Justification	Example of Proposed Scope
		(where an equipment failed that did not meet any of the above criteria but deemed as very significant)	<b>Q.</b> Are the parts: <ul style="list-style-type: none"><li>• Available (for purchase or spares on hand)?</li><li>• Obsolete?</li><li>• Long lead items?</li></ul>	

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## DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL

General Questions for all Scope Requests (in any category)	
<b>Stakeholders/ Integration/ Objectives</b>	<ul style="list-style-type: none"> <li>Has an assessment been done of other upcoming scope/projects to determine whether there are opportunities for integration of work to realize cost/schedule savings?</li> </ul>
	<ul style="list-style-type: none"> <li>Is this scope or proposed project dependent on other planned scope/ projects being included in refurbishment scope? If so, specify.</li> </ul>
	<ul style="list-style-type: none"> <li>Have all key stakeholders (e.g. DN Refurbishment, DN Operations, Nuclear Engineering, and Regulatory Affairs) provided input and have their issues been dispositioned?</li> </ul>
	<ul style="list-style-type: none"> <li>How does this scope or proposed project address one or more of the Refurbishment Program Objectives? Specify.</li> </ul>
<b>Alternatives</b>	<ul style="list-style-type: none"> <li>Has the alternative of doing the work during the pre- refurbishment period been considered/assessed? Provide clear rationale why not feasible; i.e. discuss drawbacks, major risks.</li> </ul>
	<ul style="list-style-type: none"> <li>Has the alternative of doing the work during the post- refurbishment period been considered/assessed? Provide clear rationale why not feasible, i.e. discuss drawbacks, major risks.</li> </ul>
	<ul style="list-style-type: none"> <li>Is the technical justification for completing the work during the refurbishment outage robust?</li> </ul>
	<ul style="list-style-type: none"> <li>Have all feasible alternatives (or alternative approaches) of executing the work during the refurbishment outage been developed?</li> </ul>
	<ul style="list-style-type: none"> <li>Has the impact on refurbishment outage schedule and cost of the preferred alternative been assessed?</li> </ul>
<b>Scope/ Project Cost Estimate</b>	<ul style="list-style-type: none"> <li>Has a scope and cost estimate been developed for all feasible alternatives?</li> </ul>
	<ul style="list-style-type: none"> <li>Is the basis for the estimate of scope/ project costs clearly stated?</li> </ul>
	<ul style="list-style-type: none"> <li>Have cost estimate ranges been provided for scope/ project costs to indicate the accuracy of the estimate?</li> </ul>
	<ul style="list-style-type: none"> <li>Does the estimate include contingency and provide the basis for the contingency?</li> </ul>
<b>Economic Analysis of Feasible Alternatives/ Risk Assessment of Preferred Alternative</b>	<ul style="list-style-type: none"> <li>Have major risks and mitigating actions been identified? (Risks areas include finance, schedule, quality, corporate reputation, regulatory, health &amp; safety, environment &amp; nuclear safety).</li> </ul>
	<ul style="list-style-type: none"> <li>Have potential incremental schedule /cost impacts been assessed if these risks materialize?</li> </ul>
	<ul style="list-style-type: none"> <li>Has specific contingency been included in the schedule/cost estimates to address these potential risks?</li> </ul>
	<ul style="list-style-type: none"> <li>Has the alternative of doing the work during the pre-refurbishment period been considered / assessed?</li> </ul>
	Does the NPV analysis include a table showing a breakout of the contributions to NPV of each of the expected savings/impacts?

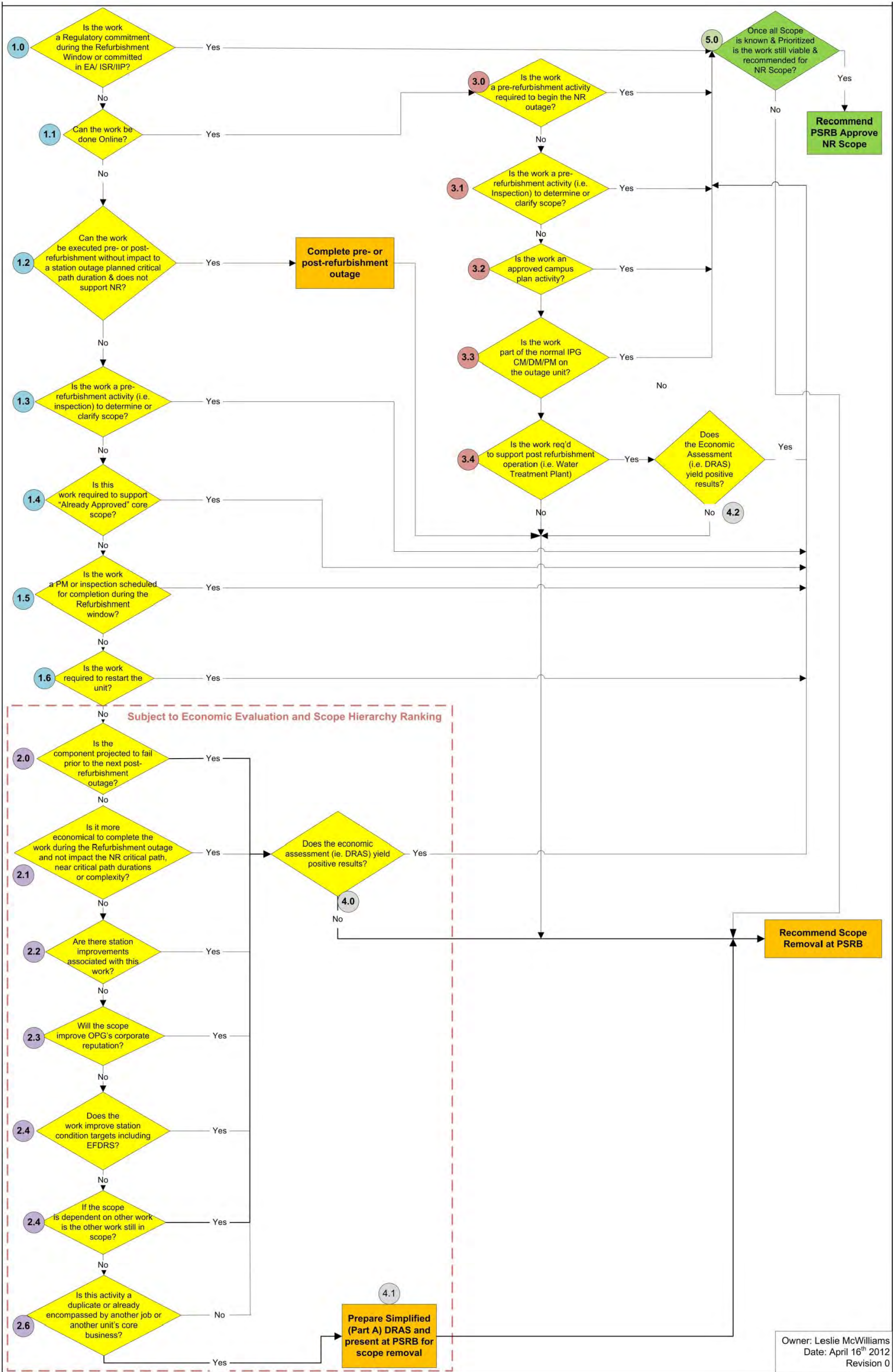


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Appendix C: Nuclear Refurbishment Scope Decision Matrix





**Scope Management for the Darlington Refurbishment Program**

```

graph TD
    PO[Program Objectives  
Ref. Project Charter  
D-PCH-09701-10102] --> CS[1.0 CS - Core Scope]
    PO --> SU[2.0 SU - Sustaining - Non-Core Scope]
    PO --> VE[3.0 VE - Value Enhancing - Non-Core Scope]
    PO --> PF[4.0 PF - Performance Improvement - Non-Core Scope]
    
    CS --> CS01[CS01 - Regulatory Improvements to meet current Standards]
    CS --> CS02[CS02 - Life Limiting Components]
    CS --> CS03[CS03 - Mandatory Support for Core Scope]
    CS --> CS04[CS04 - Mandatory 'Construction Period' Outage Work]
    CS --> CS05[CS05 - Regulatory Improvements beyond current Standards]
    
    SU --> SU01[SU01 - Sustaining Infrastructure]
    SU --> SU02[SU02 - Station Upgrades]
    SU --> SU03[SU03 - Equipment Renewal]
    
    SU --> VE
    SU --> PF
    
    VE --> VE01[VE01 - Operations, Outage, Cost, Resource & Maintenance Efficiencies]
    VE --> VE02[VE02 - Safety Improvements beyond Standards]
    VE --> VE03[VE03 - Environmental Improvements beyond Standards]
    VE --> VE04[VE04 - Infrastructure upgrades that are expected to increase efficiencies for the Refurbish Outage period only, but do not directly support Core Scope.]
    VE --> VE05[VE05 - Enhance Corporate Reputation]
    
    PF --> PF01[PF01 - Reduce Unit Backlog (non-core, most likely CM or EM work orders)]
    PF --> PF02[PF02 - Operator Work-Around (non-core)]
    PF --> PF03[PF03 - Design Modifications (non-core) required to maintain operation of an existing non-life limiting component (likely a CM or EM backlog work order origin)]
    PF --> PF04[PF04 - Reliability Improvement]
    
    CS --> A[Accepted]
    SU --> CA1[Conditional Acceptance  
Assuming Economic Benefit (i.e. DRAS) and Doability]
    VE --> CA2[Conditional Acceptance  
Assuming Economic Benefit (i.e. DRAS) and Doability]
    PF --> CA3[Conditional Acceptance  
Assuming Economic Benefit (i.e. DRAS) and Doability]
  
```

**Program Objectives**

**Ref. Project Charter**  
D-PCH-09701-10102

**Principle Program Objectives**

1. Confirm feasibility of refurbishing Darlington NGS reactors
2. Plan and execute all work required to refurbish the Darlington units
3. Ensure the scope of the refurbishment outages will enable economic Top Decile operations of each unit for an additional 30 years, following post-refurbishment synchronization

**1.0 CS - Core Scope**

Core Scope directly supports the Program Objectives to ensure the success of Refurbishment.

**CS01 – Regulatory Improvements to meet current Standards**

- 1.01 Scope that is not optional in order to support the Station License and Regulatory Requirements.
- 1.02 Nuclear Refurbishment CNSC Commitments.
- 1.03 ISR / EA, IIP Regulatory Commitments.

**CS02 – Life Limiting Components**

- 1.04 Major component modification, repair or replacement that cannot survive operation for an additional 30 years
- 1.05 They could only be repaired or replaced under refurbishment outage plant condition (i.e. De-fuelled/dewatered)

**CS03 – Mandatory Support for Core Scope**

- 1.06 Must do in order to support execution of Core Scope.

**CS04 – Mandatory 'Construction Period' Outage Work**

- 1.07 Preventative Maintenance Work that would normally be executed during the time period during the Refurbishment Outage.
- 1.08 Mandatory Inspections that would normally be executed during the time period during the Refurbishment Outage.

**CS05 – Regulatory Improvements beyond current Standards**

- 1.09 Regulatory suggested improvements that are not required as per current codes and standards.

**2.0 SU - Sustaining – Non-Core Scope**

Sustaining Scope is not mandatory to execute the Refurbishment Outage and achieve the Program Objectives. It may provide long term benefits to the Darlington Site and stations outside the primary Program Objectives.

**SU01 – Sustaining Infrastructure**

- 2.01 Infrastructure upgrades required to sustain an additional 30 years of operations.
- 2.02 Work is listed as part of the Darlington Master Campus Plan and the Darlington Program Campus Plan Scope Statement. Is not part of, nor does it directly support core scope.

**SU02 – Station Upgrades**

- 2.03 Non-infrastructure station upgrades required to sustain an additional 30 years of operations. Is not part of, nor does it directly support core scope.

**SU03 – Equipment Renewal**

- 2.04 One time replacement at current end of component life (Nominal 30 years).
- 2.05 Replacement of obsolete components (criticality 1 + criticality 2).
- 2.06 Inspections to determine equipment condition not part of normal PM program.

**3.0 VE - Value Enhancing – Non-Core Scope**

Value Enhancing Scope is not mandatory to execute the Refurbishment Outage. There may be significant advantages to the station or to OPG by executing some value enhancing scope. It will primarily have an impact on the post-refurbishment time period. Value Enhancing scope would optimize (primarily) the cost efficiencies post-refurbishment and may help the Station meet efficiency targets (these are not Refurbishment targets). Value Enhancing scope could also provide cost or resource efficiencies during Refurbishment, but are not absolutely essential in completing the work.

**VE01 – Operations, Outage, Cost, Resource & Maintenance Efficiencies**

- 3.01 Scope can be proven to add value to the station operations in future by improving maintenance methods, saving costs on outages, optimizing resources or improving operations.
- 3.02 Replacement of components which due to scale of work makes economic sense.

**VE02 – Safety Improvements beyond Standards**

- 3.03 Station or Refurbishment suggested improvements that are not required as per current codes and standards.

**VE03 – Environmental Improvements beyond Standards**

- 3.04 Station or Refurbishment suggested improvements that are not required as per current codes and standards.

**VE04 – Infrastructure upgrades that are expected to increase efficiencies for the Refurbish Outage period only, but do not directly support Core Scope.**

- 3.05 Scope that can improve efficiencies during the refurbishment such as improved resource effectiveness, reduction of delays, improved site transportation/logistics.

**VE05 – Enhance Corporate Reputation**

- 3.06 Proposed scope that will/may enhance OPG's or Darlington Refurbishment Program's corporate reputation with Clarington, Ontario or other groups.

**4.0 PF - Performance Improvement – Non-Core Scope**

Performance Improvement Scope is non-core scope that supports the reduction of Unit backlog work orders or supports System Health targets beyond the condition at unit turnover to the Refurbishment Program management team.

**PF01 – Reduce Unit Backlog (non-core, most likely CM or EM work orders)**

- 4.01 Non-core work that will help reduce backlogs on Darlington Units.
- 4.02 Work may be required for unit start-up (i.e. you need the CM or EM equipment fixed to perform start-up of the unit). This may be mandatory to execute for unit condition, but is still not core scope.

**PF02 – Operator Work-Around (non-core)**

- 4.03 Non-core work that will remove a requirement for an Operator Work Around. Work may be mandatory for start-up, but is still not core scope.

**PF03 – Design Modifications (non-core) required to maintain operation of an existing non-life limiting component (likely a CM or EM backlog work order origin)**

- 4.04 Proposed modification may be required to continue operations of a system or component, but is not core scope and does not contribute in the greater '30 year' life span of the equipment or system.
- 4.05 May be required for Unit start-up if it is emergent.

**PF04 – Reliability Improvement**

- 4.06 Proposed scope has high likelihood of improving unit reliability and contributes to reducing unit forced loss rate and optimizing unit capacity factor.
- 4.07 Has caused an Equipment Reliability Reset.
- 4.08 Allows station to achieve Top Decile performance.
- 4.09 Supports outage improvements.

**Accepted**

**Conditional Acceptance**  
Assuming Economic Benefit (i.e. DRAS) and Doability

**Conditional Acceptance**  
Assuming Economic Benefit (i.e. DRAS) and Doability

**Conditional Acceptance**  
Assuming Economic Benefit (i.e. DRAS) and Doability



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## Appendix E: Core Scope of the Darlington Refurbishment Program

### Refer to NK38-PLAN-01060-10003, Darlington NGS Refurbishment Project Reference Plan – Scope Definition

Core Scope of the Refurbishment Program will support the primary objectives of the Program. Core Scope is included in the Business Case Summary for the Program.

The following is a **brief** summary of the current documented major components of Core Scope.

- Replacement of all Fuel Channels (calandria tubes and pressure tubes)
- Replacement of all Feeders
- Balance of Plant life limiting components only where justified to support Program Objectives and support an economic business case
- Regulatory work required to be performed in order to extend the life of the station by an additional thirty years, as indicated in the CNSC approved Integrated Safety Report (ISR), Environmental Assessment (EA), and Integrated Implementation Plan (IIP).
- Work related to outage preparation, including development of tooling, mock-ups, training, unit islanding, installation of barriers, modifications, etc. to support the outage, and all planning activities related to items included in the scope of the Darlington Refurbishment Program.
- Infrastructure development to directly support the refurbishment outage
- Work Management work committed to be performed on the unit within the start and end date of that unit refurbishment outage.

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**Appendix F: Darlington Refurbishment Program – Funding Matrix for Program Level Scope**

The following is a funding guide for all scope related to the Darlington Refurbishment Project.

Funding Program \ Program Phase	Pre-Refurbishment Period	Refurbishment Period	Post-Refurbishment Period
	Schedule Accountability <sup>(1)</sup> – NGS Operations (Non-Outage, Outside Protected Area and Outage Work Control)	Schedule Accountability <sup>(1)</sup> – NR Program Management Office (PMO)	Schedule Accountability <sup>(1)</sup> – NGS Operations (On-line and Outage Work Control)
Darlington Operations (Business Plan)  <i>Operate and Maintain the plant pre- and post- refurbishment</i>	<ul style="list-style-type: none"> <li>Maintain the plant until Refurbishment:               <ul style="list-style-type: none"> <li>All Cyclic Outage work and inspection programs associated with normal operations and maintenance.</li> <li>Life-cycle management work including items identified in CCAs.</li> <li>Pre-refurbishment outages</li> <li>Minor Mods Program</li> </ul> </li> <li>Execution of station strategies to meet DN Station Vision</li> </ul>	<ul style="list-style-type: none"> <li>No budget for online and outage work programs for unit(s) during the refurbishment period.</li> </ul>	<ul style="list-style-type: none"> <li>Maintain the plant post Refurbishment:               <ul style="list-style-type: none"> <li>All Cyclic Outage work and inspection programs associated with normal operations and maintenance.</li> <li>Life-cycle management work including items identified in CCAs.</li> <li>Post-refurbishment outages</li> <li>Minor Mods Program</li> </ul> </li> <li>Execution of station strategies to meet DN Station Vision</li> </ul>
Darlington Refurbishment Program  <i>Prepare for and execute the refurbishment outage on time, on budget, and with 100% scope completed; as identified in Release Quality Estimate.</i>	<ul style="list-style-type: none"> <li>Any Core <sup>(2)</sup>, Scope approved by SRB where NR has requested delivery of scope prior to the refurbishment outage<sup>(3)</sup>, and / or where station work management agree to perform scope in pre-refurbishment period (outage or online).</li> <li>Non Core <sup>(2)</sup> scope, as approved by SRB, and where required to be done prior to the refurbishment outage; including</li> </ul>	All execution activities, including: <ul style="list-style-type: none"> <li>All Core <sup>(2)</sup> scope approved by the SRB, as generated by CCA, ISR, and EA process.</li> <li>All Non Core <sup>(2)</sup> scope approved by the SRB, where executed during the refurbishment outage period, and not funded by AISC.</li> <li>All staff engaged in the refurbishment program, whether directly assigned or other-business-unit support; including</li> </ul>	<ul style="list-style-type: none"> <li>Refurbishment funded scope, Core <sup>(2)</sup> or Non Core <sup>(2)</sup>, approved by the SRB, which is deferred to a post-refurbishment period <sup>(4)</sup>.</li> </ul>

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**DARLINGTON NUCLEAR REFURBISHMENT PROGRAM-SCOPE CONTROL**

Funding Program	Program Phase	Pre-Refurbishment Period	Refurbishment Period	Post-Refurbishment Period
		Schedule Accountability <sup>(1)</sup> – NGS Operations (Non-Outage, Outside Protected Area and Outage Work Control)	Schedule Accountability <sup>(1)</sup> – NR Program Management Office (PMO)	Schedule Accountability <sup>(1)</sup> – NGS Operations (On-line and Outage Work Control)
		facility and infrastructure modifications, or islanding modifications in support of the refurbishment outage. <ul style="list-style-type: none"> <li>Incremental inspection programs, beyond normal life-cycle management inspection programs, required to define scope of work for the refurbishment outage.</li> <li>All staff engaged in the refurbishment program, whether directly assigned or other-business-unit support; including staff supporting planning, scoping, engineering, etc.</li> </ul>	staff supporting project oversight and/or execution activities. <ul style="list-style-type: none"> <li>All regular online and outage work programs optimized during the refurbishment period including mandatory PM's and Inspections.</li> <li>All commissioning and unit clean-up costs to turn-over the station to Operations.</li> </ul>	
Project Portfolio	Support the station in the development of regulatory or value enhancing modifications	<ul style="list-style-type: none"> <li>Approved projects per AISC</li> </ul>	<ul style="list-style-type: none"> <li>Approved projects per AISC where project is to be performed during refurbishment outage, and where Darlington Refurbishment Program Management Office approves work to be performed during refurbishment window.</li> </ul>	<ul style="list-style-type: none"> <li>Approved projects per AISC</li> </ul>
Capital Spares		<ul style="list-style-type: none"> <li>As identified by station to support 30 year end of life for major components</li> </ul>		

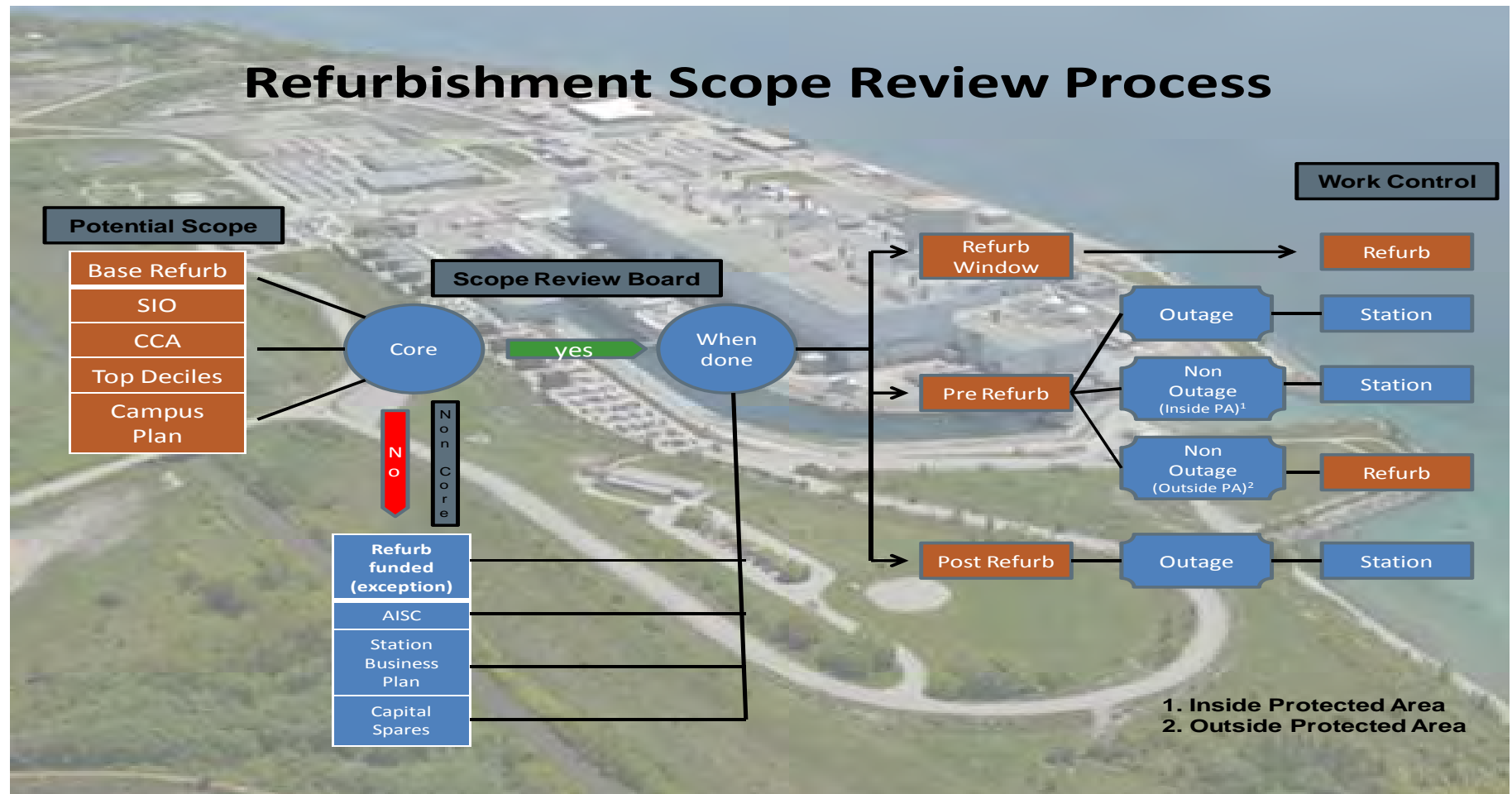
**Note:** Activities performed in station outages pre-refurbishment, and post-refurbishment, will be controlled by Darlington NGS (Operations) work control. Activities performed during Refurbishment, including station and project activities, will be co-ordinated through the Darlington Refurbishment Program Management Office to confirm do-ability and scheduling window.

**Title:**

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## Appendix G: Refurbishment Scope Review Process



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**Appendix H: Nuclear Refurbishment Scope Hierarchy**

CODE	SCOPE TYPE	ISR	RISK	PREREQ	NPV
AA1	CS01	Y		Y	
AA2	CS01			Y	
AA3	CS02			Y	
AA4	CS02		>=H15		
AA5	CS02		<H15		
AA6	VE02	Y		Y	>\$1M
AA7	CS05			Y	
AA8	CS01	Y	>=H15		
AA9	CS01	Y	<H15		
AA10	VE02	Y			>\$1M
AA11	CS05				
AA12	CS04		>=H15		
AA13	CS04		<H15		
AA14	CS03		>=H15		
AA15	CS03		<H15		
BA1	SU			Y	>\$1M or N/A
BA2	SU		>=H15		>\$1M
BA3	SU		<H15		>\$5M
BA4	VE/PF				>\$100M
CA1	VE/PF				>\$10M<\$100M
CA2	VE/PF				>\$5M<\$10M
CA3	VE/PF				>\$1000k<\$5000K
CA4	VE/PF				>\$500k<\$1000K
CA5	VE/PF				<\$500K

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**Appendix I: Scope Decision Matrix Summary Table**

#DSR's Owned:	Appendix J: Scope Decision Matrix Summary Table			Date :	
#DSR's Presented:	Note: To be used in conjunction with Appendix C			Project Manager:	
Item #	DSR Line Item	IN/OUT	Removal Point (i.e. 2.1,etc)	Comments / Recommendation	DRAS#
1					
2					
3					
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5					
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## Appendix J: DSR types (DSR number pre-fixes)

DSR Database

Select a DSR type

- ☒ Campus Plan (DR03)
- ☐ Refurb Technical (DR02)
- ☐ Regulatory (DR04)
- ☐ Strategic Initiative (DR05)
- ☐ Other
- ☐ Unit Work Management

Enter a descriptive Title (Cannot be changed after DSR created)

Back Next

(Prompt window from the DSR database)

DSR Type	Prefix		Description
Campus Plan (DR03)	CP	Campus Plan	Facilities & Infrastructure upgrades to (inside and outside) the plant to support a successful refurbishment
Regulatory (DR04)	IP	Improvement Plan	Station or Safety or improvements beyond standard that provide benefits to the station in terms of increased reliability and/or lower operating costs.
Other	MS	Maintenance Scope	Related to or generated by Maintenance. Includes assessment of station services and equipment.
Strategic Initiative (DR05)	SI	Strategic Initiative	It is not required but good to have (long term benefit).
Refurb Technical (DR02)	TS	Technical Scope	Engineering Design Support: Create; modify technical specifications and Standards within NR scope. Design within the EPC framework items assigned to the NR Design Department.
Unit work management	WM	Work Management (DR06)	Work schedule and windows management.

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Appendix K: MEMO: Value-Enhancing Investment at DNGS during Refurbishment



700 University Avenue, H7G5, Toronto, ON M5G 1X6

MEMORANDUM

April 12, 2013

MR. D. REINER  
Senior Vice President  
Nuclear Refurbishment

Value-Enhancing Investment at DNGS during Refurbishment

The Refurbishment of Darlington represents a significant milestone in the evolution of OPG. During the life of this project, we will see the cessation of coal (2014) and the potential end of operations at both Pickering A and Pickering B (2020). Both of these major events will lead to a significant shrinking of OPG's operations. At this time, there is no guarantee of New Nuclear becoming a reality, or a repowering of the Thermal sites. This downsizing of operations, and the need to be cost competitive going forward puts significant pressure on our ability to raise capital and to sustain operations over the long-term.

To minimize our capital requirements during the refurbishment outage and to make quality investments in the plant that support high quality, profitable operations going forward, I am proposing that the Refurbishment Project adopt more stringent criteria for assessment of sustaining, value-enhancing and performance improvement work that is to be included in the refurbishment outages. The criteria will apply to all scope that is not considered core scope as defined by the Scope Review Board governance.

The adoption of more stringent criteria on sustaining, value-enhancing and performance improvement initiatives during the refurbishment outage, would help to constrain scope to only those high value scope items that show a significant contribution to the bottom line. These more stringent criteria would include a hurdle rate of 9.5% (WACC) valued on the forecast System Economic Values and a simple payback period of six years, or 2 outage cycles.

A handwritten signature in black ink, appearing to read "Donn Hanbidge".

Donn Hanbidge

c: W. Robbins  
D. Power  
R. Heard



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Nuclear Refurbishment - Program Change Management

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## Nuclear Refurbishment - Program Change Management

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R1	2016-04-22	Revision to section 6.4 contingency; add fast track process; update with new cost system terminology.

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# NUCLEAR REFURBISHMENT - PROGRAM CHANGE MANAGEMENT

## 1.0 BACKGROUND

*Change* is inevitable in a project. Well managed and controlled projects must manage change. A robust change management process provides guidance on how changes are assessed, implemented and reported on a project. This change manual will be reviewed and updated periodically to reflect the changing environment with respect to project controls tools.

## 2.0 PURPOSE

The primary purpose of Program Change Management is to control cost, schedule and scope changes against approved *baselines*, to manage the proper allocation of contingency funds, to document the nature and cause of changes and to analyse and minimize the impact to cost and schedule.

## 3.0 DIRECTION

### 3.1 Principles

- The *executing organization* will first attempt to mitigate the impacts of change by evaluating alternatives, such as reassigning resources to other available work, to mitigate the impact of change.
- Change is managed at the lowest level of the organization that has the authority to do so.
- Change that has a significant potential impact on project or program scope, cost and schedule is reviewed in detail and the recommended direction is approved at the appropriate level.
- The process balances flexibility and control.
- All changes are documented, tracked and included in relevant reports.
- Detailed evaluation of the impacts of the change takes place when necessary.
- Trends of changes are identified and followed up; the Station Condition Record (SCR) system is utilized when applicable.
- Only after the change is approved by the appropriate authority level, is the work assigned for action by the executing organization.
- Changes are not made solely for the purposes of correcting performance issues that are within the control of the work program owner.



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- Projects are re-baselined only when the cumulative effect of multiple Changes or a significant execution strategy Change renders the existing baseline no longer meaningful.

### 3.2 Definition of Change and Change Management

For the purposes of this procedure, a *change* is any deviation from an approved plan or procedure that results in a real or potential impact on program or project cost, schedule or scope.

*Change Management* is the Project Management process (including the supporting tool) that provides a framework to identify and record changes in cost, schedule and or scope against the approved baselines.

See Section 11.0 for a complete list of definitions for this procedure.

### 3.3 Program Baseline and Performance Measurement Baselines

The Change Control Process as defined in this document is performed from project inception through completion. The constraints of cost, schedule and scope must be continuously and rigorously managed either by rejecting or approving changes and subsequently incorporating approved changes into the revised *Program* and *Performance Measurement Baseline*, where applicable.

#### Program Baseline

The aggregate planning efforts during Definition Phase will converge to an overall Program Plan at Release 5, or Release Quality Estimate (RQE). This is the point when the majority of projects have sufficiently defined their execution strategies, cost, schedule and scope that will allow an overall Program Baseline to be set. The Program Baseline will be maintained as a high confidence estimate for all four units and project level changes assessed.

#### Performance Measurement Baseline

The Performance Measurement Baseline for Project and Functions is the cost, schedule and scope approved during the Release Quality Estimate (RQE) and Changes subsequently approved via this Change Management process. The Project Performance Measurement Baseline will be maintained and cost and schedule performance against the baseline monitored.

The use of Baseline in this document refers to the Performance Measurement Baseline.

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## 4.0 SCOPE

This document takes authority from N-STD-AS-0028 Project Management Standard and guidance from N-MAN-00120-10001-PC, Project Controls.

This Change Management process, illustrated in Appendix A, Change Process Flow, is for NR Funded and Darlington Outage Cyclical Maintenance work, including transfers in and out of the Program, is applicable to the following:

- Changes that occur between Gates to Projects already approved by the gating process and approved by the Gate Review Board (GRB), including scope transfers between Projects, Bundles or sub-Bundles;
- Changes to OPG functional work programs approved by the Functional Business Planning Release;
- Changes to contractual agreements between OPG and external contractors, suppliers or vendors when the change impacts project scope, cost or schedule;
- Changes in contracting or execution strategy;
- Engineering change control process outputs that impact project scope, cost or schedule;
- New/Changed Project Numbers;
- New/Changed Work Packages;
- Changes to *Work Breakdown Structure (WBS)*;
- Changes to project attributes, example Bundle or Sub-Bundle
- Changes to cost, schedule or scope that are approved by other governing documents or bodies, including the Project Decision Meetings, Options Review Boards, Regulatory Affairs or alternative localized decision making committees.
- Changes to scope and scope transfers agreed by both receiving PM and transferring PM.
- New scope, including scope funded by other methods (example AISC) if the work is being executed during the NR Execution Outage.
- Advancing or transferring funds that have not been released by the GRB in circumstances where the work must be performed prior to the next Gate and funding is required to proceed in order to control risk.
- Project and program contingency changes irrespective of value, either drawn or returned back to contingency.

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- Administrative updates to the Program Baselines as approved by senior management.

This Change Control process is **not** applicable to:

- Projects that have not yet been presented and approved by the Gate Review Board (GRB), i.e., projects for which there is no approved baseline.
- Changes to correct performance issues that are within the control of the work program owner, unless the change renders the existing baseline no longer meaningful
- Changes to budget amounts in closed accounting periods (changing historic data).

## 5.0 ORGANIZATION, ROLES AND RESPONSIBILITIES

All project team members are empowered and encouraged to identify and initiate the Change Control Process.

The OPG behaviours of “Say it, Do it, Simplify it, Think Top and Bottom Line, Integrate and Collaborate and Tell it as it is” apply to the change management process. Early identification of changes and their impacts and trends allow NR Management to focus attention on performance improvements, and drive the core behaviours.

### 5.1 Change Initiator

The Change Initiator, in conjunction with their manager, is responsible for reporting a change to cost, schedule or scope of their work. Anyone can be a change initiator. The Change Initiator contacts the P&C Lead for the executing organization for assistance with completion of the *Change Control Form* (CCF) N-FORM-11252.

### 5.2 Project Manager

The Project Manager (PM) is responsible for:

- Executing the full scope of project within constraints of working safely, meeting quality requirements, and performing within the approved schedule and budget.
- Reacting to change trends, taking corrective action and identifying and mitigating project risks.
- Limiting, controlling and recommending use or return of contingency.
- Managing contractors to control and mitigate increases to cost and delay to schedule.

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- Ensuring no commitment (including Project Change Directives (PCD), Project Change Authorizations (PCA), Consent to Proceed (CTP), or any other commercial commitment) is entered into with vendors or contractors, or into the approved baseline, prior to having sufficient budget and/or approval when necessary via a CCF.
- Assessing the impacts of changes to cost, schedule and risk as well as to commercial, union jurisdiction, safety and environment, work and radiation permits, decontamination, material handling and storage, change in resource, quality, other impacts if applicable and impacts to other projects.
- Providing all required data and supporting document for the CCF.
- Attend the Change Control Board to discuss and respond to questions for CCFs pending approval.
- Updating the Project Management Plan as a result of a change if required.

Within the context of the change management process, the PM has the ultimate accountability to ensure changes are fully documented via a CCF and approved by the appropriate authority level as outlined in Section 0 and that the processes documented within this procedure are adhered to.

### 5.3 Project Director

The Project Director is responsible for:

- Reviewing and challenging changes proposed by the PM that are within PM's approval authority.
- Challenging the Project Manager to find offsetting reductions to minimize cost increases.
- Recommending contingency changes to the appropriate contingency owners.

### 5.4 Unit Outage Manager

The Unit Outage Manager is responsible for:

- Ensuring new work orders are reviewed and urgent actions taken to protect the critical path schedule, while ensuring follow up with Project Managers to ensure baselines are maintained.
- Ensuring new work orders are assigned to Project Managers for acceptance of scope.
- Screening new scope through the Daily Work Screening process.

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- Referring new scope that is not accepted by the Project Manager during the Screening process to the CCB.
- Concurring that a CCFs requires use of the Fast Track process described in Section 7.4.3

### 5.5 Planning & Controls (P&C)

#### 5.5.1 Director, Planning and Controls, NR

The Director, Planning and Controls is responsible for:

- Establishing and setting the direction for Program Change Management activities for NR.

#### 5.5.2 Manager Project Controls, Cost & Change Management, NR

The Manager Project Controls, Cost & Change Management is responsible for:

- Establishing and managing the processes, guides, and tools necessary to facilitate successful implementation of Program Change Management process.
- Administration of the Program Change Control Board (PCCB) process.
- Reviewing CCF's for compliance with the principles and governance of this manual and providing feedback and coaching on requirements.
- Tracking and following up on requests made or actions assigned by the PCCB.

#### 5.5.3 P&C Leads

The P&C Leads are responsible for:

- Coordinating evaluation and disposition/approval of the change including routing the CCF to the appropriate functional department or subject matter expert to perform an independent evaluation of the impacts of the change.
- Assisting the PM with preparation of change documentation.
- Confirming impacted systems or tools are updated such as P6, the Master Project List (MPL), etc.
- Creating a SCR for adverse trends identified from change pattern analysis if applicable as defined in Section 6.

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### 5.5.4 P&C Cost/Schedule Analyst (CSA)

The P&C CSAs are responsible for:

- Supporting the P&C Leads in coordinating evaluation and disposition/approval of changes.
- Reviewing the CCF and supporting documentation to ensure compliance with the criteria set out in this procedure.
- Communicating disposition of the CCF to the stakeholders.
- Updating the cost management system.
- Maintaining the change register.

### 5.5.5 P&C Reporting Department

The P&C Reporting Department is responsible for:

- Providing monthly metrics including trend reports and reporting out of the Change Management process as required.

### 5.5.6 P&C Change Administrator

The Change Administrator is responsible for:

- Administration of the CCB process.
- Reviewing CCF's for compliance with the principles and governance of this manual and providing feedback and coaching on requirements.
- Analyzing CCF trends and presenting analyses to the CCB as required.
- Tracking and following up on requests made or actions assigned by the CCB.
- Following up on SCR actions related to this procedure and/or CCF trends.
- Providing an interface between the committees and boards in this Change Management process.

### 5.5.7 P&C NR Estimating

The P&C NR Estimating department are responsible for:

- Reviewing and/or validate estimating basis of submitted changes including the estimate class and accuracy and completing CCF input in Section 2.

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### 5.6 NR Controllership

NR Controllership is responsible for:

- Deciding the correct accounting determinations and project funding sources.
- Reviewing the change register including selected review of individual CCFs (Finance Assurance).

### 5.7 Functional Departments

Functional Department processes are governed by their functional procedures; however when changes in functional work impacts NR project cost, schedule or scope baselines the Change Management process applies. Example:

- To draw contingency when a contract change (an amendment, PCD, PCA or CTP) is required for additional scope, a CCF must be raised and approved prior to updating the vendor contract and commencing work.

Functional Department Managers' budgets released through the business planning release process are governed by this Change Management process if the change meets the criteria detailed under section 6.0. For the purposes of this procedure, Functional Managers hold the same accountabilities as a Project Manager.

### 5.8 Subject Matter Experts

Depending on the nature of a change, a Subject Matter Experts (SME) may be requested to provide written feedback and recommendations on a proposed change. SME's can be anyone with the specialized knowledge or experience to provide additional analysis and recommendations.

SME's provide an independent assessment of the impacts of change for consideration by the approving authority.

### 5.9 New Work Screening Committee

The Director Unit Outage is responsible for the New Work Screening process. Chaired by the Project Control Centre (PCC) Manager, the New Work Screening Committee is comprised of:

#### Required Attendees:

Operations  
Work Management  
Planning & Controls  
Maintenance  
Engineering  
Finance  
CPAAC Member

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Optional Attendees:  
Representative from Regulatory Affairs

All proposed scope additions, deletions or changes will be screened by the New Work Screening Committee prior to being released to the Project Manager to execute with the following being considered:

- Confirm if the work order requires an outage to execute, if no outage is required the work will be rejected.
- Determine if the new work is considered to be operations or maintenance work and if Operations or Maintenance agrees to accept the work, the work order can be approved into scope and a CCF will be submitted if required.
- Determine if the work is to be executed by a Project, and if the project owner accepts the work, the work order can be approved into scope and the Project submit a CCF if required.
- Determine if an Action Request from Regulatory Affairs and ensure the screening process is followed with Operations or Maintenance or a Project accepting the work.
- Work Orders removed from scope with greater than 1,000 hours will be reviewed to determine if an action needs to be assigned by the Screening Committee for the Project to initiate a CCF to reduce budget.

If the Screening Committee can't come to an agreement on an owner for the work then the person / group sponsoring the work (typically the SCF initiator) will prepare a CCF and the CCB will assign the work to Project. Once the Project is assigned, the project will finalize the CCF and obtain appropriate approval.

Action items arising from the Screening Committee will be recorded in the Risk Management and Oversight Tool (RMO) using Meeting Source "New Work Screening Committee".

### 5.10 Change Control Board

Chaired by the Vice President, Refurbishment Execution, the Change Control Board (CCB) is a diverse group of individuals who are responsible for making the ultimate decision regarding project changes. The CCB considers the implications of changes that exceed a Project Managers authority, approves Tier 3 Milestone changes and refers significant new or changed scope to the Project Decision Meeting or if deemed necessary obtain concurrence of the Program Scope Review Board (PSRB) or Program Change Control Board (PCCB). See NK38-CORR-09071-0591482 for the Terms of Reference for the CCB.

Note that staffing and resource changes are not within the authority of the CCB. The CCB needs to assess these requests and either reject the change or recommend the change for approval to the PCCB.



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Action items arising from the CCB will be recorded in the RMO Tool using Meeting Source "Change Control Board".

When the need arises for urgent approval of a CCF, a fast track process to allow CCB members to vote via email has been developed, see Section 7.4 Decision.

#### **5.11 Project Decision Meeting (PDM)**

When significant new or changed scope requires a decision as to whether or not it should be included in the NR Program or be moved to Darlington Station for processing through their change management process, a Project Decision Meeting (PDM) will be held.

The chair of the PDM is the Vice President, Refurbishment Execution (or delegate) along with senior representatives from Refurbishment Operations & Maintenance and Station Engineering.

Meeting participants will consider the appropriateness and implications of adding new scope. The following considerations should be made when evaluating the proposed scope:

- The scope requires the reactor to be de-fueled/de-watered.
- The scope could significantly exceed normal outage durations.
- The scope could significantly extend normal outage durations.
- The scope has other overriding long term operational impacts to the Station.

If the PDM decides that the proposed change warrants further work by the NR Program, a sponsor will be designated to create a DRAS as appropriate.

#### **5.12 Options Review Board (ORB)**

In cases where there are multiple potential options to address new scope, and the option set does not provide a clear preferred option, an Options Review Board (ORB) will review each option and decide which will be pursued. The ORB is responsible for making an informed and business-conscious decision. The ORB is administered by NR Execution.

The ORB is chaired by the Vice President, Refurbishment Execution along with senior representatives from Operations and Maintenance, Engineering, Planning and Controls, Execution, Supply Chain, Finance and External Oversight.

The ORB is empowered to make decisions to progress work toward full definition. Cost implications require a CCF and approval via this Change Management Process.

#### **5.13 Program Change Control Board**

The PCCB, Chaired by the Vice President Planning and Controls is convened to approve significant Program level cost and schedule changes. The PCCB also approves all Program Contingency draws or returns and impacts to Tier 1 and 2

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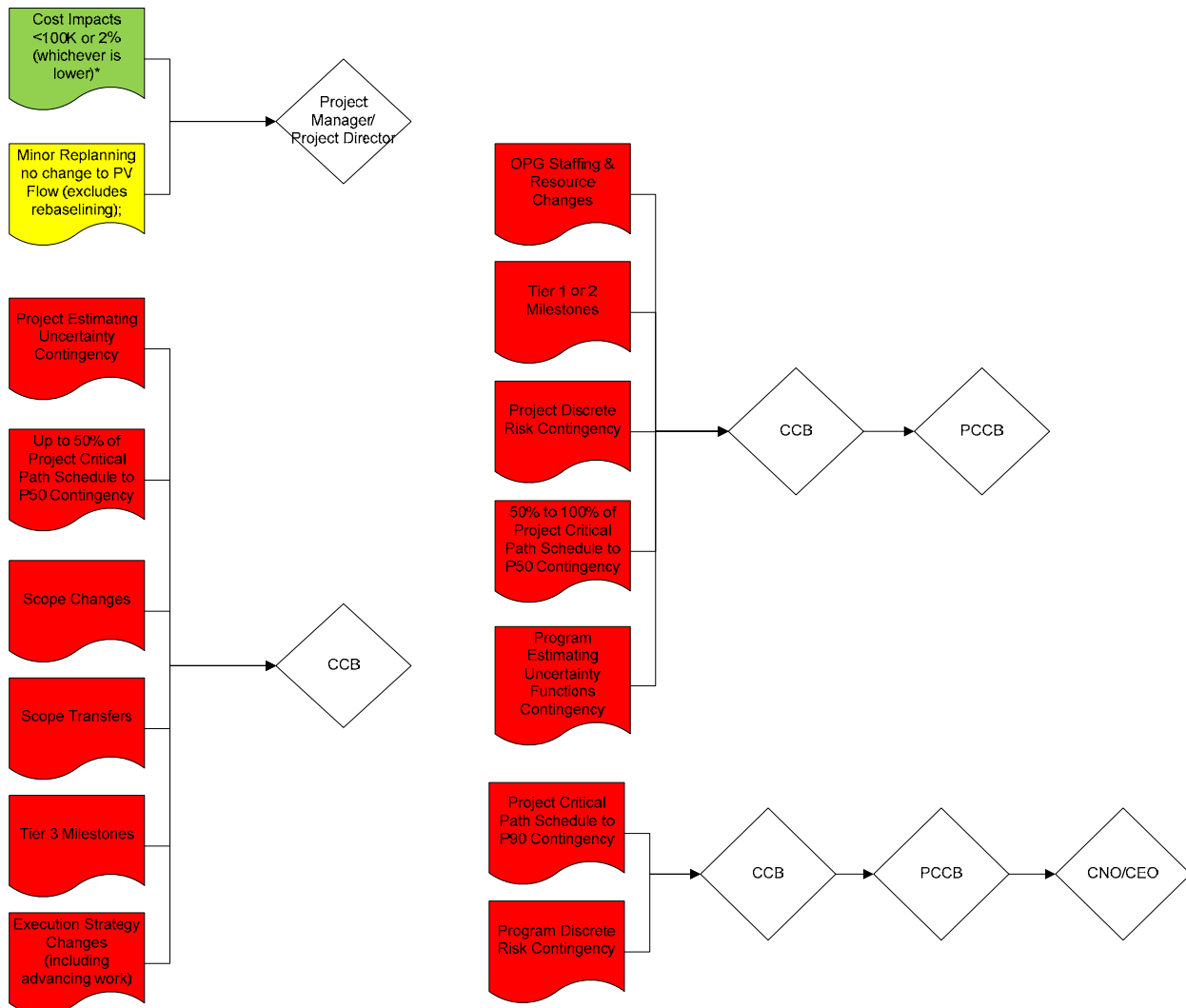
Milestones. See NK38-CORR-09071-0591416 for the Terms of Reference for the PCCB. The PCCB approves OPG staffing and resource changes.

Action items arising from the PCCB will be recorded in the RMO Tool using Meeting Source "Program Change Control Board".

## 6.0 CHANGE MANAGEMENT PROCESS

### 6.1 Change Decision Criteria

The Change *decision criteria* utilize GREEN, YELLOW, RED labels to identify the level of impact the change has on the project baseline, and consequently the level of approval required. The criteria are noted in the diagram below:



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Separate schedule criteria based on durations are not laid out as it is assumed that all schedule changes/delays will be translated to cost based on the *project burn rate* and the cost criteria applied.

#### **6.1.1 Green Changes**

GREEN changes are addressed within the level of authority of the project/function, an example is a change to contractor field execution work where an agreed alternate arrangement has been developed by the executing organization; a CCF will be entered for a GREEN change and will be tracked for trends. Green changes update the project forecast, but not the baseline. Green changes will be reviewed to ensure that they are accurately labelled as Green. For RFP approvals, Finance will accept an approved GREEN CCF as authorization for PO increases.

Adverse trends will be monitored by the Project Managers to ensure action is taken to correct, and submitted a RED CCF when required.

For small projects where the two percent threshold is not material, the Senior Vice President Execution has the authority to override the percentage and approve the change up to \$100K. Section 1 of the CCF completed with the amount initialled by the Senior Vice President Execution.

#### **6.1.2 Yellow Changes**

YELLOW changes are addressed within the level of authority of the Project Manager and Director within the envelope of the latest approved project's baseline. YELLOW changes will go through rigorous review and evaluation. YELLOW changes do not change the overall control budget. YELLOW changes can facilitate re-planning of future work within the same project budget (example cash flows). If there is an impact to field work, a scope change or a change in contracting, procurement or executing strategy the CCF is considered RED and must be approved by the CCB. The principles of not changing past and not changing solely for the purposes of correcting performance issues within the control of the project will be strictly enforced.

#### **6.1.3 Red Changes**

RED changes have a material impact on the Gate approved cost, schedule or scope. These include fundamental changes to Contracting Strategy, Procurement Strategy, Execution Strategy or Design Requirements and require a contingency draw or return. RED changes will go through rigorous review and evaluation. All scope changes, additions or transfer requests are considered to be RED changes that require significant review for impacts. All contingency draws are considered RED changes. The material cost impact threshold is considered:

<b>Projects &amp; Functions, the lower of</b>	<b>\$5M</b>	<b>10%</b>	<b>of the current approved baseline budget</b>
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The material schedule threshold is considered a revision to any of the Tier 1, 2 or 3 milestones as listed below (refer to N-MAN-00120-10001-SHT-06: Nuclear Refurbishment- Milestone Definition Framework):

Milestone	Description	Example
Program Tier 1	Milestones that are commitments to the Board or decisions at Board Level	Release Quality Estimate, and Unit Start/Finish Dates
Program Tier 2	Critical Impact Milestones normally documented in Phased based Program Business Case Summaries per Release Strategy	CNSC Approval of ISR
Program Tier 3	Program Controls, including the NR AIP Milestones and NR AIP Scorecard, Milestones that manage the health of the Program and keep it on track	All Projects Scope Freeze/Detailed Engineering Finished

Program Tier 1 and 2 Milestone schedule delays require approval by the PCCB.  
Program Tier 3 Milestone schedule delays require approval of the CCB.

Schedule impacts that do not impact on Tier 1, 2, or 3 milestones may also be considered to be a Red change if the cost impact of a delay reaches one of the cost thresholds listed above when taking the project burn rate into account.

The Schedule Change Control process is governed by N-MAN-00120-10001: SCH-11, DR Schedule Management Plan for Integrated Level 3 Execution.

Decision Type	Contingency				
	Impacts Forecast	Impacts Baseline or Cash Flow	Program	Project	Management Reserve
<b>GREEN</b>	Y	N	N	N	N
<b>YELLOW</b>	Y	MAYBE	N	N	N
<b>RED</b>	Y	MAYBE	Y	Y	Y

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### 6.2 Change Classification

The Initiator will choose a *Change Classification* from a drop down list. The following is a list of change classifications:

Classification			
1	Scope - OPG	9	Quality & Conformance - OPG
2	Scope - Vendor	10	Quality & Conformance - Vendor
3	Resources/Materials - OPG	11	Safety - OPG
4	Resources/Materials - Vendor	12	Safety - Vendor
5	Process & Communication - OPG	13	External Influence Nuclear Refurbishment
6	Process & Communication - Vendor	14	Refurb Program Strategy & Integration
7	Contract Management - OPG	15	Estimate Change - OPG
8	Contract Management - Vendor	16	Estimate Change - Vendor

Individual changes may not have an immediate significant impact on cost, schedule, or scope but they may be symptomatic of a larger problem that may cause more significant impacts in the future or may affect other projects. For example delay in or unavailability of a field service such as radiation protection, scaffolding or permitry may not cause a significant impact for one particular case if alternate work arrangement is possible; however future similar service issues could have much larger impacts if this trend continues and the systematic issues go unresolved.

Change classifications are assigned to all levels of changes to facilitate reporting on trends. Change classifications also have potential commercial implications related to contractor changes or claims.

### 6.3 Change Type

There are three (3) basic *Change Types*: *Forecast Change*, *Budget Change* and *Schedule Change*. The table below contains details of which categories are updated depending on the type of change:

Change Type				Contingency		
	Impacts Forecast	Impacts Schedule	Impacts Scope	Program	Project	Mgmt. Reserve
Forecast Change	Y	MAYBE	N	N	N	N
Budget Change	MAYBE	MAYBE	MAYBE	MAYBE	MAYBE	MAYBE
Schedule Only Change	N	Y	N	N	N	N

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### 6.4 Contingency Changes

The development of contingency amounts and time-phased planning and monitoring of contingency forecasts are governed by the Risk Management and Cost Management Sections respectively using N-MAN-00120-10001: RISK, Nuclear Projects Risk Management.

The Program Change Management process provides the structured framework and the mechanism to document, review and approve “draw” or “return” of contingency funds.

To facilitate tracking contingency usage, unused contingency must be returned to program contingency account using a CCF; it cannot be transferred between projects or bundles. The process of returning contingency does not apply to an underrun or savings realized on completed work.

Note that schedule contingency/float shall be reviewed for the impact on critical path, reference procedure N-MAN-00120-10001: SCH, Nuclear Projects Schedule Management.

The contingency management process for the DRP is incorporated in the project controls framework and focuses on early identification of risks and trends, active mitigation, forecasting, and contingency adequacy reviews in order to proactively manage the project estimate at completion.

Whenever possible, drawdown of contingency will be avoided by effectively managing and mitigating risks and trends including the use of favourable variances identified through project cost forecasting. When a risk or trend cannot be fully mitigated a drawdown of contingency will occur.

The following controls will be incorporated into the process for managing the drawdown of contingency:

All project changes, including scope, cost, and schedule, will be documented, reflected in the risk register and reviewed and dispositioned by the CCB.

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**6.4.1 Project Contingency**

Source	Approver	Approval Threshold
Estimating Uncertainty – Projects	SVP Refurbishment Execution	100%
Critical Path Schedule to Medium Confidence	SVP Refurbishment Execution	To 50% Consumption
	SVP Nuclear Projects	50% to 100% Consumption
Critical Path Schedule to High Confidence Duration	CNO and CEO	100%
Discrete Project Risks	SVP Nuclear Projects	100%

(1) Includes \$42 Million for Facility and SIO Projects

**6.4.2 Program Contingency**

Source	Approver	Approval Threshold
Estimating Uncertainty – Functions	SVP Nuclear Projects	100%
Discrete Program Risks	CNO and CEO	100%

All program contingency changes, including scope, cost, and schedule, will be documented, reflected in the risk register and reviewed and dispositioned by the CCB and PCCB.

In addition to the above approvals, the following controls will be implemented:

Any discrete risk resulting in an allocation of contingency greater than \$40 Million will require CNO and CEO approval. This aligns with the Organizational Authority Register (OAR) requirement for in-budget project investments.

Notification will be provided to the CNO and CEO on contingency draw downs that impact multiple units.

Any contingency allocation requiring CNO and CEO approval also requires CFO approval.

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Any low probability high consequence event that is outside the contingency determined for the project (e.g. Force Majeure, significant labour disruption, an international Fukushima Type Event) will be escalated to the DRC for approval. This may result in a revision to the DRP Business Case.

#### 6.4.3 Management Reserve

Management Reserve funding approval, if it becomes necessary, will require resubmission of the NR business case to the Board of Directors prior to approval in a CCF.

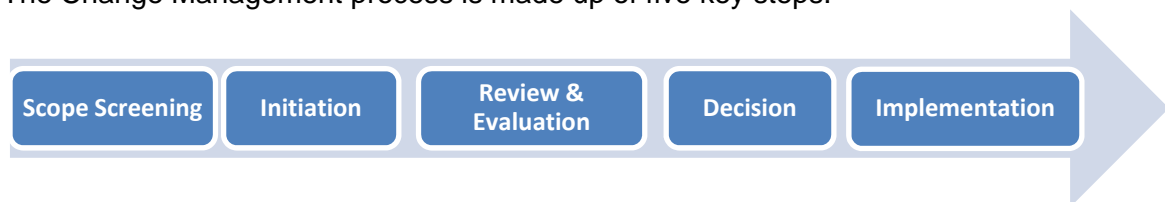
#### 6.5 CCF Approval Authority Level

The CCF approval authority level is based on the cumulative change impact of all GREEN, YELLOW AND RED CCFs, not incremental change. When a project is re-baselined, the cumulative approvals of remaining contingency apply to the re-baselined value and not to the original project baseline value. Example:

	Incremental Change	Cumulative Change	Total	Growth	Authority Level
Project Baseline			\$6,000,000		
CCF #1	\$550,000	\$550,000	\$6,550,000	9%	within PM Authority, <10% or \$5M of Project or Functional Baseline
CCF #2	\$400,000	\$950,000	\$7,500,000	15%	not within PM Authority, >10% or \$5M of Project or Functional Baseline

#### 7.0 CHANGE MANAGEMENT STEPS:

The Change Management process is made up of five key steps:



See Appendix D, Process Overview.

#### 7.1 Screening, Scope Changes/Additions

All proposed scope changes and additions initiated by creation of a new Work Order or work request will be screened daily by the New Work Screening Committee. The process of screening scope is further defined in Appendix B. The Project Manager accepts the scope change and initiates a CCF if required based on the criteria of this procedure for approval at the CCB. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.



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Significant new or changed scope will be referred by the CCB to the PDM and if approved, a scope sponsor prepares a DRAS for budget approval by the PSRB. In cases where there are multiple potential options to address new scope, the ORB will review the options and decide which will be pursued.

## 7.2 Initiation

The initiator starts the process with a CCF. Refer to Appendix E for an example of a CCF with instructions for completing the form.

For GREEN changes, the initiator completes Section 1 of the CCF. Section 1 provides the minimum information required to register a change for trending. GREEN changes are reviewed and if agreed to be GREEN go directly to Implementation. The output of Implementation for a GREEN change is trending metrics.

For RED or YELLOW changes, the initiator completes **all** Sections of the CCF, **no blank fields will be accepted**.

All required data on the CCF must be completed and the following supporting documents are required as applicable:

- Business rationale or justification for the requested change.
- Technical supporting documents if applicable.
- Cost Estimates prepared by OPG and/or Contractors in sufficient detail to allow review, including hours, rates, quantities and assumptions. Contractor estimates are reviewed and validated by P&C Estimating Department.
- Identify the change impact on project interest and include in the cost estimate.
- A resource loaded schedule with affected activities and Critical Path impacts listed if applicable.
- Identify impacts to the Work Breakdown Structure (WBS) including to the overall Program WBS if applicable.
- Identify impacts to the Risk Register, including listing any additional risks, closed risks, changes in impacts on probability, schedule and cost and mitigating actions required.
- A listing of the Work Packages affected by the proposed Change in the required in the following format:

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Work Package ID	Work Package Title	Original Budget	Approved Changes	Control Budget	Pending Changes	Control Budget + Pending Changes

- Identify impacts to Contingency.
- Identify the impact to the Project Life Cycle Estimate at Completion (EAC), provide a definitive EAC and compare to the Control Budget.
- Any other relevant supporting documents that facilitate review and evaluation of the change.

The CCF is a stand-alone document subject to audit and significant scrutiny, all documentation must be attached.

### 7.3 Review and Evaluation

The CCF is reviewed to ensure that an adequate amount of information and backup to fully support the proposed change is included as listed in Section 7.2 and that all required fields of the CCF are completed and correct. The evaluation of the impacts of change is integral to the success of a Project.

If required, the CCF is routed to the appropriate functional department or subject matter experts to perform an independent evaluation of the impacts of the change. Impacts that must be evaluated are:

- Cost
- Schedule
- Scope
- Basis of Estimate
- Estimate at Completion
- Risk

Project or vendor basis of estimates must be evaluated by the P&C Estimating Department. For estimates less than \$500K, allow two working days for review. For estimates greater than \$500K or of a complex nature, allow five working days. NR Estimating complete the "Estimate Review" section of the CCF.

Other Impacts to consider, but not limited to, are:

- Nuclear Safety
- Conventional Safety
- Environmental
- Union Jurisdiction
- Commercial
- Design

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- Work and Radiation Permits
- Decontamination
- Material Handling and Storage
- Work support activities

The key outputs of the Review and Evaluation of a CCF are:

- Independent written feedback regarding the identified impacts.
- Recommend action to the approving authority.

Outputs of evaluation are attached to the CCF as backup documentation.

### 7.4 Decision

The core expectation of this procedure is that change is managed at the lowest level of the organization that has the authority to do so and that change that has a significant potential impact on project or program scope, cost and schedule is reviewed in detail and the recommended direction is approved at the required level. Approval is based on the decision criteria applied in section 6.1.

#### 7.4.1. Change Control Board

The CCB is Chaired by the Senior Vice President, Nuclear Refurbishment (or delegate) and scheduled as/when required. The CCB may also refer a change for additional approval as required. The CCB approved change within their authority. The CCB recommend to the PCCB OPG staffing and resource changes.

#### 7.4.2. Program Change Control Board

The Program Change Control Board (PCCB) Chaired by the Vice President, Planning and Controls is scheduled as/when required. The PCCB convenes to approve significant Program level cost and schedule changes that require additional approval. The PCCB approve OPG staffing and resource changes.

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#### 7.4.3 CCF Fast Track Process

Due to the nature of construction projects and the need to process urgent changes that impact field work, a Fast Track process exists for urgent CCF's:

Step	Description	Responsible	Notes
1	Prepare CCF and Supporting Documentation	Project Manager	The Fast Track CCB processes will require quality CCF form, with supporting documents.
2	Assess if fast track process is required	Planning & Control Lead	Criteria for Fast Track: - Immediate impact to field work - Is not caused by poor planning
3	Concur that the fast track process is applicable.	Unit Director (Work Control)	Email: Project, Unit Director, Copy Change Administrator
4	If #3 = NO, CCF will be submitted via the regular CCB process and schedule	Planning & Control Lead	Register for next CCB
	If #3 = YES, Review CCF for quality, then prepare for a email-based voting process.	Change Administrator	Voting email to CCB members, copy Project Manager to respond to questions.
5	CCB Vote	Change Control Board	Upon approval, the results will be communicated and the change recorded in cost management system.

It should be noted that the Project Control Centre (PCC) has the authority to approve changes in the field in emergency situations and the change paperwork will be submitted after the fact.

Expectation is that turn-around time for fast track is to be less than 5 business days.

#### 7.5 Implementation

The final decision and disposition of a CCF will be communicated to all stakeholders listed on the CCF. The status of a CCF will be changed to "approved" once all actions are completed.

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The following systems and tools shall be updated, as applicable and verified updated by the P&C Lead:

ACTION	RESPONSIBLE
Budget cost and cash flow ("PV") baseline Proliance	NR Cost Management Section
Schedule baseline plan in Primavera P6	NR Schedule Management Section
Risk Management and Oversight (RMO) database	NR Risk Management Section
Project Management Plans	Project Managers, or designate
Contracts/Purchase Orders with Suppliers	Supply Chain
Update Change Register	NR Cost Management Section
Update IDB Data Sets	Data Stewards

## 8.0 CHANGE REGISTER

A Change Register will be maintained in the Cost Management system by the P&C Cost Management Section to record the sources of change, track and monitor status and provide inputs for key change related metrics.

The following are maintained in the Change Register:

- (a) Change Identification
- (b) Date Initiated
- (c) Change Type
- (d) Resultant Change Status
- (e) Action By (Submitter, Approver, Rejecter)
- (f) Approve/Reject Comments
- (g) Disposition Date (date approved or rejected)
- (h) Cost
- (i) Total Milestone Variance Days

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### 9.0 METRICS AND REPORTING

The data compiled in the Change Register will be used to generate Program and Project metrics. Metrics will be generated on a monthly basis and include statistics such as:

- (1) Number initiated
- (2) Number Approved
- (3) Number Rejected
- (4) Change Classification Trends
- (5) Contingency Drawn Percentage
- (6) Remaining Contingency value
- (7) CCF Cycle Time

A Station Condition Report (SCR) shall be created for adverse trends identified from GREEN change pattern analysis if applicable. The intent of the SCR is to put in place corrective actions that are consistent with the consequences involved.

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### 10.0 DEFINITIONS

A comprehensive listing of P&C Terms, Acronyms and Definitions are provided in N-MAN-00120-10001 PC-16. Acronyms and definitions used in this document are summarized below.

Term/ Acronym	Definition
Baseline	See Performance Measurement Baseline
Change	For the purposes of this procedure, a change is any deviation from an approved plan or procedure that results in a real or potential impact on project or program cost or schedule.
Change Classification	Used to differentiate the reasons for a change to facilitate trending analysis.
Change Control Form (CCF)	Change Control Form N-FORM-11252; used to document changes for trending and approval purposes.
Change Management Process	Change Management is the Project Management process (including the supporting tool) that provides a framework to identify and record changes in cost, schedule and or scope against the approved baselines.
Comprehensive Work Package (CWP)	A CWP is a collection of all necessary information required to complete the field implementation of construction work. It provides a systematic approach to completing the installation while taking into account nuclear, conventional, radiological and environmental safety.
Decision Criteria	RED, YELLOW or GREEN labels applied to differentiate the severity of a change so that the right risk-based change management controls are applied.
Executing Organization	The Project Team, OPG Function or Contractor's organization executing the scope of work.
Forecast	Forecast represents the projected cost of the Work Package, including any pending changes yet to be approved.
Integrated Data Base (IDB)	IDB is Nuclear Refurbishment's data repository where integration and mapping occur. Information is pulled into IDB for the purpose of integration, mapping, data quality analysis, data integrity, and reporting.
Performance Measurement Baseline (PMB)	<p>The Performance Measurement Baseline is the Project scope, cost and schedule approved during the Gated process for Project and Bundle Releases</p> <p>The approved budget and schedule allocated to Work Packages indicate cost and schedule performance which will be measured against Current Budget in the Cost Management System and the Project Baseline Schedule.</p> <p>The Performance Baseline will be established for both Cost and Schedule:</p> <ul style="list-style-type: none"> <li>Project Performance Baseline – Will be established at each Gate.</li> <li>Functional Performance Baseline – Will be established at each Release</li> </ul> <p>The Performance Measurement Baseline will not include:</p> <ul style="list-style-type: none"> <li>Contingency</li> <li>Management Reserve</li> </ul>

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Term/ Acronym	Definition
Program Baseline	The aggregate planning efforts during Definition Phase will converge to an overall Program Plan at Release 5, or Release Quality Estimate (RQE). This is the point when the majority of projects have sufficiently defined their execution strategies, cost, schedule and scope that will allow an overall Program Baseline to be set. The Program Baseline will be maintained and actual cost versus budget monitored.
Program Integrated Master Schedule (PIMS)	The Program Integrated Master Schedule is the Level 1 schedule controlled by OPG senior management and contains all control accounts from all projects, OPG functional as well as for program management work.
Program Milestone Schedule (PMSS)	The Program Milestone Schedule is the Level 0 schedule controlled by OPG senior management.
Program Tier 1 Milestone	Program tier 1 milestones are milestones that are commitments to the Board or decisions at Board Level.
Program Tier 2 Milestones	Program tier 2 milestones are milestones that are critical to the Program, normally documented in Phased based Program BCS's per Release Strategy.
Program Tier 3 Milestones	Program tier 3 milestones are milestones that manage the health of the Program and keep it on track
Project burn rate	The cost a project incurs on a daily or weekly basis as a result of overheads, direct expenses (e.g. equipment rental) and labour.
Program Work Breakdown Structure (PWBS)	The Program Work Breakdown Structure is a hierarchical decomposition of the entire scope of work to be executed by the program team to accomplish the program deliverables.
Scope	Within the context of this document scope refers to the data sets that are used to manage projects and the Darlington Refurbishment Program. These include for example, Darlington Scope Requests, Engineering Changes, Work Orders, <i>Comprehensive Work Packages</i> , Construction Completion Declarations (CCDs).
Work Breakdown Structure (WBS)	A hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables. The main purpose is to breakdown the scope of work into more controllable components and to identify responsible organizations for the completion of all components.



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### 11.0 REFERENCES

#### 11.1 Performance References

- [R-1] N-MAN-00120-10001-PC: Project Controls
- [R-2] N-MAN-00120-10001-GRB: Nuclear Projects Gated Process
- [R-3] N-FORM-11252: Change Control Form
- [R-4] NK38-PLAN-09701-10003: Darlington Refurbishment Program – Program Scope Review Board – Terms of Reference
- [R-5] N-MAN-00120-10001: RISK, Nuclear Projects Risk Management
- [R-6] N-MAN-00120-10001:SCH-06, NR Milestone Definition Framework
- [R-7] N-MAN-00120-10001: SCH, Nuclear Projects Schedule Management
- [R-8] N-PROC-AS-0042: Quality Assurance Records
- [R-9] N-PROC-AS-0003: Controlled Document Management
- [R-10] OPG-STD-0017: Organizational Authority Register
- [R-11] N-PROC-RA-0022: Processing Station Condition Records
- [R-12] N-MAN-00120-10001: SCH-11, DR, Schedule Management Plan for Integrated Level 3 Execution.

#### 11.2 Developmental References

- [R-13] A Guide to the Project Management Body of Knowledge, 5<sup>th</sup> Edition (PMBOK Guide)
- [R-14] Managing Change in Organizations, PMI Practice Guide
- [R-15] Total Cost Management Framework: An Integrated Approach to Portfolio, Program, and Project Management, 1<sup>st</sup> Edition, Revised (TCM)
- [R-16] Project Control Handbook, September 2004 U.S. Department of Energy

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## Appendix B: Scope Change/Addition Screening Process

For the purposes of this document, "Project Manager" represents the Project Manager, Maintenance or Functional Manager who holds the budget to execute the work.

During Refurbishment execution, all requests for new scope will be handled through Asset Suite through the OMS Work Order Approval Process. A New Work Screening Committee (Screening Committee) will review work requests on a frequency depending on the volume received and categorize the work as to either execute during the Refurbishment outage or deferred as post-breaker close work.

For all types of new work orders not linked to current projects, consideration of the impacts of union jurisdictional issues and the Chestnut Park Accord Addendum (CPAA) work assignments should be made, reference file NK38-CORR-09701-0408278-T10. The CPAA Committee is available to assist with this impact assessment (contact Dan Smith dan.smith@OPG.com).

### 1.1 Emergent Work

#### Non-Project Emergent Work

Emergent work categorized as Refurbishment by the Screening Committee and accepted by the Project Manager will be added to OMS and dispositioned by the Outage Manager as being an Available for Service requirement. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

Significant new or changed scope will be referred by the CCB to the PDM and if approved, a scope sponsor prepares a DRAS for budget approval by the PSRB.

#### New Work Team - Fix It Now (FIN)

If the emergent work requires immediate action due to station conditions, the Outage Manager (pre-breaker open) or the PCC (post-breaker open) will assign the work to the FIN Team.

The FIN team is a multi discipline team that reports to Director of NR Operations & Maintenance, which will support the Unit Director. The team will act as "first responders" for emergent work on the unit where repairs are required on Operating Systems not in the control of an EPC vendor.

Work Orders for urgent work generated from the FIN process must be accepted by the Project Manager the next business day. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

Work Orders that cannot be completed by FIN process will be prioritized, planned and integrated with appropriate windows in the outage schedule with the acceptance of the Project Manager.

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#### Project Emergent Work

Individual projects will manage their own project schedule and plan in P6, but these plans will interface with the Outage execution integrated schedule.

Additional work may be added to scope though the Screening Committee, CCB or PDM. The work must be characterized (mandatory or nice-to-have) based on work in progress, schedule and cost. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance.

#### **1.2 Cyclical Outage**

The Cyclical portion of the Refurbishment will be executed by the Refurbishment organization using Asset Suite and will follow the Refurbishment Planned Outage Management milestones and planning process.

#### Cyclical Scoping

Cyclical scoping will require a collaborative effort of Station & NR Engineering, Operations, Maintenance and Work Control. Accountability is maintained by Unit Director (NR Work Control). The Cyclical Scope selection will include the following:

##### Must Do:

- Station License or Regulatory Requirements.
- Testing/inspections required for normal shutdown and start-up of the Unit.
- Mandatory Inspections due during the Outage Period.

##### Need or Want To Do:

- Life Cycle Management inspections or Maintenance as required to facilitate RTS (Return to Service) expectations.
- Preventative Maintenance, Deficient Maintenance (DM) and Corrective Maintenance (CM) Work Orders as requested to achieve RTS expectations. These will be a subset of: PRL (Plant Reliability List) Work to Improve Unit Reliability, Reduce Forced Loss Rate, Station Cycle Plan Support and Operating Backlog Targets Support.
- Cyclical outage scoping strategy will consider scope that can be proven to add value to the station operations in future by improving maintenance method saving costs on outages, optimizing resources or improving operations. Replacement of components which due to scale of work makes economic sense.
- Operator Burden and Operator Work-Around elimination.

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This work is assigned to the Project Manager by the Screening Committee. The Project Manager confirms the correct project has been assigned and, if required, raises a CCF upon acceptance. If the Project Manager does not accept the scope, a new scope sponsor must raise the CCF for approval at the CCB.

**Note:** The cyclical scoping process cannot be used to circumvent the CCF or DSR/DRAS process.

#### Cyclical Schedule

The Unit Director is accountable for the preparation of cyclical schedules that will include all cyclical outage approved scope (Operations & Maintenance work orders, from breaker open to closed, required to allow operation until the next planned outage, D2221).

The cyclical outage schedule will include Operations I RTS detailed shutdown and return to service activities. Additionally, this schedule shall be reviewed for horizontal and vertical integration with the IL3 (Integrated Level 3) and CCL2 (Coordination and control level 2) schedule. Refer to N-MAN-00120-10001-SCH-11 (Darlington: Schedule Management Plan for Integrated Level 3 Execution) for more details on IL3.

The cyclical outage scoping process is initiated following the last planned outage prior to the start of the unit as per the Work Management Ownership Transfer Plan (NK38-PLAN-09701-10113-WM-01).

### 1.3 Major Scope

Significant new or changed scope will be referred by the CCB to the PDM and if approved, a scope sponsor prepares a DRAS for budget approval by the PSRB. In cases where there are multiple potential options to address new scope, the ORB will review the options and decide which will be pursued.

Major program scope changes referred to the PSRB by the CCB or PDM follow the Darlington Nuclear Program Scope Control, NK38- INS-09701-10001.

### 1.4 New Projects and Station Sponsored Work

During the time period when NR is the scheduling authority, the Station may desire to have work (new scope) performed on the unit. Since there is only one schedule to perform work in the Refurbishment unit, all Station or Projects & Modifications work groups must ensure their tasks are approved and shown on the Refurbishment schedule once approved.

New scope identified at the Screening Committee requires a scope sponsor who prepares a CCF for approval at the CCB. Significant new or changed scope will be referred by the CCB to the PDM and if approved a DRAS for budget approval by the PSRB is required. In cases where there are multiple potential options to address new scope, and that option set does not provide a clear

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preferred option, an Options Review Board (ORB) will review each option and decide upon which of the options will be pursued.

#### **1.5 Decision Escalation (Appeal) Process**

In the situation where a scope addition or change has been rejected by the Project Manager, a request can be made to escalate the decision to the CCB and PDM.

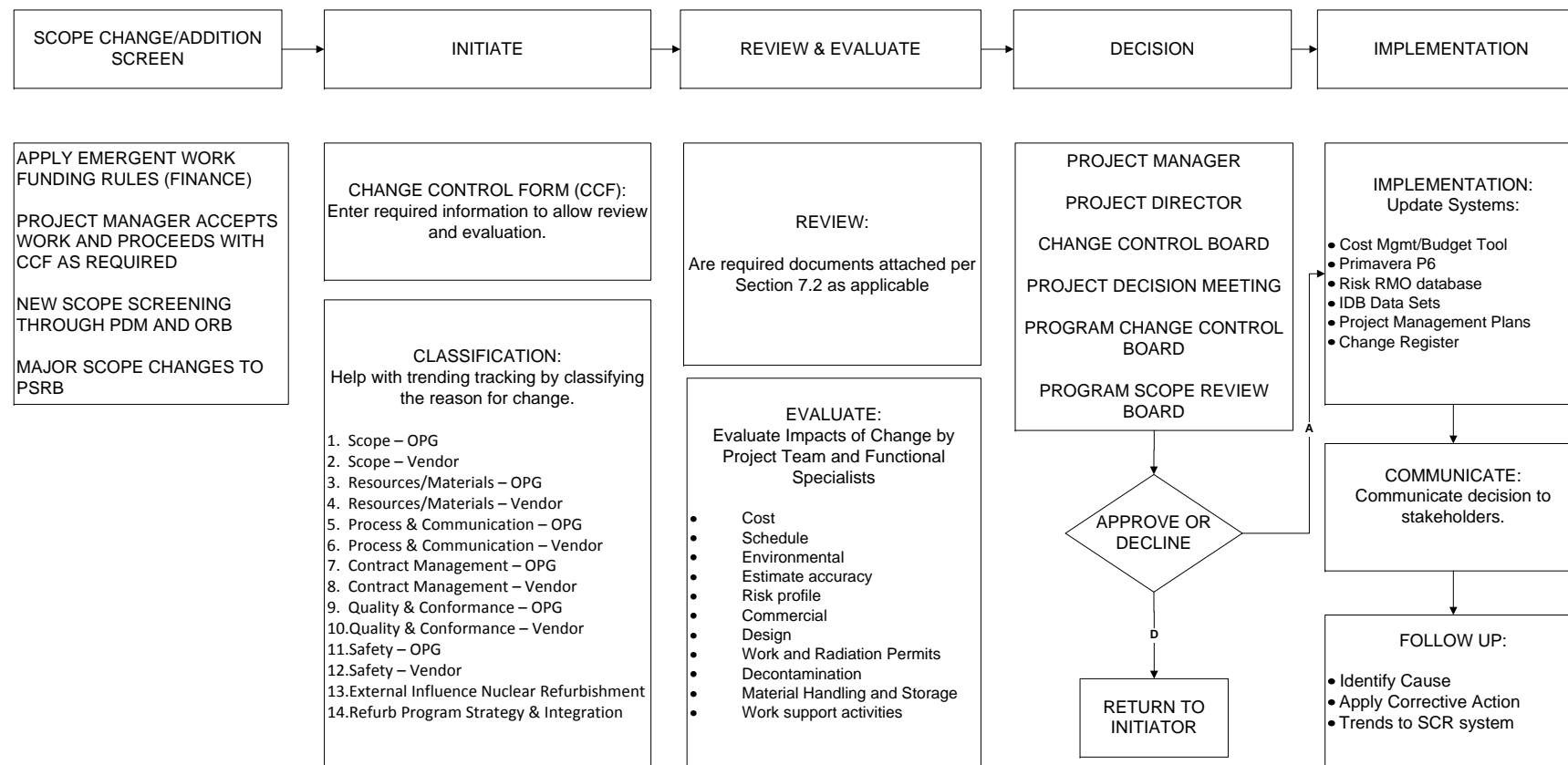
In the situation where a scope addition or change has been rejected by the CCB, a request can be made to escalate the decision to the PSRB. In such cases, a written request by the Sponsor must be made to the Chair of the PSRB with rationale. The PSRB chair will arrange an ad hoc PSRB meeting to consider the request.

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### Appendix C: Process Overview



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### Appendix D: Example of CCF



Records File Information: 6  
years after project close  
Management for File

Internal Use Only

N-FORM-11252-R004\*

Nuclear Refurbishment Change Control Form

Management for File Internal Use Only N-FORM-11252 003 **Nuclear Refurbishment Change Control Form N-MAN-0012-100001-PC-12 Program Change Management**  
**TO VIEW OR HIDE INSTRUCTIONS FOR FORM COMPLETION GO TO: START, WORD OPTIONS, DISPLAY, HIDDEN TEXT-CHECK BOX.**

Date: (YYYY-MM-DD) \_\_\_\_\_

CCF #: \_\_\_\_\_

#### SECTION 1: INITIATE

<b>Project No.:</b>	12345	<b>Project Title:</b>	Nuclear Work
<b>Initiator:</b>	Your Name	<b>Initiating Organization</b>	Your organization (example P&M)
<b>Change Title:</b>	<p>A brief title that is descriptive of the change:</p> <p>Prefix + Short Title</p> <p>Prefix include: Scope Transfer, Scope Addition, Scope Change, Scope Deletion, Contingency Drawdown, Contingency Return, etc....</p>		
<b>Description:</b>	<p>A key component for the evaluation of a CCF is the description of the change. A quality narrative aids in the approval and trending of the CCF.</p> <p>In a quality narrative, initiators need to explain what has changed and how the work is being managed to minimize impacts. Demonstrate that corrective actions are being taken and that SCR's, OPEX and Lesson Learned are being completed where necessary. Demonstrate that project risks are being reviewed with mitigation action plans in place. Discuss the state of contingency and this CCF's impact on contingency.</p> <p>A list of work packages being impacted by the change is not a description of change. Avoid explanations such as "poor estimate", changes are variances against an estimate that contained assumptions, explain what changed in the assumptions.</p> <p>Generic Format:</p> <p>#. HEADING</p> <p>&lt;Insert Narrative&gt;</p> <p>&lt;Insert Statement&gt;, confirmed by &lt;insert name and position&gt;. [See attachment X]</p> <p>1. BACKGROUND</p> <p>Narrative of how the change came to fruition.</p> <p>Explain stakeholders involved</p> <p>Explain who determined that a change was required.</p> <p>If fasttrack is sought: attach Unit Director concurrence email</p> <p>2. DESCRIPTION OF CHANGE</p> <p>Describe what the change is.</p> <p>Describe the situation before RQE</p> <p>Describe the situation after RQE.</p> <p>3. SCOPE IMPACT</p> <p>Using scope included in RQE as a basis, describe if the change involves a change in scope that deviated from the assumption made at RQE.</p> <p>Describe the scope change, if one exists.</p> <p>If no scope change is involved, state what the current scope is and that it has not changed.</p> <p>If it's a scope transfer, state who is taking over and whether or not it's committed.</p> <p>Suggest to seek confirmation from, if applicable:</p> <p>DA or Design Mgr (Design related)</p> <p>Unit Director (Scope related)</p> <p>4. COST IMPACT</p> <p>State RQE budget of Project.</p>		

\*Associated with N-MAN-0012-100001-PC-12, Program Change Management

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	<p><i>State impact to RQE budget of Project as a result of this change</i>  <i>State what deliverables the extra budget is paying for.</i>  <i>State why extra funds is/is not required.</i></p> <p><i>Suggest to seek confirmation from, if applicable:</i>  Cost Mgr (NR,NP)</p> <p><b>5. BASIS OF ESTIMATE of CHANGE</b>  <i>Discuss the results of the review and push back/cost mitigation attempts on OPG/Vendor estimates</i>  <i>Seek confirmation if applicable from,</i>  NR/NP Estimating (Section 2)</p> <p><b>6. RISK DESCRIPTION</b>  <i>Risk realized, quote risk number:</i>  <i>Risks generated as a result of this change:</i>  <i>State cost uncertainty assumptions at RQE.</i>  <i>State any changes in cost uncertainty assumptions.</i></p> <p><i>Suggest to seek confirmation from, if applicable:</i>  NR/NP Risk Section</p> <p><b>7. SCHEDULE IMPACT</b>  <i>State what the schedule impact is (even if none).</i>  <i>State impact to other bundle or functions' schedules</i>  <i>State impact to program critical path or project critical path.</i>  <i>State who will be monitoring the schedule of this change</i></p> <p><i>Suggest to seek confirmation from, if applicable:</i>  Scheduling section, work control</p> <p><b>8. COMMERCIAL/CONTRACTUAL IMPACT</b>  <i>State if change impacts contractual terms and conditions</i>  <i>State any PCAs pending this approval.</i></p> <p><i>Suggestion to seek confirmation from, if applicable,</i>  Contract Management, Supply Chain</p> <p><b>9. ADD OTHER HEADINGS HERE AS REQUIRED</b></p>				
<b>Reason:</b>	<p><i>The reason or cause of change should provide approvers with sufficient information to understand the business reasons of the change or the operational reason for change.</i></p> <p><i>Example of a business reason is scope change required due to an EC and an operational reason is an organizational change that requires a baseline adjustment.</i></p> <p><i>Other questions to consider:</i>  <i>Was there a risk being mitigated because of this change?</i>  <i>Did we save money because of this change?</i>  <i>Did we relieve schedule pressure because of this change?</i></p>				
<b>Classification:</b>	Choose an item. Select Classification from drop-down menu.	<b>Level:</b>	Choose an item. Select Level from drop-down menu.	<b>ROM \$K:</b>	Enter Rough Order of Magnitude \$ Impact

**SECTION 2: REVIEW & EVALUATE**

<b>COST IMPACT (ATTACH WORK PACKAGE CHANGE REPORT):</b>	Provide a narrative on cost impact of the change and if a rebaseline request, the reason a cost rebaseline is required. Only approved if a major change in execution strategy, or multiple changes making the baseline no longer effective for the purposes of earned value. ATTACH WORK PACKAGE CHANGE REPORT.	
Is a re-baseline of the Planned Value being	YES <input type="checkbox"/>	NO <input type="checkbox"/>

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requested for this change?		
----------------------------	--	--

<b>ESTIMATE AT COMPLETION IMPACT:</b>	<i>Provide a narrative on the impact to the current approved EAC, currently Release Quality Estimate.</i>		
Is the EAC impacted by this change?	YES <input type="checkbox"/>	NO <input type="checkbox"/>	EAC \$:

<b>SCHEDULE IMPACT:</b>				<i>(Ensure Schedule is Updated)</i>	
Milestone/ Work Package ID	Description	Approved Date (mm/dd/yyyy)	Forecast Date (mm/dd/yyyy)	Requested Date (mm/dd/yyyy)	Variance Days
					0
					0
					0
					0
					0

<b>SCHEDULE REBASELINE IMPACT:</b>	<i>Provide a narrative on the impact to schedule, if a rebaseline request the reason a schedule rebaseline is required. Only approved if a major change in execution strategy, or multiple changes making the baseline no longer effective for the purposes of earned value.</i>		
Is a re-baseline of the schedule being requested for this change?	YES <input type="checkbox"/>	NO <input type="checkbox"/>	

<b>RISK IMPACT:</b> <i>Provide a narrative on risk realized or new risks due to this change.</i> <i>(Ensure RMO tool is Updated)</i>		
Risk ID	Description	Impact
123456	Risk Description from RMO	

<b>OPG/VENDOR ESTIMATE REVIEW:</b>	
Estimate Validation Required?	YES <input type="checkbox"/> NO <input type="checkbox"/>
AACE Estimate Class:	Estimate Accuracy Level:
Value of Vendor Estimate: \$	
Value of NR Estimating Estimate: \$	N/A <input type="checkbox"/>
Notes:	
	NAME DATE
PREPARED BY:	
REVIEWED BY:	

<b>REVIEW &amp; EVALUATION ISSUES/NOTES:</b>

**SECTION 3: DECISION**

Title	Name	Signature	Date (YYYY-MM-DD)	Approve	Reject
Initiator:					
Project Manager:				<input type="checkbox"/>	<input type="checkbox"/>

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Project Director:				<input type="checkbox"/>	<input type="checkbox"/>
CCB (Chair):				<input type="checkbox"/>	<input type="checkbox"/>
Additional Approvals:				<input type="checkbox"/>	<input type="checkbox"/>
Is a re-baseline approved for this change?		YES <input type="checkbox"/>	NO <input type="checkbox"/>		
Decision Notes:					

**SECTION 4: IMPLEMENTATION**

IDB:	<input type="checkbox"/>	RMO TOOL:	<input type="checkbox"/>	iTWO:	<input type="checkbox"/>
MPL:	<input type="checkbox"/>		<input type="checkbox"/>	P6:	<input type="checkbox"/>
ECOSYS:	<input type="checkbox"/>		<input type="checkbox"/>	AS7:	<input type="checkbox"/>



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**DARLINGTON REFURBISHMENT PROGRAM QUALITY SURVEILLANCE GUIDE**

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## Darlington Refurbishment Program Quality Surveillance Guide

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**Revision Summary**

Revision Number	Date	Comments
R000	2015-09-30	Initial issue.



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## Records Table

The following Records may be generated by use of this document and shall be registered in the appropriate document management system in accordance with the following table:

Record Created	Associated Form or Template Number	QA Record? Y/N	Filing Information/Retention (AIMS Type/Sub-Type)
Quality Surveillance Plan		N	Approved Quality Surveillance retained in the local files of Quality Management
Quality Surveillance Report		N	Recorded in the RMO Tool

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### 1.0 PURPOSE

This document provides the required guidance in planning and conducting quality surveillance activities for the Darlington Refurbishment Program (DRP). It is prepared as part of implementing the Darlington Refurbishment Program Quality Plan (NK38-NR-PLAN-09701-10001). The Quality Plan takes its authority from the Darlington Refurbishment Program Charter (D-PCH-09701-10000), which is linked to the Nuclear Management System.

Quality surveillance will be performed to provide added assurance that the completion of activities at different phases of the project such as Shutdown Lay-up, Engineering, Construction, Commissioning, "Available for Service", Unit Readiness, and Closeout meets the specified requirements. It also assures configuration management oversight is maintained throughout the project phases. Surveillance includes activities performed as part of Engineering Modifications as well as Non-Modification activities such as Maintenance and Inspection.

Quality surveillance activities will be performed utilizing a **graded risk based approach** that will focus on:

- 1) Safety significant items
- 2) Regulatory items (including Safety Improvement Opportunities (SIOs), and Integrated Implementation Plan (IIP), and
- 3) Other production and reliability project items

The following set of principles will be applied on the selection of surveillance activities:

1. Review of work conducted by Contractors based on Contractor performance.
2. Review of nuclear safety significant items and Regulatory items such as Licence Conditions Handbook (LCH) requirements.
3. Review of items critical to Operation.
4. Review of both Contractor and OPG performed work.
5. Review of completed and in-progress items to show rate of progress and configuration management.
6. Validation of Quality Management Guidelines.
7. Review of modification and non-modification work.
8. Review of IIPs, SIOs, and Environment Assessment items.

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Currently there are several governing and supporting documents associated with the DRP that discuss oversight and oversight plans in different functional areas. For example:

- N-STD-AS-0030, Project Oversight Standard
- N-MAN-09701-10002, Nuclear Refurbishment Project Oversight
- N-INS-09701-10007, Project Oversight Planning and Implementation
- N-GUID-09701-1000, Guideline for Engineering Oversight
- N-GUID-09701-09701-10120, Guideline for Construction Oversight
- N-MAN-01983-10000, Field Engineering Quality Control Manual.
- N-LIST-01300-10000, Bounded Document Set
- N-COI-00120-00001, Contractor /Owner Interface Requirements for Nuclear.
- N-GUID-09701-10022, Supply Chain Oversight.

The above documents discuss surveillance activities as part of respective Project Oversight Plans. To ensure compliance and completeness of key requirements throughout each phase of DRP, a continuous quality surveillance process is required as described in this guide.

A schematic of the Darlington Refurbishment Program (DRP) Quality Surveillance Planning and Execution process is given in Figure 1.

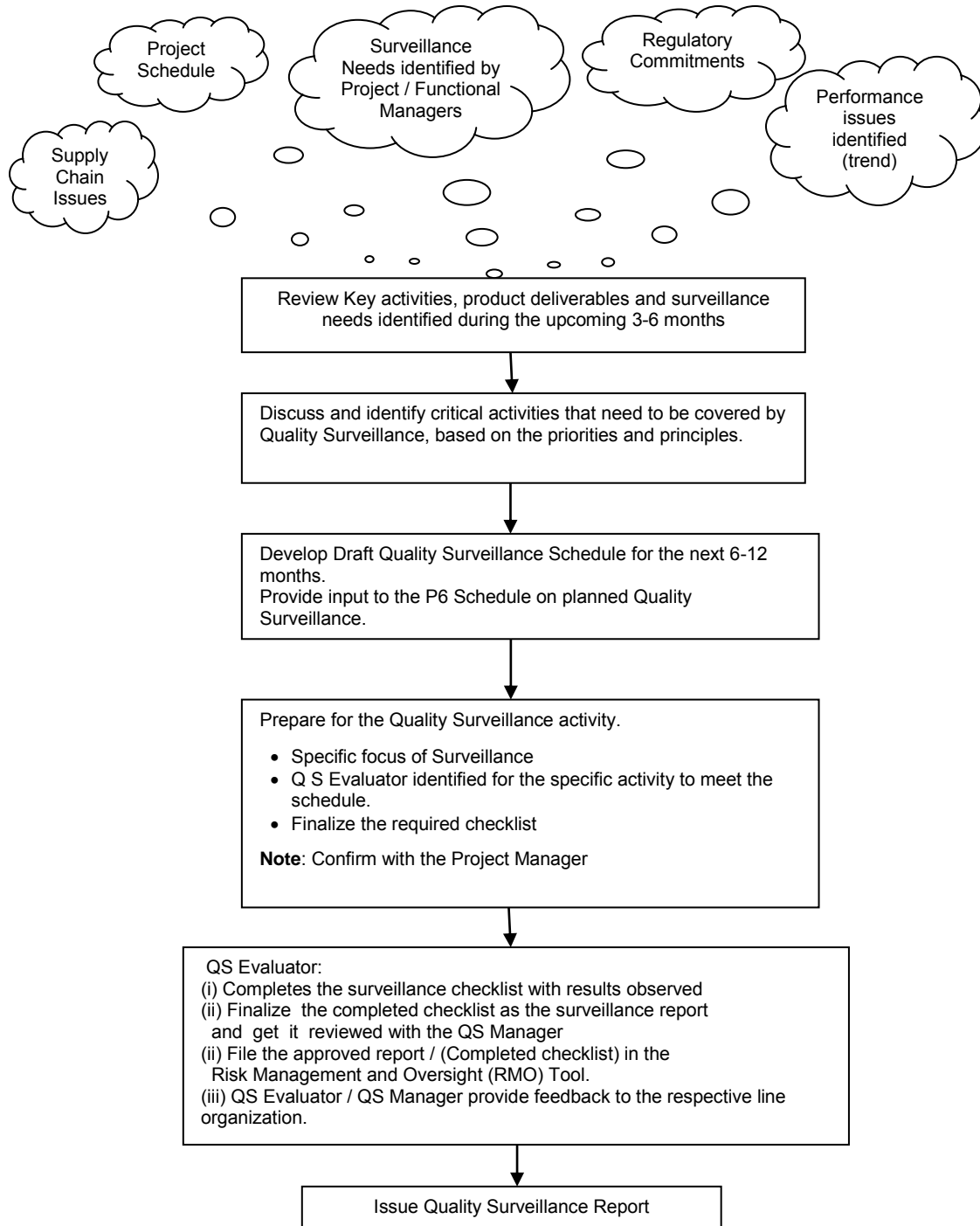
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**Figure 1: Schematic of DRP Quality Surveillance Planning and Execution**



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## 2.0 ROLES AND RESPONSIBILITIES

### 2.1 Director Quality Management

- a) Responsible for ensuring the quality and management system requirements for the Darlington Refurbishment Program (DRP) are executed and completed.
- b) Responsible for ensuring quality surveillance is performed during each phase of DRP to obtain project completion assurance.
- c) Responsible for providing assurance through the quality surveillance activities that Project Completion Assurance is obtained through each phase.
- d) Can escalate and implement corrective actions for critical issues.
- e) Responsible for the interfaces with other DRP internal and external assessment activities to coordinate and optimize the required quality surveillance activities for DRP.
- f) Responsible for establishing metrics and reporting requirements that assess effectiveness of the DRP Quality Plan and surveillance activities performed.
- g) Can direct specific quality surveillance activities based on risk, Lessons Learned and OPEX.
- h) Oversee management of records of changes to the units during refurbishment.

### 2.2 Quality Surveillance Staff

Staff assigned to the DRP Quality Management department will comprise of functions related to:

- Quality Engineering
- Procurement and Supply Chain Oversight
- Field Execution
- Performance Reporting
- Records

This staff will perform the following quality surveillance activities within the Quality Management department.

- a) Identify the Quality Surveillance needs for the DRP considering the risks based on issued identified, history of past performance, issues identified in Issue

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Tracking File, performance trend, the integrated DRP schedule etc., and discuss with the Director Quality Management Director and Functional Managers

- b) Input the scheduled Quality Surveillance activities into the DRP Integrated schedule as per concurrence by the Director Quality Management.
- c) Prepare Quality Surveillance Plan including completing the required checklist for the specific Quality Surveillance identified in the schedule for execution.
- d) Perform Quality Surveillance as discussed in this guide, document results, identify non-conformances or deviations from expected performance identified in Engineering Deliverables, Comprehensive Work Plans, Purchase Orders, and Inspection Requirements.
- e) Prepare Surveillance Reports, and discuss with Quality Management Director and the Functional Managers to finalize the Quality Surveillance Reports.
- f) Carry out trend analysis periodically and discuss with the Director Quality Management.

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### 3.0 QUALITY SURVEILLANCE PROCESS

Quality surveillance activities for the DRP will be planned and carried out from the “Concept to Return to Service” of key systems or Engineering Changes. The need for quality surveillance plans, and the extent of surveillance activities will be determined based on the graded risk approach and principles identified in section 1.0 to the key product deliverables during the different phases of the project.

The primary objective of the Quality Surveillance activities is to ensure appropriate documents and records are maintained and retrievable to ensure **configuration control** is maintained through all phases. **Figure 2** provides an overview of the configuration management requirements at different phases of the project as identified through N-LIST-01300-10000, Bounded Document Set, and the product deliverables at each phase of the project, including any additional deliverables per Project COIR document N-COI-00120-00001.

A risk based graded approach will be used to identify specific needs for quality surveillance activities using the following priorities as applicable to Darlington Refurbishment Project:

1. Safe Return to Service
2. Regulatory items.
3. High Risk Items (using graded approach as discussed in 5.0),
4. Low Risk Items that need to be covered by surveillance because of past performance or other factors.

**Appendix- A** provides an overview of the different phases of the refurbishment project, related processes in each of the phases, and the key deliverables during those phases.

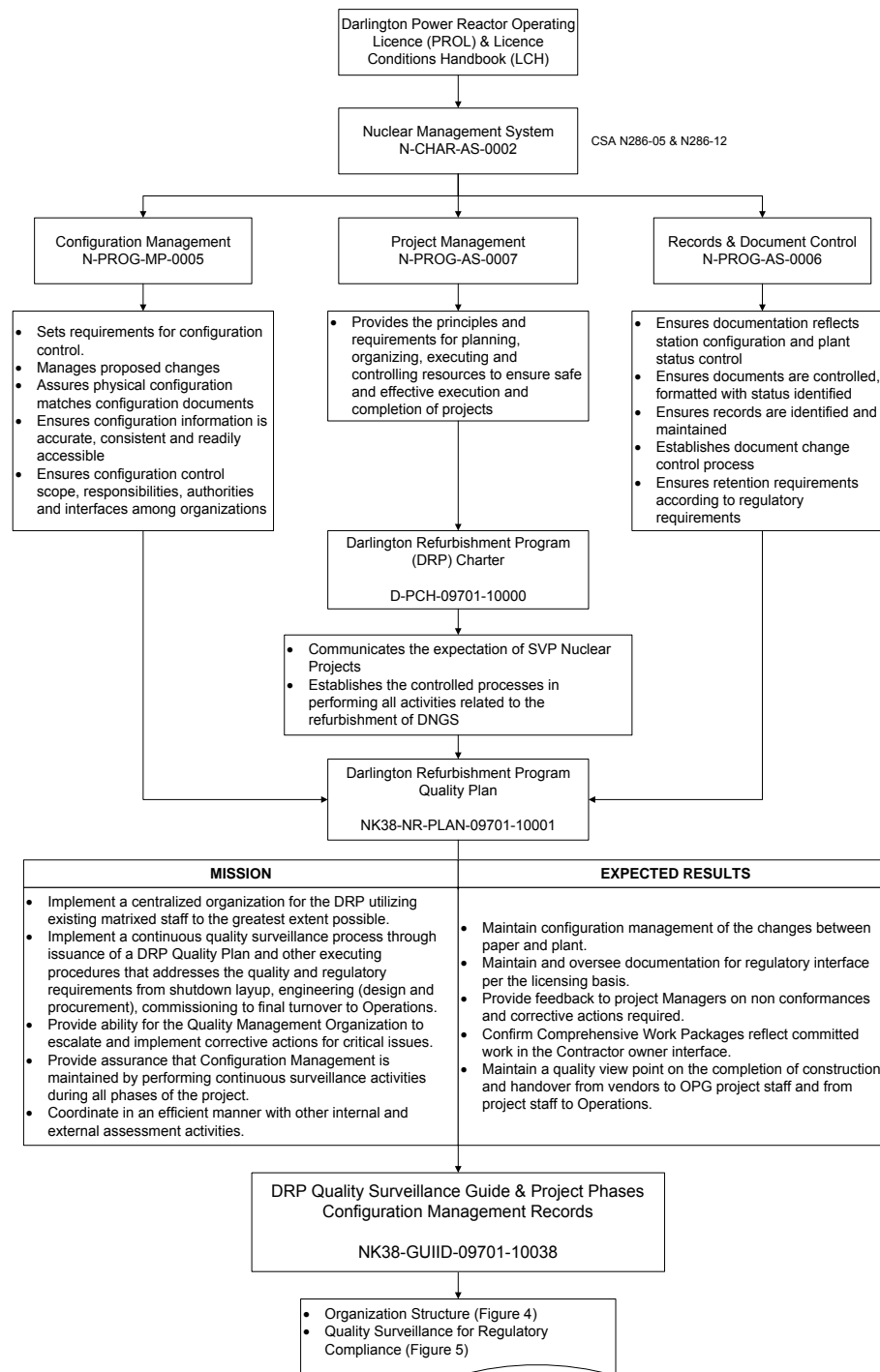
**Appendix- B** provides a comprehensive list of the Configuration Management documents and records as identified in the Bounded Documents set (N-LIST-01300-10000), the Contractor Owner Interface Requirements (COIR), and key process deliverables at each of the project phases.

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**Figure 2: Configuration Management through Quality Surveillance (Darlington Refurbishment)**





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### 4.0 PLANNING AND SCHEDULING QUALITY SURVEILLANCE

- 1) Integrated DRP schedule will be the basis for developing an integrated Quarterly Quality Surveillance Plan. The Integrated DRP Schedule is expected to include key surveillance activities based on the following:
  - i. Regulatory Commitments (CNSC, Ministry of Energy, Ministry of Labour, TSSA etc.
  - ii. Inspection & Test Plans that lists specific tests and inspections that may have to be witnessed or identified as a Hold Points.
  - iii. Hold Points and Witness Points as identified in documents such as COIR, and the schedule of upcoming key activities, and
  - iv. Other project related activities that require Quality Surveillance.
- 2) Inputs to the Quarterly Quality Surveillance Plan will include:
  - i. Common issues highlighted through performance reporting
  - ii. Impact on Safety and Quality
  - iii. Schedule milestones and related activities
  - iv. Availability of resources; skills, training, staff vacations, base numbers
  - v. Operating Experience and lessons learned
- 3) The Quality Surveillance Plan will be reviewed and updated on a monthly basis, with a 90 days look ahead and accomplishments in the last 90 days. The Quality Surveillance Manager will arrange to populate planned Quality Surveillance activities in the Integrated DRP schedule as a plan and will arrange to update activities based on progress achieved.

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### 5.0 PREPARING FOR QUALITY SURVEILLANCE

- 1) Personnel assigned to perform quality surveillance should be qualified and familiar with the process for performing the task to be evaluated. **Appendix- C** discusses the training and qualifications requirements and the desired traits for the quality surveillance personnel to perform surveillance. Specialized expertise required, if any, is to be obtained within the Nuclear Refurbishment (NR) organization or using external expertise as may be required. Respective functional organizations may also identify subject matter experts to participate in the team.
- 2) The Quality Surveillance Evaluator(s) (QSEs) conducting the surveillance should, as appropriate:
  - Review the quality surveillance schedule, monitor the scheduled work for the surveillance, and plan the surveillance.
  - Obtain and review the specific references, governing documents, report and records that pertain to the activity considered to be observed. This may include documents identified as deliverables in the Contractor Owner Interface Requirements (COIR) documents or other governing documents associated with engineering deliverables. It would also include self-assessments and SCRs related to the topic of surveillance. The table provided in **Appendix-B** lists the Configuration Management documents and the records as identified in the Bounded Document set, the Contractor Owner Interface Requirements and the key process deliverables at each of the project phases. These could help in choosing the product deliverable(s) for doing quality surveillance.
  - Key points to consider when developing checklist for surveillance during the different phases are discussed in **Appendix-D**.
  - Prepare a quality surveillance checklist making use of the standard checklist template and examples provided in this guide. The Quality Surveillance Checklist is expected to identify the requirements, acceptance criteria, and other items to be evaluated depending on the product deliverables / activities selected for surveillance. Review of checklists prepared/used earlier may be useful in the context.
  - Reference the documents for the quality surveillance, including revision numbers, on the checklist.
  - Obtain comments and assistance, as appropriate, during the preparation of the quality surveillance checklist, from the functional area experts, and as advised by the Manager Quality Surveillance.
- 3) The assigned QSE shall prepare a checklist before performing the quality surveillance and documenting the observations. A checklist should not limit the quality surveillance activities coverage. The QSE should observe activities, review

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documents/ records and note down observations on the performance aspects related to the surveillance activity.

- 4) Assigned QSE should prepare a Surveillance Plan as identified in **Appendix-E**. The Surveillance Plan should be reviewed and approved by the Quality Surveillance Manager.

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### 6.0 PERFORMING QUALITY SURVEILLANCE

- 1) QSE should observe activities, review documentation, inspect hardware, etc., to ensure compliance with the specified technical and administrative requirements and to verify whether the performance requirements were met. QSEs should use the surveillance checklist prepared for documenting the observations.
- 2) QSE should document, the results of the surveillance observations in sufficient detail to ensure that the record clearly reflects who was contacted, what was observed, when it was observed or reviewed, and what results were identified.
- 3) QSE should make sure that the results of each quality surveillance check will include, as appropriate, an evaluation of:
  - (a) The conformance of the activity or item to its quality requirements and objectives.
  - (b) The adequacy of the work or QA practices observed and the effectiveness of the results. When required, additional observations should be made or take up follow-up surveillances.
  - (c) Likely causes and recommendations for improvement, and the need for initiating Station Condition record (SCR) as required.
  - (d) The need to schedule follow-up reviews/surveillance for evaluation of identified issues.
- 4) QSE should spend adequate time in the area where the activities occur and document observations required for developing or supporting the conclusions from the surveillance.

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### 7.0 REPORTING QUALITY SURVEILLANCE RESULTS

- 1) QSE should prepare a quality surveillance report summarizing the surveillance activities performed. It should be posted in the Risk Management and Oversight (RMO) tool and will include items such as the performance area covered by the Quality Surveillance, key issues observed, and actions taken. Details are discussed in **Appendix-F**.
- 2) QSE should discuss the surveillance observations with the Quality Surveillance Manager and the interfacing /functional organization(s) to identify corrective actions as required.
- 3) QSE should discuss the QS report with the Quality Management Director and obtain concurrence before finalizing and obtaining the necessary signatures.
- 4) QSE will analyze the surveillance data and observations to identify any trends or areas for improvement.

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### 8.0 ACTIONS RESULTING FROM SUVEILLANCE

Station Condition Records (SCRs) may be initiated based on the nature of issue(s) observed and in accordance with N-PROG-RA-0003 Corrective Action Program, N-PRC-RA-0022, Processing Station Condition Records and other supporting documents.

When an issue is identified with concern that may require potential escalation, elements of escalation process similar to the one identified for audits in N-PROC-RA-0129, Elevation and Escalation should be applied as required.

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### 9.0 RECORDS KEEPING OF SURVEILLANCE REPORTS

Quality Surveillance Reports along with Quality Surveillance Plan will be filed in the RMO tool for reference and use as required.

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### 10.0 TRENDING

- 1) The Darlington Refurbishment Quality Surveillance data and observations will be used to determine if there are any adverse trends based on issues identified.
- 2) Study of issues will include project specific observations, Engineering Procurement Construction/ Engineering Master Service Agreement (EPC/ESMSA) contractor specific observations, as well as patterns and trends if any observed along the different phases of the project.
- 3) Results from the above will be discussed with the OPG management for actions as appropriate to address adverse trends to quality.



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## 11.0 DEFINITIONS & ACRONYMS

### 11.1 Definitions

***Audit*** is a planned and documented activity performed to determine by investigation, examination, or evaluation of objective evidence, the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents, and the effectiveness of implementation. An audit should not be confused with surveillance or inspection activities performed for the sole purpose of process control or product.

***Inspection*** is the act of looking at something closely, or evaluation of a product deliverable to determine compliance with specified requirements.

***Oversight*** is a set of activities including audits, assessments, and surveillances carried out to confirm that products and services are delivered to the specified requirements. Oversight includes the use of tools intended monitor, check and confirm.

***Quality Surveillance*** is the act of observing activities or reviewing documentation to verify conformance to specified requirements and to evaluate their adequacy and effectiveness. It is ongoing monitoring and verification of status of conditions, methods, procedures, and products, and analysis of associated records to ensure that established requirements are being complied with. Quality Surveillance is different from Quality Audit and Inspection activities. American Society for Quality (ASQ) Quality Surveillance Handbook prepared by the Nuclear Energy identifies the difference using the context of taking a snapshot using camera with different lenses.

- An audit uses a wide angle lens
- An inspection uses a close-up lens
- A Quality Surveillance uses a standard lens

### 11.2 Acronyms

ASQ	American Society for Quality
CNSC	Canadian Nuclear Safety Commission
COIR	Contractor Owner Interface Requirements
DRP	Darlington Refurbishment Program
EPC	Engineering Procurement Construction
ESMSA	Engineering Services Master Services Agreement
OPG	Ontario Power Generation
QS	Quality Surveillance

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QSE	Quality Surveillance Evaluator
RMO	Risk Management and Oversight
TSSA	Technical Standards and Safety Authority
SCR	Station Condition Record
SIO	Safety Improvement Opportunity

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## 12.0 REFERENCES

### 12.1 Performance References

- 1) CSA N 286-12, Management system requirements for nuclear facilities.
- 2) N-CHAR-AS-0002, Nuclear Management System.
- 3) D-PCH-09701-10000, Darlington Refurbishment Program Charter, (and its supporting Programme Management Plans.
- 4) NK38-PLAN-09701-10001, Darlington Refurbishment Program Quality Plan.
- 5) N-STD-AS-0030, Project Oversight Standard
- 6) N-MAN-09701-10002, Nuclear Refurbishment Project Oversight
- 7) N-GUID-01070-01070, Nuclear Oversight Audit Handbook
- 8) N-TQD-901-00001, Nuclear Refurbishment Training and Qualification
- 9) N-JTA-901-00011, Comprehensive Training Needs Analysis for Quality Management Personnel Reporting for Darlington Refurbishment
- 10) NK38-NR- PLAN-09701-10001-Sheet 23, Darlington Refurbishment Program Quality Plan
- 11) N-GUID-09701-10123, Nuclear Projects Risk Management and Oversight (RMO) Tool.

### 12.2 Developmental References

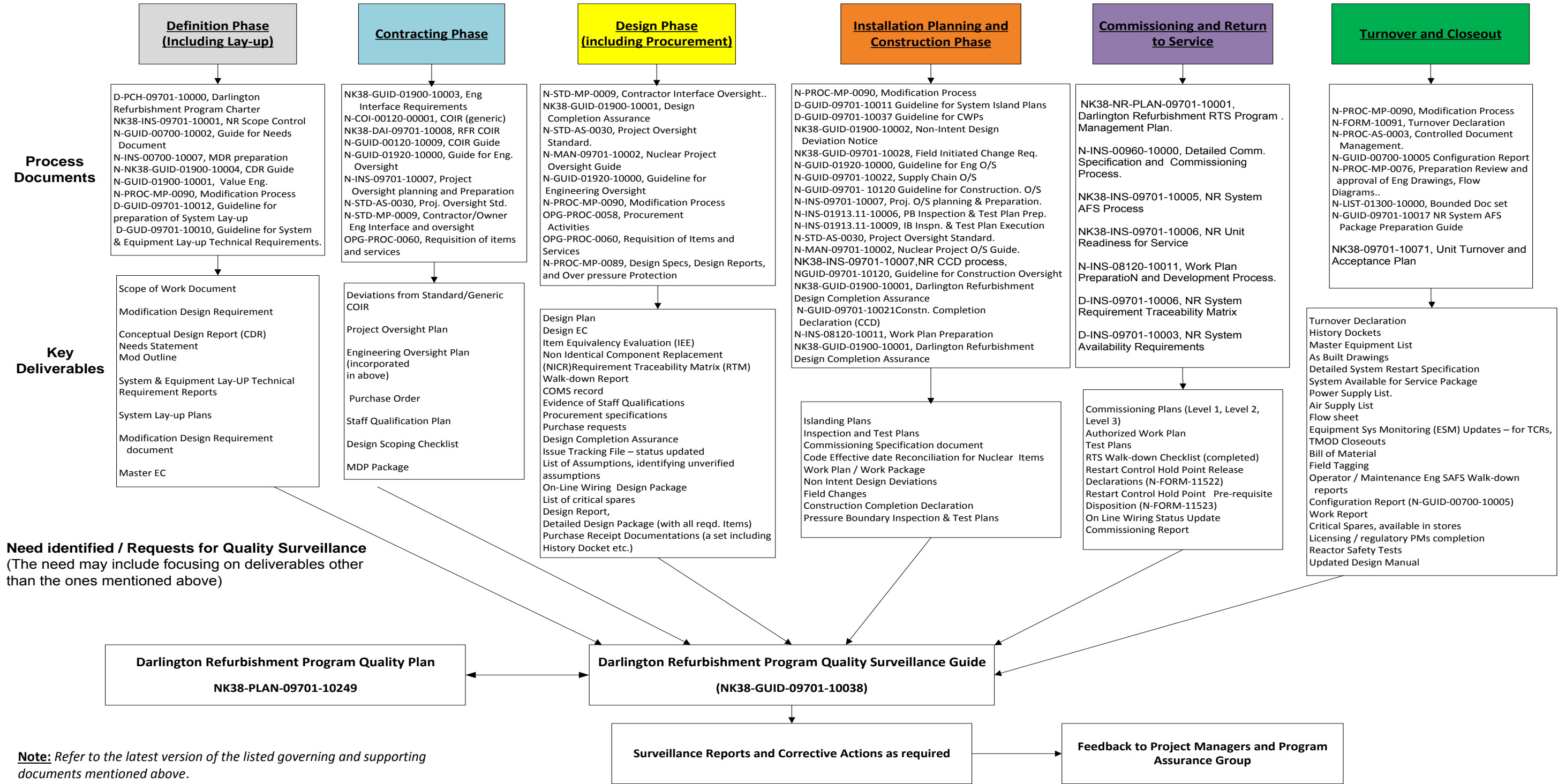
- 12) Quality Surveillance Handbook: Published by ASQC / ASQC Energy Division, Quality Surveillance Committee.
- 13) N-GUID-09701-10120, Guideline for Construction Oversight
- 14) N-COI-00120-00001, Contractor / Owner Interface Requirements.
- 15) N-GUID-01070-10001, Nuclear Oversight Performance Based Audit and Assessment Handbook.

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Appendix A: Nuclear Refurbishment Phases, Key Processes during those Phases and the Key Deliverables



**Note:** Refer to the latest version of the listed governing and supporting documents mentioned above.

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Appendix B: Project Phases Configuration Management Records

#	Name / Title of the Record/Forms	Lay-up	Engineering & Procurement	Construction	Commissioning (though not shown for this in the N-LIST-	AFS	Unit Readiness (Though not shown for this in the N-LIST-..	Closeout	Remarks
1	Ministry of Energy (MOE) Certificate of Approval			√ prior to installation					Required record for the project
2	Building Permits			√ prior to installation					Required record for the project
3	TSSA Registration for Reconciliation N-FORM-10354 (Statutory Declaration, Non-nuclear fittings)		√ ( P Eng Signature)	√ prior to installation					QA Record for Life of the facility P Eng stamp required (Int. & Ext)
	“ “ N-FORM-10442 (Statutory declaration, Nuclear Fittings)		√ ( P Eng Signature)	√ prior to installation					QA Record for Life of the Facility (LOF)
4	Pressure Vessel Certificates: - Certificate of inspection			√		√ before AFS		√. (As part of History Record)??	QA Record for LOF
	- Repair and Alteration Form N-FORM-10436			√		√ before AFS		√ (as part of WO closeout/as applicable)	QA Record for LOF
5	Concession Application / Flaw disposition (N-TMP-10010 and N-TMP-10180)			√ (P Eng may be reqd. due to legal statutes)		√ before AFS			QA record for L O F. P Eng stamp may be required due to legal statutes or codes other than PB
6	System Code Classification List: N-FORM-10250 System Classification List		√ ( P Eng Signature)					√. (reqd. as part of closeout)	QA Record. P Eng stamp required
7	Over Pressure Protection Report N-TMP-10139		√ ( P Eng Signature)					√. (reqd. as part of closeout)	P Eng stamp required
8	Pre-Start Health and Safety Report (N-FORM-10853)		√					√. (reqd. as part of closeout)	P Eng stamp may be required due to legal statutes or codes other than PB
9	External Third Party Fire Protection Review Report (N-FORM-10287)		√					√. (reqd. as part of closeout)	(P Eng may be reqd. due to legal statutes)
10	Code Classification / Registration Approvals and Exemptions N-FORM-11003		√ (as part of Eng Mod Packages)					√. (reqd. as part of closeout)	QA Record for LOF filed in Asset Suite (with reqd. Change papers
	Portable Assembly Exclusions N-FORM-11524		√ (as part of Eng Mod Packages)					√. (reqd. as part of closeout)	QA Record for LOF filed in Asset Suite (with reqd. Change papers
11	Reconciliation statement – No Re-registration Required. N-FORM-10971: Class 6		√ (as part of Eng Mod Packages)					√. (reqd. as part of closeout)	QA Record – LOF. Filed in Asset Suite. P Eng stamp required.
	Reconciliation statement – No Re-registration N-FORM-10972 – for Nuclear Class		√ (as part of Eng Mod Packages)					√ (as part of Eng Mod Packages)	QA Record – LOF. Filed in Asset Suite. P Eng stamp required.
12	Safety Report N-TMP-10179: - System Design Requirements - System Design Description - Equipment Design Description - List of Design related documents and Legacy Design Manual		√ (as part of Eng Mod Packages)					√ (as part of Eng Mod Packages)	QA record. LOF. Indexed in Asset Suite
13	System Design Manual part 1- N-TMP-10143		√ (as part of Eng Mod Packages)					√ required for closeout	QA Record. Indexed in Asset Suite- Controlled Docs LOF or until

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#	Name / Title of the Record/Forms	Lay-up	Engineering & Procurement	Construction	Commissioning (though not shown for this in the N-LIST-	AFS	Unit Readiness (Though not shown for this in the N-LIST-..	Closeout	Remarks
									superseded
	Part 2: System Design Requirements- N-TMP-10143		√ (as part of Eng Mod Packages)					√ required for closeout	QA Record. Indexed in Asset Suite- Controlled Docs LOF until superseded
	Part-3 System Equipment Design Description- N-TMP-10143		√ (as part of Eng Mod Packages)					√ required for closeout	QA Record. Indexed in Asset Suite
	Part-4: Listing of Design related (1.e., Design Output) Documents. N-TMP-10143		√ (as part of Eng Mod Packages)					√ required for closeout	QA Record. Indexed in Asset Suite
	Part -5- List of other Design related documents such as Software, system structures		√ (as part of Eng Mod Packages)					√ required for closeout	QA Record. Indexed in Asset Suite
	Legacy Design Manual if applicable N-TMP-10189 (as per N-INS-00700-10002)		√ (as part of Eng Mod Packages)					√ required for closeout	QA record indexed in Asset Suite, Controlled Docs. QA Record LOF
14	History Docket - for Nuclear Components and Nuclear Materials as part of Procurement & Receiving Inspection. (As per CSA N285.0 and as identified in N-TS-08173-10001, Appendix-A)		√ (as part of Procurement / Item Receiving docs )	√ prior to installation				√ required for closeout	QA record indexed in Asset Suite Records Module. Some such as correspondence and Registration Package would go in Asset Suite Controlled Docs Module
15	EQ Design Guide in accordance with N-PROC-RA-0051		√ (as part of Eng Mod Packages)					√ required for closeout	QA Record. LOF
16	Design Specification: Pressure Boundary Design Report N-TMP-10020		√ (as part of Eng Mod Packages)					√ required for closeout	QA record. Indexed in Asset Suite , Controlled Docs Records
	Pressure Boundary Design Specification N-TMP-10190		√ (as part of Eng Mod Packages)					√ required for closeout	QA record. Indexed in Asset Suite , Controlled Docs Records
	Over Pressure Protection Report N-TMP-10139		√ (as part of Eng Mod Packages)					√ required for closeout	QA record. Indexed in Asset Suite , Controlled Docs Records
	Reconciliation statement (Vendor Design Spec reconciliation) N-TMP-11271		√ (as part of Eng Mod Packages)					√ required for closeout	QA record. Indexed in Asset Suite , Controlled Docs Records
	PB Valve Specification Data, N-FORM-11612		√ (as part of Eng Mod Packages)					√ required for closeout	QA record. Indexed in Asset Suite , Controlled Docs Records
	Procurement Plan, using Template N-TMP-10295		√ (as part of Eng Mod Packages)					√ required for closeout	Not identified as QA Record. To be indexed in Asset Suite Controlled Docs with Doc Type as PLAN
	Code Compliance Verification Checklist for Valve Spec Data Sheet, for Nuclear valve SPEC		√ (as part of Eng Mod Packages)					√ required for closeout	QA record. Indexed in Asset Suite , Records Management Module
17	Procurement Specification (Eng Specification), N-TMP-10019		√ (as part of Eng Mod Packages)					√ required for closeout	QA record. Indexed in Asset Suite , Records Management Module
18	Vendor Manuals (manufacturer's manual), (N-PROC-MP-0078)			√ (required prior to installation)					QA Record, Indexed in Asset Suite Controlled Doc Module
19	Vendor Correspondence that includes requirements			√ (required prior to installation)					QA Record, Indexed in Asset Suite Records Module
20	Engineering Calculations, Analyses: - Operational Safety Requirements (OSR)		√ (marked up OSR to be available and the respective doc # is in			√ (required prior to AFS)			When updated and issued, it is in the Asset Suite Controlled Doc module

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			ADL)						
	Instrumentation uncertainty calculations. N-TMP-10020		√ (as part of Eng Mod Packages)					√ required for closeout	Indexed in Asset Suite – Controlled Doc Module ( <i>QA Record LOF</i> )
	Stress Analysis / Design Report (P Eng. stamp required)		√ (as part of Eng Mod Packages)					√ required for closeout	Indexed in Asset Suite – Records Module ( <i>QA Record LOF</i> )
	Electrical Load Analysis		√ (as part of Eng Mod Packages), <i>as part of Mod Package</i>					√ required for closeout	Using the appropriate calculation model (updating ETAP etc.). QA Record in Asset Suite Controlled Doc module.
	Seismic Analysis		√ (as part of Eng Mod Packages), <i>as part of Mod Package</i>					√ required for closeout	Using the appropriate calculation model. QA Record in Asset Suite Controlled Doc module
	Water hammer Analysis		√ (as part of Eng Mod Packages), <i>as part of Mod Package</i>					√ required for closeout	QA Record in Asset Suite Controlled Doc module
	Design Assist Analysis (as applicable). <i>To check this with some examples</i>		√ (as part of Eng Mod Packages)					√ required for closeout	Indexed in Asset Suite – Records Module ( <i>QA Record LOF</i> )
	Safety Analysis Report		√ (as part of Eng Mod Packages), <i>as part of Mod Package (requires Change Paper stamp)</i>					√ required for closeout	Using the appropriate calculation model. QA Record in Asset Suite Controlled Doc module. Safety Analysis report revised as per schedule approved CNSC
	Reliability Assessment (using N-TMP-10020) (with required change papers)		√ (as part of Eng Mod Packages)					√ required for closeout	QA Record in Asset Suite Controlled Doc module
	Risk Assessment (using N-TMP-10020) (with required change papers)		√ (as part of Eng Mod Packages)					√ required for closeout	QA Record in Asset Suite Controlled Doc module
	Instrument error calculation and Calibration sheets. (with required change papers)		√ (as part of Eng Mod Packages)					√ required for closeout	QA Record in Asset Suite Controlled Doc module (Use SCI as identified in N-PROC-MP-0044)
	Motorized equipment and Air Operated Equipment calculations (including differential pressure and thrust calculations)		√ (as part of Eng Mod Packages)					√ required for closeout	In accordance with N-INS-04940-10006, and N-INS-04940-10007)
	EQ Room Condition Manual		√ (as part of Eng Mod Packages)					√ required for closeout	In accordance with N-INS-03651-10003
	EQ Technical basis		√ (as part of Eng Mod Packages)					√ required for closeout	In accordance with N-INS-03651-10002
	Design Basis Accident List		√ (as part of Eng Mod Packages)					√ required for closeout	In accordance with N-INS-03500-10000
21	Engineering Calculations: Fire hazards Assessment Report		√ (as part of Eng Mod Packages)					√ required for closeout	If the Report (NK38-REP-78000-10002) is impacted then the document is identified in ADL and updated and issued in Asset Suite CD module.
	Fire Safe Shutdown Analysis		√ (as part of Eng Mod Packages)					√ required for closeout	If the Report (NK38-REP-78000-10003) is impacted then the document is identified in ADL and updated and issued in Asset Suite

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									CD module.
	Fire Protection Code Compliance Review (3 <sup>rd</sup> party review report) as per N-PROC-MP-0090, and its Guide		√ (as part of Eng Mod Packages)					√ required for closeout	If the document NK38-REP-78000-10001 is impacted then the document is identified in ADL and updated and issued in Asset Suite CD module. QA Record LOF.
	Reliability Centered Maintenance / Condition Maintenance/ Preventive Maintenance strategy		√ (as part of Eng Mod Packages)					√ required for closeout	Report generated/updated in accordance with Mod Scoping Checklist N-FORM-10521 and the document becomes a part the Eng package.
	Seismic withstand capability assessment		√ (as part of Eng Mod Packages)					√ required for closeout	If the document NK38-DG-03650.2B is impacted then the document is identified in ADL and updated and issued in Asset Suite QA Record LOF.
	Vendor (Manufacturer) Equipment Environmental or Seismic Qualification Reports		√ (as part of Eng Mod Packages)					√ required for closeout	QA record LOF. Indexed and issued in Asset Suite.
	EQ Assessment Part I Evaluation (site specific (using N-TMP-10045)		√ (as part of Eng Mod Packages)					√ required for closeout	QA record LOF. Indexed and issued in Asset Suite, Doc sub type EQA.
	EQ Assessment Part II		√ (as part of Eng Mod Packages)					√ required for closeout	QA record LOF. Indexed and issued in Asset Suite, Doc sub type EQA.
	Human Factors Assessment using N-FORM-10221		√ (as part of Eng Mod Packages)					√ required for closeout	QA Record. Attached to the Master EC Record.
	Conventional and Radiation Safety Assessment, as part of Master EC package		√ (as part of Eng Mod Packages)					√ required for closeout	Mod Outline covers these initially and becomes a part of the MO package in the M EC. <i>In case a separate report is required, it gets added to the design documents as part of RDL</i>
	Environmental Assessment (N-FORM-10422)		√ (as part of Eng Mod Packages)					√ required for closeout	Prepared as part of the MOD package (MEC) and filed with the MEC documents
	Effluent Monitoring and Effluent Limits		√ (as part of Eng Mod Packages)					√ required for closeout	Prepared as part of the MOD package (MEC) and filed with the MEC documents
22	ALARA Assessments		√ (as part of Eng Mod Packages)					√ required for closeout	Prepared as part of the MOD package (MEC) and filed with the MEC documents
	Drawings: Design Flow Diagrams		√ (as part of Eng Mod Packages)					√ required for closeout	Marked up documents forms a part of Modification package identifying document as ADL and get updated and issued in Asset Suite (CD module)
	Operational Flow Sheets					√ (required prior to AFS)			Flow sheets updated and posted in ESM II database by Operations



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									based DCRs/ TPARs on them
	Plant lay out and general arrangements drawings		√ (as part of Eng Mod Packages)					√ required for closeout	Vendor documents may be kept in Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA record. If done by OPG, with Change paper it goes in to Asset Suite. (ADL). QA record
	Vendor Drawings including electrical connection, torque/speed curves, control wiring etc.)		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Vendor (Manufacturer) Installation Drawings		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Vendor (Manufacturer) Detail Assembly and Bill of Material (BOM)		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Mechanical Piping Drawings: Mechanical Equipment Arrangements		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. Updated Drawings to record changes to the buried services, steam doors, flooding pathways, and areas inaccessible at power. Otherwise Reference only
	Mechanical Lay out		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. Updated Drawings to record changes to the buried services, steam doors, flooding pathways, and areas inaccessible at power. Otherwise Reference only
	Piping, Ducting Isometrics, and Arrangements		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. Updated Drawings to record changes to the buried services, steam doors, flooding pathways, and areas inaccessible at power. Otherwise Reference only
	Pipe Supports and Piping Hangers		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Electrical Drawings: Elementary Wiring Diagram		√ (as part of Eng Mod Packages)			√ (required prior to AFS)			Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Fuse Allocation Drawings or Fuse Data Sheets		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Single Line Drawings		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record

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	Connection Wiring Diagrams		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Installation Drawings		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Electrical Panel Drawings		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Cable Tray Layout Drawings		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Cable Block Diagrams		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Cable Shield Connection Drawings	Not applicable to DNGS as per N-LIST-01300-10000, Bounded Document Set							
	Instrumentation and Control (I&C) Drawings -I&C Details		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Control Logic Diagrams		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Control Panel (Cubicle) Drawings		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Instrument <u>Location</u> Drawings		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Instrument Installation Drawings		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Instrument Panel/Rack Drawings		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Instrument Schematic		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Instrument Tubing Layout Drawings (Update drawings to record changes to buried services and areas inaccessible at power. Otherwise Reference only)		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Equipment location Drawings. (Update drawings to record changes to buried services and areas inaccessible at power. Otherwise Reference only)		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Cable Support Drawings. (Update only if no design guide exists)		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record

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	Civil and Architectural Drawings: -Civil Embedment's and Holes Drawings. (P. Eng signature may be required due to legal status or codes other than those for Pressure Boundary).		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Civil Earthworks Pilings Drawings (P. Eng signature may be required due to legal status or codes other than those for Pressure Boundary).		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Concrete and Reinforcing Drawings. (P. Eng signature may be required due to legal status or codes other than those for Pressure Boundary).		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Civil General Arrangement Drawings (P. Eng signature may be required due to legal status or codes other than those for Pressure Boundary).		√ (as part of Eng Mod Packages)			√ (required prior to AFS)			Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Civil Miscellaneous Drawings (P. Eng signature may be required due to legal status or codes other than those for Pressure Boundary).		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Civil Special internals Drawings (P. Eng signature may be required due to legal status or codes other than those for Pressure Boundary).		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Civil Structural and Misc Steel Drawings. (P. Eng signature may be required due to legal status or codes other than those for Pressure Boundary).		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Architectural / Civil Drawings. (P. Eng signature may be required due to legal status or codes other than those for Pressure Boundary).		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
	Construction Utility Drawings. (P. Eng signature may be required due to legal status or codes other than those for Pressure Boundary).		√ (as part of Eng Mod Packages)					√ required for closeout	Accepted documents are posted in Asset Suite and linked to the EC through RDL. QA Record
23	Design / Engineering Analysis and Support Software Services ( <i>to make sure compliance to CSA N286.7</i> ). -Design Analysis Software models - On-Line wiring - Safety Analysis Codes - Safety Analysis simulations - System Unavailability Model - Fault Tree Models - Risk Assessment Models - Simulator Software - Outage Heat Sink Risk Model		√ (as part of Eng Mod Packages)					√ required for closeout	<i>Look for completed software checklists N-FORM-10445, N-FORM-10446, N-FORM-10408, and N-FORM-10409, if identified as required in Design Scoping Checklist and as per N-PROC-MP-0049.</i>

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	- On-Line Maintenance Risk Model - CHECWORKS Model (pipe wall thinning) - Engineering Tools (CIGAR, UDM, SLAR etc.) -Fuelling Codes (SORO and NuFLASH)								
	LISTS / DATA Sheets								
24	Safety Analysis Data List (SADL)			√ Required before installation				√ required for closeout	
25	Environmental Qualification List Development Package (EQLDP)			√ (as part of Eng Mod Packages)				√ required for closeout	
26	Computer Input or Output Datasheet			√ (as part of Eng Mod Packages)				√ required for closeout	
27	Computer Annunciation and Alarm Listings					√ ( required prior to AFS)			
28	Calibration Specs / sheets					√ (required prior to AFS)			
29	Relay Setting – Field Work Sheets								
30	Asset Suite (MEL) or ESM II								
	Equipment List (Data)					√ ( required prior to AFS)		√ required for closeout	
	Motor Control Centre (MCC) Data List (Data)					√ (Doc issue required prior to and after AFS			
	Containment Boundary List (Data)					√ ( required prior to AFS)			
	Q-List (Data)			√		√ issue required prior to and after AFS			
	Criticality Code (data)			√		√ (required prior to and after AFS			
	Equipment Bill of Material (BOM) (Data)					√ (required prior to AFS)		√ required for closeout	
	Drawing Bill of Material (DBOM)		√			√ (required prior to AFS)		√ required for closeout	
	Embedded Parts List					√ (required prior to AFS)			
	Junction Box List					√ (required prior to AFS)			
	Motor List					√ (required prior to AFS)			
	Equipment Power Requirements List					√ (required prior to AFS)			

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	Power Supply List (PSL)					√ (required prior to AFS)			
	Air Supply List (ASL)					√ (required prior to AFS)			
	Electrical Panel Lists					√ (required prior to AFS)		√ required for closeout	
	Instrument Lists					√ (required prior to AFS)		√ required for closeout	
	List of safety Related Systems and Functions (document)		√			√ (required prior to AFS)			
	OH Programmable Controller Lists (Data)					√ (required prior to AFS)			
	Motorized Valves					√ (required prior to and AFS)			
	Valves					√ (required prior to AFS)			
	Position Assured Components					√ (required prior to AFS)			
	Relief Valve Maintenance History					√ (required prior to AFS)			
	Valve Packing					√ (required prior to AFS)			
	Equipment maintenance Information System					√ (required prior to AFS)			
	Lubrication List					√ (required prior to AFS)			
	Relay Settings					√ (required prior to AFS)			
	Item Equivalency Evaluations					√ (required prior to AFS)			
	Surveillance Documentation								
31	Safety Related System Tests					√ (required prior to AFS)			
32	System Performance Monitoring Plan							√ required for closeout	Indexed in Asset Suite – Records Module. QA Record
33	Periodic Inspection Program Document: - Inspection – Plan “ “ Inspection Record								Both indexed in Asset Suite (CD Module)
34	In Service Inspection Program Document					√ (required prior to AFS)			
	Technical Operating and Maintenance Documentation								
35	Operating Manuals:  AIM (Abnormal Incident Manual)					√ (required prior to AFS)			

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	Emergency Response Plan					“			
	Emergency Mitigating Equipment Manual					“			
	Severe Accident Management Guidelines					“			
	Alarm / Annunciation Response Manuals					“			
	System Operating Manual					“			
	Overall Unit Operating Manual					“			
	Start-up and Shutdown					“			
	Predefines					“			
36	Outage Heat Sink Manual					√ (required prior to AFS)			
37	Operating memo					√ (required prior to AFS)			
38	Maintenance Procedures – Mechanical and Control Maintenance (includes Predefines)					√ (required prior to AFS)			In accordance with N-PROC-MA-0020
39	Operator Field Instructions					√ (required prior to AFS)			In line with D-INS-09110-100019
40	System Training Manual					√ (required prior to AFS)			N-PROC-TR-0012
41	Work Protection Manual					√ (required prior to AFS)			N-PROC-MA-0012
42	Safety Manual					√ (required prior to AFS)			Refer to N-INS-07080-10000
	<b>Other key process deliverables</b> (Not identified in the Bounded Documents List, but would used for Quality Surveillance)								
43	Restart Control Hold Point Declaration N-FORM-11522 (NK38-INS-09701-10006)						√		QA Record ( Send to file No2-0003)
44	Restart Control Hold Point Disposition Letter N-FORM-11523 (NK38-INS-09701-10006)						√		QA Record ( Send to file No2-0003)
45	Turnover and Acceptance Form D-FORM-10814 As part of NK38-PLAN-09701-10071, Unit Turnover and Acceptance Plan.						√		
46	Construction Completion Declaration. N-FORM-11530 (N-GUID-09701-10021, NR Construction Completion Declaration)			√					QA Record. Filed as part of the Construction Completion Package
	Walk-down Record (as part of			√					Filed as part of the Construction

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47	construction completion Declaration) N-FORM-11525, as identified in N-GUID-09701-10021								Completion Package
48	Construction Completion Declaration Walkdown Checklist. N-FORM-11526, as identified in N-GUID-09701-10021			√					Filed as part of the Construction Completion Package
49	Construction Completion Package. N-FORM-11527, as identified in N-GUID-09701-10021			√					Filed as part of the Construction Completion Package
50	Detailed Commissioning Specifications using template N-TMP-10277 (N-INS-00960-10000)				√				It is a QA Record. Send to file N02-00003 LOF. Indexed in Asset Suite Controlled Docs Module
51	Commissioning Report using N-TMP-10277 (N-INS-00960-10000)				√				It is a QA Record. Send to file N02-00003 LOF. Indexed in Asset Suite Controlled Docs Module
52	Detailed Restart Specifications (N-TMP-10277) as per NK38-INS-09701-10002, Preparation for Restart Specifications and Restart Reports						√		Filing information in AS7 NK38-REP-SCI-xxxxx-Ux
53	Restart Reports (N-TMP-10277) as per NK38-INS-09701-10002						√		Filing information in AS7 NK38-SPEC-SCI-xxxxx-Ux
54	System Available For Service (SAFS) Declaration Form N-FORM-11520, in accordance with NK38-INS-09701-10005 SAFS process					√			QA Record. To be filed with SAFS Package
55	System Available For Service (SAFS) Package					√			QA Record to be documented in the binder as per N-GUID-09701-100017
56	System Available For Service (SAFS) Walkdown Checklist N_FORM-11521 in accordance with NK38-INS-09701-10005 SAFS process					√			QA Record. To be filed with associated SAFS package
57	System Lay-up Technical Requirements for the specific system, using N-TMP-10010. (as per D-GUID-09701-10010)	√ (required for Lay-up)							Issued in Controlled Documents Module of Asset Suite
58	System Lay-up Requirements Traceability Matrix, using N-TMP-10010. (In accordance with D-INS-09701-10006)	√ (Lay up Plans may refer to this)	√ as part of Design Package release)	√ (Required prior to start of construction)	√				QA Record. LOF. Controlled Document numbering to use NK-38-REP-09701-xxxxx
59	Authorized Work Plan using N-TMP-10208, as per N-INS-08120-10011 (e.g. NK38-WPL-SCI-..)			√ (Required prior to execution)					QA Record. LOF. (N02-0003)
60	N-FORM-10091 Turnover Declaration			√ (part of Operations turnover)	√ (part of Commissioning acceptance)	√ (part of AFS Operations acceptance)	√	√	QA Record. LOF. (N02-0003)
	<b><u>Those as per COIR and may not be covered above:</u></b>								
61	COIR List of deviations N-FORM-11583		√						OPG’s approval of list of deviations, or as contractor’s acceptance if part of contract award

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62	CNSC Notification Approval of modification and correspondence N-FORM-10369		√						Designated OPG Licensing Authority to approve and submit to CNSC
63	Design Scoping Checklist N-FORM-10959		√						OPG provides Design Scoping Checklist
64	Modification Design Requirement (MDR)		√						OPG provides Design Scoping Checklist
65	Design Plan		√						Contractor prepares (OPG supports), and to maintain the status and accuracy of contents.
66	COMS Declaration Form N-FORM-10007		√						QA Record. Stakeholder signatures.
67	Walk down report and Field Verification (Expect preliminary walk down and Final walk down)		√						Evidence of stakeholder participation and clarifying field configuration.
68	Issue Tracking File, as per N-GUID-00700-10000		√ (As part of Design process and Design release)						Contractor populates ADL in Asset Suite and OPG reviews and accept change papers
69	ADL Change Papers (The Change paper set of documents prepared through Asset Suite with OPG Acceptance stamp for each Design EC, after DEC approval)		√ (As part of Design process and Design release)						Contractor populates the Asset Suite and OPG reviews and accept change papers (through VENDM and the Doc Transmittal Form)
70	Drawing Bill of Materials (N-TMP-10191)		√ (As part of Design)						Contractor prepares, verifies and approves. OPG accepts the change papers.
71	Affected Equipment List Updates (AEL)		√ (As part of Design)		√ (OPG Status Control to approve)			√	In Asset Suite
72	Third Party Fire Review Report (as required based on the change)		√ (As part of Design process and Design package release)						OPG reviews and accepts. Report In asset Suite
73	Field Initiated Changes and Design Revisions using N-FORM-11128		√	√		√		√	
74	EQ Completion Assurance (N-FORM-10649) In accordance with N-GUID-03651-10000		√					√	Contractor completes EQ Completion Assurance OPG to accept. Asset Suite Records module
75	Updated Configuration Report as per N-PROC-MP-0090 and as per N-GUID-00700-10000		√			√		√	Contractor review AEL prior to AFS and make changes as required. OPG to review and accept the updated configuration report
76	Drawing Bill of Materials			√				√	Final documents in Asset Suite. Contractor to incorporate change papers and revise Drawing Bill of Materials as required, verify and approve. OPG reviews and accepts.
77	Project specific Procurement Plan		√	√				√	Contractor develops procurement plan for Owner or Contractor specified materials and services. OPG to provide accept plan. Any change from mandatory criteria of



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#	Name / Title of the Record/Forms	Lay-up	Engineering & Procurement	Construction	Commissioning (though not shown for this in the N- LIST-	AFS	Unit Readiness (Though not shown for this in the N- LIST-..	Closeout	Remarks
									the procurement plan needs OPG acceptance
78	Changes to Master Equipment List (MEL) records N-FORM-10492, Equipment Data Update Request.		√	√					As part of Configuration Report update
79	Use of Commercial Grade Dedication (CGD) N-FORM-10966		√	√					OPG to accept the CGD strategy submitted by contractor
80	Concessions and Exceptions process using N-FORM-10393 (N-PROC-MM-0021)		√	√					OPG accepts the contractor submitted concession application. (forms a part of material receipt docs)
81	Construction Quality Assurance Plan		√	√					OPG to review and accept the QA plan submitted for construction activities.



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## **Appendix C: Quality Surveillance Personnel Qualification & Training**

Quality Surveillance Evaluator (QSE) should be familiar with the surveillance process covered in the NR Quality Plan and the NR Quality Surveillance Guide. N-JTA-901-00011, Comprehensive Training Needs Analysis for Quality Management Performance Reporting for Darlington Refurbishment discusses training required with reference to N-TQD-901-00001, Nuclear Refurbishment Training and Qualification. Also the following are other training items if not included in the JTA or N-TQD.

1. Nuclear General Employee Training (NGET) Qualification # 2834
2. Introduction to CANDU CBT (PEL # 3520)
3. Self-study to have adequate familiarity with the Engineering Change Control Process and Design Management (N-PROC-MP-0090)
4. Self-study to get familiarised with the Managed System Governance framework and how to identify governing and supporting documents on specific topics (N-PROC-AS-0001)
5. Self-study to have familiarity with the SCR process and Action Tracking System module of Asset Suite (N-PROC-RA-0022, and N-PROC-AS-0019)
6. Self-study to gain an understanding of the self-assessment process (N-PROC-RA-0097)
7. Self study of Inspection and Test Plan processes as applicable to the different phases of the project.
8. Self-study of Supply Chain processes such as the ones on Receiving Inspection, and Source Surveillance
9. Orientation Training to get familiarized with the Darlington Refurbishment Quality Surveillance Process (NK38-GUID-09701-10038).
10. Review of RMO Tool per N-GUID-09701-10123, Nuclear Projects Risk Management and Oversight Tool, as well as the Frequently Asked Questions (FAQ) document associated with it.

Following traits or characteristics are recommended to identify as an effective Quality System Evaluator.

- a) **Communication skills** required to communicate findings and recommendations as applicable
- b) **Credibility and respect.** The effectiveness of the quality surveillance depends strongly on the credibility and respect the functional area personnel may have for the person performing surveillance.
- c) **Objectivity:** Ability to focus on the task assigned and be objective in the evaluation.
- d) **Ability to make decision / judgement:** Ability to make a judgement conforming requirements.
- e) **Ability to deal with people effectively:** Ability to address a confrontational issue or elevate to the appropriate line management.
- f) **Ability to take constructive criticism:** Use of constructive criticism to improve the surveillance observations.
- g) **Ability to listen:** The Surveillance person to be attentive to the person speaking, by being a good listener.

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- h) **Ability to ask questions:** asking the right question at the right time and in the proper manner

**Ability to observe and make evaluations:** The person performing surveillance must have good observation skills and be able to make intelligent evaluations.

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## Appendix D: Preparing and Developing Quality Surveillance Checklists during the Different Phases

### A General tips while preparing for Quality Surveillance

Preparation of surveillance checklist is considered the most important part of surveillance preparation. Given below are some tips to be considered for Quality Surveillance.

- Items to be verified are identified from the review of documents in preparation of the surveillance. These documents could include applicable governing documents, procedure for the product activity being covered by the surveillance.
- Items to be verified based on the performance history, problems identified earlier etc.
- Items to be verified based on the critical process activities involved in the specific engineering product, and their acceptance criteria
- Items to be verified as evidence of quality planning, as applicable to the specific engineering process /product
- Items to be verified as evidence of in-process quality control
- Items to be verified as evidence of corrective actions and preventive actions and their effectiveness
- Items to be verified as evidence of having complied with the applicable code requirements
- Use of OPEX and lessons learned as applicable to activity being covered by surveillance
- Any other items identified during the preparation for Quality surveillance.

Note: When verifying evidence of each element for compliance. Make sure that observations are based on a representative sample.

### B Quality Surveillance activities during Design:

As identified in N-GUID-01920-10000 , Guideline for Engineering Oversight, in-process engineering review and release for further work occurs at the following hold points:

- Engineering Mobilization Hold Point
- Design Plan Hold Point
- COMS Hold Point
- 40% and 85% Design Review, as identified in Design Plan
- Independent Technical Review / Design Challenge Hold Point (as identified in the Mod Out Line)
- Design Completion Assurance Hold Point (DCAVR)
- EC Release Hold Point
- Construction Completion Declaration Hold Point
- Available for Service Hold Point

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While the above reviews as part of activities during the above hold points provide for quality checks as part of the process, specific quality surveillance checks are to be taken periodically to confirm compliance with applicable requirements making use of the following:

- (i) The Designer's ECC Job Aid (N-FORM-11443), and N-PROC-MP-90 with its supporting Guide document.
- (ii) QA records as identified in N-PROC-MP-0090, Modification Process are listed below:

<b><u>QA Record (description)</u></b>	<b><u>Associated Form / Template</u></b>	<b><u>Remarks / Filing Instructions</u></b>
EC Modification Records. (Also known as EC Bookmarked Records such as MODs, NICR..)	Not Applicable	Index in Asset Suite Records Management Module
Change Paper Documents. (Examples are Mod packages, Engineering Drawings, Bill of Materials, Technical Specifications, )	<i>(Eng documents with the Change Paper stamp and associated signatures of preparer, verifier and Approver)</i>	File in Design EC Modification Records ( in Records Management Module)
TMOD Removal / Extension Form	N-FORM-10005	File in EC Modification Records
COMS Stakeholder Declaration	N-FORM-10007	As per N-PROC-MP-0083. (Indexed in Asset Suite and book marked in Master EC)
Controlled Document Request Form if used to revise an existing EC	N-FORM-10027	Refer to N-PROC-MP-0090 Records table for details
Turnover Declaration	N-FORM-10091	File in Master EC Mod Records, (in Records Mgmt Module)
Human Factors Worksheet	N-FORM-10221	Attached to Master EC
Fire protection Impact Evaluation ( <i>Note: Fire Protection 3<sup>rd</sup> Party Report when evoked will also be a QA record</i> )	N-FORM-10287	File with Mod Outline EC Modification Records
CNSC Approvals and Notification Screening	N-FORM-10369	File with Mod Outline in EC Modification Records
Environmental Impact Worksheet	N-FORM-10422	File with Mod Outline in EC Modification Records
Software categorization Checklist	N-FORM-19445	File with EC Modification Records
Software categorization Results	N-Form-10446	File with EC Modification Records
Pressure Boundary Designer's Checklist	N-FORM-10528	File with EC Modification Records
Reactor Safety Designer's Checklist	N-FORM-10529	File with Design Scoping Checklist in EC Modification Records
Chemistry Design Change	N-FORM-10560	File with Mod Outline in EC

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<u>QA Record (description)</u>	<u>Associated Form / Template</u>	<u>Remarks / Filing Instructions</u>
Checklist		Modification Records
Identifying Human Factors Level of Activity	N-FORM-10580	File with Mod Outline in EC Modification Records
Modification Outline	N-FORM-10958	File in Master EC Modification Records
Design Scoping Checklist	N-FORM-10959	File with Modification Outline in EC Modification Records
Fire Codes and Standards Compliance record	N-FORM-11180	Indexed in Asset Suite Records management
Third Party Report	OPG-TMP-0003	Indexed in Asset Suite Controlled Documents
OPGN Letter to CNSC for notification of Change	OPG-TMP-0007	Indexed in Asset Suite Records Management
NICR Justification	N-FORM-11239	File in NICR EC Modification Records
Code Edition Compatibility Review Nuclear Class and Class 6	N-FORM-11325	Completed N-FORM-11325 to be filed in Design EC Bookmarked Record
Checklist for CNSC Approval Request for Nuclear Class Non-Standard Repairs	N-FORM-11539	File as a Record in Asset Suite Records Management
Design Plan	N-TMP-10090	Indexed in Asset Suite Controlled Documents Module
Deliverables and Activities interface Agreement	N-TMP-10185	Indexed in Asset Suite Controlled Documents
Modification Design Requirements	N-TMP-10187	Indexed in Asset Suite Controlled Documents Module
AFS Report	N-TMP-10209	Indexed in Asset Suite Controlled Documents Module
Detailed Commissioning Specifications	N-TMP-10277	Indexed in Asset Suite Controlled Documents Module
Commissioning Report	N-TMP-10277	Indexed in Asset Suite Controlled Documents Module
Engineering Calculation (Eng. Calculation Report)	N-TMP-10020	Indexed in Asset Suite Controlled Documents Module
Pressure Boundary Design Report	N-TMP-10020	Indexed in Asset Suite Controlled Documents Module
PB Design Specification	N-TMP-10020	Indexed in Asset Suite Controlled Documents Module
Over Pressure Protection Report	N-TMP-10139	Indexed in Asset Suite Controlled Documents Module
Reconciliation Statement	N-FORM-11271	Indexed in Asset Suite Records Management
PB Valve Specification Data Sheet (VSDES) - Nuclear Class 1, 2 or 3 Valves	N-FORM-11612	Indexed in ASSET SUITE Controlled Docs

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<u><b>QA Record (description)</b></u>	<u><b>Associated Form / Template</b></u>	<u><b>Remarks / Filing Instructions</b></u>
Code Compliance Verification Checklist for VSIDS Nuclear valve Spec	N-FORM-11616	Indexed in Asset Suite Records Management
System Classification List	N-FORM-10250	Completed Form is filed as a Controlled Document Module
Code Classification / Registration Approval and Exemptions	N-FORM-11003	Filed as a Record in Asset Suite / Records Module. <i>Cross-referenced to the associated SCL that is issued as a Controlled Doc.</i>
Updated Darlington Design Manual	N-TMP-10189	Indexed in Asset Suite Controlled Documents Module. (Before closeout).

Specific quality surveillance activities may be selected based on the issues identified through SCRs, self-assessments, or other project oversight activities. Such quality surveillances should focus on looking for evidence that demonstrates compliance to key requirements as applicable to the specific product deliverable(s), their preparation, review and verification, or the records management as applied to them. For every Quality Surveillance, a Surveillance Plan with applicable checklist will be developed. An example of a Design Change Package checklist for Design Completion Assurance is provided in **Appendix G**.

- C Quality Surveillance/ Oversight activities by Refurbishment Supply Chain** are carried out by the Nuclear Refurbishment Supply Chain organization following the process described in N-GUID-09701-10022, Supply Chain Oversight.

The current focus of NR Supply Chain Oversight is the following:

- Procurement Planning
- Bid Evaluation
- Selection of sub-contractors by a Supplier
- Review of procurement documents before release
- COIR Clauses related pre award and post award activities
- Manufacturing process
- Post delivery/Materials management

Activities selected for oversight/surveillance are selected from

- (i) The Schedule of various procurement activities
- (ii) Witness Points identified on ITP by Contractor/ OPG.

Based on the NR Management needs, surveillance activities other than the ones mentioned above may be taken up as directed by NR Management.

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### D Quality Surveillance activities during Lay-Up

Quality Surveillance during lay-up will verify compliance to the requirements identified in the lay-up plans and lay-up Technical Requirements, and the specific Lay-up Requirements Traceability Matrix.

A Quality Surveillance checklist will be prepared using the lay-up plans for the specific system. A sample checklist is provided in **Appendix H**.

### E Quality Surveillance activities during Construction/ Field Execution:

Field Execution Completion Assurance /Quality Surveillance organization is expected to conduct quality surveillance using the related processes and available checklists as discussed in the Governing and supporting documents such as the ones listed below:

- N-MAN-01983-10000, Field Engineering Quality Control Manual
- N-GUID-01983-10000, Field Engineering Guide to Planning and Assessing Work
- N-GUID-01983-10002, Guide to Field Engineering Design Interface and Support
- N-GUID-01983-10004, Field Engineering Quality Control Mechanical
- N-GUID-01983-10005, Field Engineering Quality Control Electrical and Control
- N-GUID-01983-10003, Field Engineering Quality Control Civil
- N-GUID-09701-10120, Guideline for Construction Oversight

A Quality Surveillance checklist for Comprehensive Work Packages and for verifying Construction Completion are provided in **Appendix-I** and **Appendix-J**

#### Note:

The checklist for the specific situation would vary and will be based on the type of equipment and the work carried out, including verification of completed Inspection and Test Plan.

Detailed Quality Surveillance Checklists will be prepared based on the Inspection and Test Plans for the work execution of the specific job and the referenced documents.

It will include checking the completion and verification of ITP activities to meet the specified criteria as well as evidence of having recorded the required details to demonstrate compliance applicable to witness and hold points.

#### For Non-Modification Jobs:

In the case of non-modification jobs such as Maintenance Predefines, and other rehabilitation jobs, inspection and test plans referenced in the work package or the task instructions identified in the Work Order task instructions will be used.

*Additional Quality surveillance may be carried out by the Refurbishment Quality Management Organization on a sample basis making use of the checklists being used by Field Execution organization.*

### F Quality Surveillance during Commissioning

Specific checklist for use with Commissioning will be prepared making use of the following:



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- NK38-NR-PLAN-09701-10001- Sheet 3, Darlington Refurbishment Return to Service Program Management Plan

The system specific Commissioning Specifications and Commissioning Reports prepared in accordance with N-INS-00960-10000, Detailed Commissioning Specifications and Commissioning Reports. A generic Checklist is provided in **Appendix K**:

### **G Quality Surveillance at AFS**

Depending on whether the system (i) remained in normal service with no modification or component replacement (ii) was placed in a desired lay-up or shutdown state according to operating procedures (iii) was modified, the checks to be conducted would vary. While the Quality Surveillance checklists for a specific system AFS would be prepared considering the above and the specifics as applicable to the system, a generic checklist for the situation when the system was modified is given in **Appendix L**.

### **H Quality Surveillance at Unit Readiness**

Sample checklist for quality surveillance at Unit Readiness is given in **Appendix M**: Once the related processes documents are finalized, this draft sample checklist will be updated incorporating input from Refurbishment Operations.

### **J Quality Surveillance during Closeout.**

Quality Surveillance during Closeout will be mostly with respect to documents that are required and resulting from the Engineering and Field Execution processes that lead to final stage of Closeout.

Surveillance activities will be planned and carried out involving the respective functional organizations and involving the Records Management Personnel. Checklists as applicable to the context will be prepared based on the focus of surveillance. A generic sample checklist is discussed in **Appendix N**.

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## Appendix E: Quality Surveillance Plan

<b>Quality Surveillance Plan #</b> XXX-xxxx-xxx	<b>Date:</b>
<b>Quality Surveillance Activity Title:</b>	
<b>Quality Surveillance Evaluator:</b>	
<b><u>Objective/Scope:</u></b>	
<b><u>Reference Documents/Bases:</u></b>	
<b><u>Surveillance Checks:</u></b> (Attach detailed checklist as appropriate)	
<b>Schedule / Date(s):</b>	
<b>Review of OPEX / Lessons Learned (as applicable):</b>	
<b>Prepared by:</b>	<b>Reviewed and Approved by:</b>

Note: If required, a Form Number would be created before finalizing this guide document.

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### Appendix F: Quality Surveillance Reporting Template

Details from Quality Surveillance are to be documented in the Oversight part of the Risk Management and Oversight (RMO) tool covering the following items and the fields available in the RMO tool.

- Date(s) on which the surveillance was performed, location,
- Identification of the QSE(s), who conducted the quality surveillance
- Description of the activity observed
- Summary of observations (Summary Report)
- Key issues: Concise statements on issues observed and findings, if any
- Station Condition Record # (if applicable)

Note: Refer to N-GUID-09701-10123, Nuclear Projects Risk Management and Oversight (RMO) Tool, and the associate document, Frequently Asked Questions and Answers.

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### Appendix G: Surveillance Checklist for Detailed Engineering Design Packages (Design Completion Assurance Checks)

Date:

	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Remarks / Evidence to check</u>
		Yes	No	Not Applicable	
<b><u>Master EC Package: General</u></b>					
1	Modification Design Requirement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prepared in accordance with N-INS-00700-10007
2	Mod Out Line (N-FORM-10958), Along with the required Forms, applicable (listed below)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Completed with the required signatures.
2 a	Design Scoping Checklist N-FORM-10959, (completed with signatures)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	As part of MEC, (updated with each released Design EC, when several DEC's are involved and released at different times.)
2 b	Document Scoping Checklist N-FORM-10521.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	(Same as above)
2 c	Prestart Health & Safety Review – N-FORM-10853. (completed with signatures)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable.
2d	Pressure Boundary Designers Checklist N-FORM-10528	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable. If it is clearly known as PB related package the use of checklist may not be required.
2 e	CNSC Approval & Notification Screening (N-FORM-10369)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable, as identified in the Design Scoping Checklist
2 f	Chemistry Design Change checklist (N-FORM-10560)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable.
2 g	Fire Protection Impact Evaluation (N-FORM-10287)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable.
2 h	Environment Impact Worksheet N-FORM-10422	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable
2 i	Reactor safety Designer's checklist N-FORM-10529	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	As applicable
2 j	Human Factor Level of Activity Determination (N-FORM-10580)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	As applicable
3	Design Plan updated with DA approval.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	In accordance with N-PROC-MP-0074, with required signatures.
4	Value Engineering Report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	As applicable, based on accepted deviations or already completed by OPG as part of MDP Package.

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	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Remarks / Evidence to check</u>
		Yes	No	Not Applicable	
5	Evidence of having done COMS review (including Enhanced COMS as required)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence through completed N-FORM-10007, complying with applicable requirements.
6	Deviations to COIR (to ensure these were used as required while approving the package)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable. Check with PO Files through NR Supply Chain, if required.
7	Staff Qualification Evidence. As per accepted practice such as Staff qualification matrix signed by the QA Manager with a signed covering letter stating all engineers engaged have P. Eng and have completed the training required for the respective role.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8	Issue Tracking File updated with justifications for issues still outstanding for DEC's approved and released	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Updated with all information such as responsible person, TCDs etc. In the case of MECs with several DEC's, and being released at different times, focus on open issues related to released ECs.
9	Completed Requirement Traceability Matrix	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10	Approval /Acceptance of MEC and DEC packages in Asset Suite by DTL and Section Manager	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	For EPC / ESMSA prepared packages, contractor's Section Manager approves and OPG Section Manager Accepts.
11	Design Completion Assurance Letter as evidence of DA Approval for every release (if done by Design Agency) Note: this is also identified under each Design EC, to make sure there was one covering that DEC.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If the design was by OPG, Design Authority Release in Asset Suite, in attribute panel. In case several releases involving different DEC's, there should be evidence for each such release covering all the DEC's approved..
12	CNSC Code Classification Approvals / Notifications/Exemption (N-FORM-11003)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable depending on the package
<b><u>Design ECs</u> – Mechanical</b>					
1	The DEC Change Paper package The whole package listing of all affected documents, (ADL) drawings, followed by each of the documents with the required Change Paper stamp by the contractor's staff and acceptance by OPG (on the cover page)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Note: The package is posted with the RDL documents and used as the authorized design package during installation. Posted in Records Module of Asset Suite. {DSGN-xxxxx. (the DEC#)}

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	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Remarks / Evidence to check</u>
		Yes	No	Not Applicable	
2	System Classification Lists (SCL)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3	Drawings, <i>(change papers &amp; new drawings such as piping drawings, isometrics, piping supports, flow diagrams, flow sheet, including design drawings)</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4	Drawing Bill of Materials (DBOMs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5	Configuration Management Report <i>(to ensure MEL, BOM, and Cat-Required before installation. It is updated after installation and submitted for AFS )</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	In accordance with N-GUID-00700-10005 for each Design EC.
6	Design Manual (Change paper)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7	Design Reports (OPR, stress report for mechanical EC if applicable)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check if it is identified as required in Design Plan.
8	Design Specifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9	Design Calculations /Analysis (FMEA if applicable)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10	Technical Specifications / Datasheets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
11	Comments and Dispositions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence of having addressed the comments
12	Walkdown Report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
13	OPEX Report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
14	Human Factor Worksheet N-FORM-10221	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	As applicable
15	EQ Analysis / Reports and Seismic Reports as applicable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>If identified in Mod-Outline. (Refer to Design Plan if there is any exemption)</i>
16	Evidence of Staff Qualifications of the preparer and verifier. <i>(P. Eng Qualification and the QA Manager's letter to indicate they are qualified to do their role). Can be part of MEC.</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>The Staff Qualification Matrix signed by the Contractor's QA Manager with Date and the covering letter is considered as acceptable. (it may be as part of MEC). <b>Make sure those who prepared and verified are qualified.</b></i>
17	CNSC Code Classification approvals / notification, if the modification is a pressure retaining system mod.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
18	TSSA Registrations N-FORM-10971, if the modification is a	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	If applicable.

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		Yes	No	Not Applicable	
	pressure retaining system mod.				
19	CNSC Fire Compliance Notification with 3 <sup>rd</sup> party Review Report, if required as per N-FORM-10287 (N-INS-09706-10004, Fire Protection 3 <sup>rd</sup> Party Review)				If applicable based on completed N-FORM-10287.
<b><u>Design ECs</u> – Electrical and Control</b>					
1	The DEC Change Paper package The whole package listing of all affected documents, (ADL) drawings, followed by each of the documents with the required Change Paper stamp by the contractor's staff and acceptance by OPG (on the cover page)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Note:</u> The package is posted with the RDL documents and used as the authorized design package during installation. (Posted in Records Module)
2	System Classification Lists (SCL)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3	Drawings, ( <i>change papers &amp; new drawings such as piping drawings, isometrics, piping supports, flow diagrams, flow sheet, including design drawings</i> )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4	Drawing Bill of Materials (DBOMs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5	Configuration Management Report ( <i>to ensure MEL, BOM, and Cat-Required before installation. It is updated after installation and submitted for AFS</i> )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	In accordance with N-GUID-00700-10005 for each Design EC.
6	Design Manual (Change paper)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7	Technical Reports ( <i>Technical Report / Third Party Report, memos as applicable</i> )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8	On-Line Wiring (OLW)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	(Expected to include issued form, printouts)
9	Cable Block Diagrams (as applicable) <i>showing Electrical Equipment / Panel locations as applicable.</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10	New Instrumentation Lists with calibration sheet/updated Instrumentation Calibration Sheet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
11	Technical Specifications / Datasheets (include Instrument calibration sheet if applicable)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

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		Yes	No	Not Applicable	
12	Design Calculations/ Analysis / ETAP calculations FMEA if applicable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
13	Comments and Dispositions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence of having addressed the comments.
14	Walkdown Report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
15	OPEX Report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
16	Human Factor Worksheet N-FORM-10221	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	As applicable
17	EQ Analysis / Reports and Seismic Reports as applicable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>If identified in Mod-Outline. (Refer to Design Plan if there is any exemption)</i>
18	Evidence of Staff Qualifications of the preparer and verifier. ( <i>P. Eng Qualification and the QA Manager's letter to indicate they are qualified to do their role). Can be part of MEC.</i> )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>The staff Qualification Matrix signed by the Contractor's QA Manager with Date and the covering letter is considered as acceptable. (Check for those who prepared and verified the package)</i>
19	Completed software checklists N-FORM-10445, N-FORM-10446, N-FORM-10408, and N-FORM-10409, if identified as required in Design Scoping Checklist and as per N-PROC-MP-0049.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>Evidence of completed forms if identified as required in Design Scoping Checklist.</i>
<b><u>Design ECs – Civil</u></b>					
1	The DEC Change Paper package The whole package listing of all affected documents, (ADL) drawings, followed by each of the documents with the required Change Paper stamp by the contractor's staff and acceptance by OPG (on the cover page)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Note: The package is posted with the RDL documents and used as the authorized design package during installation.
2	System Classification Lists (SCL)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3	Drawings, ( <i>change papers &amp; new drawings such as structural drawings,, isometric drawings, architectural drawings, and design drawings</i> )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4	Drawing Bill of Materials (DBOMs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5	Configuration Management Report ( <i>to ensure MEL, BOM, and Cat-Required before installation. It is updated after installation and submitted</i> )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	In accordance with N-GUID-00700-10005 for each Design EC, as applicable.



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	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Remarks / Evidence to check</u>
		Yes	No	Not Applicable	
	<i>for AFS )</i>				
6	Design Manual (Change paper)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7	Technical Report ( <i>Stress Analysis</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8	Design Specifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9	Technical Specifications / Datasheets.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10	Design Calculations, Analysis ( <i>structural calculation, anchorage calculations and vendor design calculations</i> )	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
11	Comments and Dispositions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence of having addressed the comments
12	Walk-down Report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
13	OPEX Report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
14	Evidence of Staff Qualifications of the preparer and verifier. ( <i>P. Eng Qualification and the QA Manager's letter to indicate they are qualified to do their role</i> ). This can be part of MEC.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>P. Eng Qualification and the QA Manager letter to indicate they are qualified to do their role.</i>

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### **DARLINGTON REFURBISHMENT PROGRAM QUALITY SURVEILLANCE GUIDE**

## **Appendix H: Sample Checklist to do Quality Surveillance during the Lay-up Phase**

(Based on the System Requirements Traceability Matrix for the Main Steam and Bypass system.  
Ref NK38-REP-09701-10259)

Date:

	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Remarks / Evidence to check</u>
		Yes	No	N/A	N/A – Not Applicable
<u>General</u>					
1	Main Steam and Turbine Steam Bypass system normally shutdown as per the Operating Manual	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence of normal system shutdown and having checked by DRP System Engineering.
2	Main Steam and Turbine Steam Bypass system process fluid instrumentation lines drained. Process isolators left open.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence as observed through the completed as per EC Work Order and evidence of having checked by DRP System Engineering
3	Main Steam and Turbine Steam Bypass system placed in a dry lay-up state and relative humidity maintained at the specified value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence of having completed the task (EC Work Order completion) and evidence of DRP System Engineering monitoring (walk down) on a regular basis as identified in the RTM
4	Monitoring of Relative Humidity / Dew Point Temperature monitoring. (Ongoing activity)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence of system monitoring routine by Operations to ensure conditions inside the system / equipment is maintained as identified in the technical requirement.
5	Call-ups for inspection and periodic replacement of air filters and drain lines in the dehumidifier skid (once installed through TMOD), and the activities are in alignment with manufacturer's design requirements / industry standards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence of EPC contractor complying with the requirements. Also sample check of the readings at local instrumentation as applicable. (Ongoing activity)
6	Motorized and Air Operated pneumatic valves in Main Steam and Turbine Bypass system are stroked periodically. (Note down the specific work orders and go through them while preparing)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Work order completion notes of the recurring WO / PMIDs set up. (Ongoing activity)
7	Evidence of Field Monitoring by Refurbishment System Engineering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence as identified in Action Tracking Completion notes and field verification of

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	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Remarks / Evidence to check</u>
		Yes	No	N/A	
					N/A – Not Applicable monitoring as applicable (including walkdown reports0.
8	Completion of Lay-up work orders (Mod and Non-Mod				Evidence of completed walkdown checklists /reports as per System Performance Monitoring Plan.

**Note:** The checklist to do Quality Surveillance during Lay-up of specific system to be developed based on its Lay-up plans, Lay-up Technical Requirements, and the Lay Requirement Traceability Matrix documents for that system. Such a checklist could have more number of items to check.

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### Appendix I: Sample Checklist to do Surveillance on Comprehensive Work Package

(Depending on the specific package, separate checklists for different part of the CWP may be used)

Date:

	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Evidence to check/Observations</u>
		Yes	No	N/A	N/A – Not Applicable
1	The CWP contains all information required to execute the job. Level of details adequate to facilitate coordination and control.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	A ck check to verify if it meets the requirement of (i) What, (ii) Who, (iii) How, (iv) Why and (v) When.
2	The CWP is reviewed by Knowledgeable persons as identified in the respective COIR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Appropriate review by knowledgeable persons as identified in the COIR.
3	Skills and qualifications required for the trades are identified	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	It should contain a record of reference to a database that documents the actual worker qualifications.
4	Detailed work instructions (DWI) provides step by step detailed instructions and for critical tasks required verification sign-off points are identified.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	DWI for critical tasks may have verification sign off points , and in some cases duplicate the verification, witness points in the ITP
5	CWP lists Construction Completion Declaration with walk-down with a detailed checklist as applicable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6	CWP includes Drawings, Flow diagrams, and referenced procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	It is an expectation that important steps in referenced procedures are listed in the CWP
7:	CWP includes Bill of Materials, Material Requests, Material Traceability, EC reference etc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8	The CWP has details such as Job Safety Analysis, and Contingency Plans as applicable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9	CWP lists and copy of all required authorizations for permit strategy if required by the complexity and extent of work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10	CWP has a separate section for Pressure Boundary materials including storage and FME requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
11	CWP lists Rigging and Lifting Plans	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

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	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Evidence to check/Observations</u>
		Yes	No	N/A	N/A – Not Applicable
12	CWP lists Material Receiving, Storage and preservation as required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
13	CWP has Measuring & Test Equipment and tooling requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
14	The Inspection and Test Plan prepared as part of work execution meets applicable requirements, for Pressure Boundary (PB) as well as non-PB jobs. <i>Note: (i) Key point to note is that the ITP lists the inspections, tests, and verifications for the product or services specified in the contract, to demonstrate quality is built/requirements are met during execution.</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Refer to procedural documents such as N-INS-01913.11-10006, as well as ITP requirements identified in QA standards such as Z 299.0. The verification also to include if the ITP was reviewed and accepted as identified in the COIR.
	Note: (i) In case welding jobs are involved, appropriate checklist with specific checks applicable to the type of welding, and welding material/consumable control will be included. (ii) The Construction completion/work execution checklist will also include control of material during fabrication and up to installation.				

#### Note:

Detailed Quality Surveillance Checklists will be prepared based on the Inspection and Test Plans for the work execution of the specific job.

It will include checking the completion and verification of ITP activities to meet the specified criteria as well as evidence of having recorded the required details to demonstrate compliance applicable to witness and hold points.

In the case of non-modification jobs such as Maintenance Predefines, and other rehabilitation jobs, inspection and test plans referenced in the work package or the task instructions identified in the Work Order task instructions will be used.

Oversight / Surveillance elements/checks discussed in documents such as N-GUID-09701-10120, Guideline for Construction Oversight, N-GUID-01983-10004, Field Engineering Quality Control Mechanical, N-GUID-01983-10005, Field Engineering Quality Control Electrical and Control, N-INS-01983.1-100014 Field Engineering Material Control during Installation, and N-INS-09701-10007, Project Oversight Planning & Implementation will be used as appropriate to the specific work execution in the field.

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### Appendix J: Sample Checklist to do Surveillance on Construction Completion

(Reference: N-GUID-09701-10021-Nuclear Refurbishment Construction Completion Declaration)

Date:

	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Evidence to check/Observations</u>
		Yes	No	N/A	N/A – Not Applicable
1	The executing organization had developed the scope (boundaries and contents) of the Construction Completion Declaration (CCD) prior to executing work on a system. <i>(Also check and confirm the MOD and Non-MOD CCDs are not mixed.)</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence of the number of CCDS and the list of applicable Comprehensive Work Packages (CWPs) etc. Note: <i>For MOD CCD the executing organization is the contractor and in the case of Non Mod CCD, the executing organization is Maintenance or the contractor to whom assigned.</i>
2	Construction Completion Declaration Walk down checklist has been completed and documented using N-FORM-11526	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Evidence of preparing the walk down by a team that includes Project Engineer (MTL) and representatives of Contractor, Operations, Maintenance, DTL, and others as required.
3	The results from the CCD Walk down (deficiencies) have been documented in N-FORM-11525, and it contains tracking mechanism for those	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The tracking mechanism provides for tracking actions to fix deficiencies to completion. (Check evidence of having completed)
4	Executing Organization has prepared the CCD Package using N-FORM-11527	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	It is in line with guidelines discussed in N-GUID-09701-10021
5	For MOD CCDs the DTL has checked and confirmed the Field Initiated Changes (FICs) have been incorporated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence of confirming the installed changes are as per approved Design.
6	For CCDs where the Executing Organization is a Contractor the OPG MTL has confirmed that the completion of work in the field and completion of a walk down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence
7:	The System Engineer has confirmed that all CWPs and WOs defined in CCD Package are complete and available in Asset Suite or VenDM.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence
8	The System Engineer has confirmed that Non Conformance Reports and Station Condition Records are complete and corrective actions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence

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	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Evidence to check/Observations</u>
		Yes	No	N/A	N/A – Not Applicable
	in place do not impact acceptance of CCD.				
9	The System Engineer has confirmed that all open items identified in section 1 of the CCD package (N-FORM-11527) have been satisfactorily dispositioned.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence
10	List of Completed Modification CWP's and or Work Orders for a Mod CCD and the associated Design EC reference to be electronically available in OPG Approved Information Management.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence
11	List of completed Non-MOD CWP's and or Work Orders to be electronically available in an OPG approved Information Management System.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence
12	Executing organization has prepared the Construction Completion Declaration using N-FORM-11530 in accordance with N-GUID-09701-10021 Appendix A (Guidelines for Construction Completion Forms)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	General compliance check
13	Preparation, Review and Approval Sign-offs are as identified in N-GUID-09701-10021: <i>Section C: Executing Organization prepares CCD documentation and confirms the completeness and quality of the CCD</i> <i>Section D: DTL review as per section 1.4.2 of N-GUID-09701-10021, otherwise enter Not Applicable</i> <i>Section E: OPG MTL-Review as per section 1.4.3 if the executing organization is a Contractor otherwise enters Not Applicable.</i> <i>Section F: System Engineer review as per section 1.4.4</i> <i>Section G: Senior Manager Plant Reliability confirms the CCD packages have been reviewed and recommends acceptance</i> <i>Section H: Return to Service Manager accepts the CCD on behalf of Operations</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
14	The QA Records generated through the use of N-FORM-10525, N-FORM-10527, and N-FORM-10530 are managed as identified in N-GUID-09701-10021.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

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### Appendix K: Sample Checklist to do Surveillance at Commissioning

(Reference: N-INS-00960- 10000, Detailed Commissioning Specifications and Commissioning Reports)

Date:

	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Evidence to check/Observations</u>
		Yes	No	N/A	N/A – Not Applicable
1	The Detailed Commissioning Specifications are prepared in sufficient detail to permit a commissioning responsible party to: (i) understand the operating parameters and requirements that must be verified (ii) understand the purpose of specified commissioning tests (iii) understand how to perform the required tests (iv) produce a commission report	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Based on observations and feedback from those doing the Commissioning.
2	The DCS document provides details in a manner that enables commissioning responsible party to execute the commissioning activities based solely on the DCS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Based on observations and feedback from those doing the Commissioning.
3	The DCS was reviewed by the responsible Design Engineer and DCS is issued in Asset Suite as a Controlled document	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for Evidence
4	The Commissioning Report (CR) generated is for each DCS at completion of commissioning to record results achieved in reference to the DCS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for Evidence. CR refers to the specific DCS. CR documents any deviations from design requirements and proposed follow-up actions to rectify deficiencies
5	CR preparer identifies deviations reported during commissioning. It includes (i) deviations such as alternate test methods employed (ii) Tested System Structure or Component (SSC) function and design parameters which do not meet design requirements (iii) SSC functional and design parameter inadequacies which impact operation of interfacing SSCs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check follow-up actions required have been identified for items (ii) and (iii) with TCDs using Issue Tracking File
6	CR has been accepted by Design, and issued in Asset Suite.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look For evidence
<p>Note: The above is a generic surveillance checklist. Additional checks would be included as appropriate checklists identified for the specific commissioning</p>					



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### Appendix L: Sample Checklist to do Surveillance for System AFS

(Reference: NK38-INS-009701-10005, Nuclear Refurbishment System Available for Service)

**Note:** While the specifics of checks/verifications would depend on whether the system (i) remained in normal service with no modification or component replacement (ii) was placed in a desired lay-up or shutdown state according to operating procedures (iii) was modified, the checks to be conducted would vary, a generic checklist for the situation when the system was modified is given below.

Date:

	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Evidence to check/Observations</u>
		Yes	No	N/A	N/A – Not Applicable
1	All changes made for lay-up (TCRs, TMODs) are reversed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2	System walk-down completed by NR Operations, NR Maintenance, NR System Performance Monitoring as per N-FORM-11521.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3	System alignment checks completed by NR Operations as identified in N-STD-OP-0014 RTS Alignment checks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4	System walk-down by the responsible NR System Engineer was completed (System AFS Walk-down) using N-FORM-11521.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Make sure there is evidence of having checked that the physical plant reflects the changes implemented in respective Drawings and other related documents.
5	Detailed Restart Specification (DRS) document was developed and executed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6	Detailed Commissioning Specifications (DCS) was prepared and executed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	As part of commissioning
7	As part of start-up, ensure parameters are within the expected range.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8	System availability was confirmed through the AFS declaration process and SAFS declaration approved by the NR-DOM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9	RTS System walk-down was completed as identified in N-FORM-11521 SAFS Walk-down checklist.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Making sure operations Flow-sheet consistent with tagging in the field, field equipment, Power Supply Lists, Air Supply Lists, and Master Equipment List.
10	NR System Engineer performs Eng walk-down confirming that System Performance Monitoring Plan (PSMP) and non-SPMP walk-downs have been developed and implemented	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

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	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Evidence to check/Observations</u>
		Yes	No	N/A	N/A – Not Applicable
11	System MOD AFS was completed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

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## **Appendix M: Sample Checklist to do Surveillance for Unit Readiness**

(Reference NK38-NR-PLAN-09701-10001, Darlington Refurbishment Return to Service Commissioning Specifications and Commissioning, and other related documents)

**Date:**

	<u><b>Surveillance Checks</b></u>	<u><b>Evidence Available?</b></u>			<u><b>Evidence to check/Observations</b></u>
		Yes	No	N/A	N/A – Not Applicable
1	Known scope locked and required deliverables identified as appropriate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2	Project managers have checked and confirmed Construction Completion Declarations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence
3	Operational Readiness Checklist s have been completed prior to commissioning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Including System Chemistry
4	Ensured that the documentation, training, training and regulatory commitments for fuel load are complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5	NR Peer organizations have agreed and signed on the ownership transfer plan	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	NK38-PLAN-09701-10113, all the ones for different functional areas
6	Operational Readiness has been checked and documented in D-FORM-10814 (Turnover and Acceptance Form)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence of having completed as required. Make sure the outstanding commitments, outstanding work orders, Action tracking items have been completed
	D-FORM-10814, Part A – Turnover Unit Status. (Systems, Structures, and Component status checks, Health & Safety and housekeeping status, Islanding Impact, Duty Shift and Unit Status)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence of all items listed there.
	D-FORM-10814, Part B-Readiness for Turnover (Department transition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	D-FORM-10814, Part C, Department Turnover Tracking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7	Environmental Commitments are completed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Based on evidence of completed action items in respective databases.

**Note:** Detailed checklist to be prepared once the procedures and plans are finalized by NR Restart and Operations, and based on the specifics as applicable at the time of surveillance.

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### Appendix N: Sample Checklist to do Surveillance for NICR/EC Closeout

(Reference: N-GUID-00700-10000)

*Note: While the specific checks for specific situation would vary based on type of MOD, a generic checklist for Closeout is given below.*

Date:

	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Evidence to check/Observations</u>
		Yes	No	N/A	N/A – Not Applicable
1	All open items (Design,/NICR EC) are completed within six months of AFS or Operations Acceptance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2	Equipment Minor Revision information update have been launched. MTL has ensured the assignments have been accepted within 7 days	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3	Design Change, Field Initiated Changes and minor field initiated changes are completed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	It may require the AFS or Operations Acceptance except in the case of administrative changes.
4	All action items are tracked in the system until resolution, including open items and affected document updates.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Carry out appropriate searches in the system. (MTL has reviewed Design/NICR EC open items from design, installation, commissioning, and AFS and verified they are completed.)
5	Equipment Minor revisions have been launched including equipment deletion.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Look for evidence including D078 and D030 panel.
6	Equipment abandoned in place has been labelled as required and Operations have been informed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Make note of Power connection, pressure, and potential safety issues.
7	Newly installed equipment have the MEL record operations status set to Active	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Verify evidence in the system
8	DE has ensure spare parts were in place prior to AFS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
9	MTL has communicated the surplus parts and abandoned equipments to Supply Chain.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Make sure abandoned equipments have been labelled as appropriate.
10	DE has completed the "MEL Updated" milestone	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
11	Verify status of EC to "Modified" has been done after final AFS or final Operations acceptance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Check all "Y" flagged ADL items have been flagged for update and all TPARs have been submitted.

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	<u>Surveillance Checks</u>	<u>Evidence Available?</u>			<u>Evidence to check/Observations</u>
		Yes	No	N/A	N/A – Not Applicable
12	Code edition compatibilities review was completed in accordance with N-INS-01913.11-10021 (with respect to Pressure Boundary modifications. Check if DTL has ensured all impacted Design documents are updated with code effective date used for implementation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Impacted documents as per those listed in N-FORM-11325, Code edition compatibility review Nuclear and Class 6.



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### Darlington Refurbishment Program Quality Plan

**NK38-NR-PLAN-09701-10001-0023-R000**  
2015-08-11

Order Number: N/A  
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Revision Summary

Revision Number	Date	Comments
R000	2015-08-11	Initial issue.

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### Records Table

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## 1.0 PURPOSE

The purpose of this Quality Plan (QP) is to address the quality requirements as they relate to the Darlington Refurbishment Program (DRP) per D-PCH-09701-10000, Darlington Refurbishment Project Charter. The objective of this QP is to outline the continuous quality surveillance that will be conducted to address the quality and regulatory requirements through all of the DRP phases, provide assurance that project completion assurance is obtained and to interface with the project staff and regulator.

This QP provides a link between the Ontario Power Generation's (OPG) Nuclear Management System and the quality systems of the contractors engaged in the DRP. Figure 1 depicts the overall quality management system hierarchy as implemented in OPG.

Work performed for the DRP will be subject to additional quality surveillance to ensure requirements of the Darlington Refurbishment Program Charter (D-PCH-09701-10000) are met. See Figure 2.

The preparation, approval, issue, distribution and revision of this QP is in accordance with OPG's Nuclear Management System. This QP, referenced OPG processes and Refurbishment procedures collectively meet the applicable requirements of CSA Standards and ISO (the International Organization for Standardization).

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## 2.0 REQUIREMENTS

### 2.1 Background

OPG senior management, with approval by the OPG Board of Directors and Shareholders tasked Nuclear Refurbishment with assessing the feasibility of refurbishing Darlington Nuclear Generating Station (DN GS) to enable operation for an additional 25 to 30 years.

Based on the conclusion that the refurbishment of DN GS is feasible and makes good business sense, OPG established contracts with a number of Contractors. Contracted activities include:

- Engineering (design and maintenance)
- Procurement
- Construction

OPG will also perform the above activities and conduct all required commissioning and return to service activities associated with the DRP.

### 2.2 Objectives

The objectives of the DRP are:

- i. Refurbish the Darlington Nuclear Generation Station to extend its operational life 25 to 30 years.
- ii. Complete preparations for the Refurbishment planned outages as follows:
  - Unit 2 - October 2016
  - Unit 3 - October 2019
  - Unit 1 - March 2021
  - Unit 4 – October 2022
- iii. Complete all Refurbishment Outages within the planned period with appropriate consideration to all aspects of the management of the facility including health, safety, environment, security, economics, quality and regulatory compliance.
- iv. Complete the DRP within the planned budget as approved by the OPG Board of Directors.

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- v. Complete all Refurbishment Outages with zero lost time accidents or restricted work injuries.

DRP requirements are:

- i. Refurbishment activities will be conducted in accordance with applicable federal, provincial and OPG requirements.
- ii. All refurbishment deliverables shall meet applicable Canadian Nuclear Safety Commission (CNSC) licensing requirements.
- iii. Environmental releases will be minimized and acceptable under all normal, abnormal and accident conditions in accordance with approved requirements.
- iv. Personnel exposures will be As Low as Reasonably Achievable (ALARA) through all phases (i.e., design, construction, commissioning, available for service and unit readiness) in accordance with Radiation Protection requirements.
- v. An integrated project schedule will be developed and maintained through the entire life of the DRP to ensure project design, verification, licensing, purchasing, fabrication, installation, construction, testing, commissioning and turnover activities are completed as scheduled.
- vi. The QP will be implemented to ensure all elements of the overall DRP are carried out as required and additional surveillance is conducted on the Refurbishment work.

## 2.3 Policy

To ensure refurbishment is completed in a safe, timely, economic sound manner and to the required quality expectations, the DRP implements the Darlington Refurbishment Program Charter (D-PCH-09701-10000) to perform work in accordance with the managed systems defined in:

- OPG-POL-0033, OPG Business Model,
- N-POL-0001, Nuclear Safety Policy,
- N-CHAR-AS-0002, Nuclear Management System.

All DRP project work will be conducted under the authority of OPG consistent with the licensing basis and in accordance with the OPG Nuclear Management System.

## 2.4 Licence Requirements

Per the Darlington Nuclear Generating Station Nuclear Power Reactor Operating Licence (PROL), the licensee is required to implement and maintain a management

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system in accordance with Canadian Standards Association (CSA) Standard N286, Management System Requirements for Nuclear Facilities. Figure 3 provides an overview of the regulatory requirements, project governance, and project executable processes.

For each Licence Condition (LC) in the PROL, the Licence Conditions Handbook (LCH) provides mandatory compliance verification criteria that the licensee must follow to meet the conditions in the licence, operational limits and information regarding delegation of authority and applicable version of documents referenced in the licence.

N-LIST-08130-10023, CSA N286-05 to OPGN Governance Cross Matrix provides a mapping of OPG Nuclear (OPGN) governance to CSA N286-05 to demonstrate the quality program compliance.

## 2.5 Organization

### 2.5.1 Project Organization

The Darlington Refurbishment Project Organization structure is described in the DRP Charter (D-PCH-09701-10000).

### 2.5.2 Project Quality Management Organization

The Project Quality Management Organization is depicted in Figure 4. This group will perform the following:

- Develop, maintain and implement a DRP Quality Plan that ensures the quality and management system requirements for the DRP are executed and completed.
- Establish and execute a project Quality Management Organization that:
  - a. Monitors, observes and performs continuous quality surveillance on each phase of DRP as a matrixed organization.
  - b. Provides assurance through the continuous quality surveillance activities that Project Completion Assurance is obtained.
  - c. Can escalate and implement corrective actions for critical issues.
  - d. Interfaces with other DRP internal and external independent assessment activities to coordinate and optimize the required quality surveillance activities for DRP.
- Establish metrics and reporting requirements that assess effectiveness of the DRP Quality Plan and surveillance activities performed.
- Oversee management of records of changes to the units during refurbishment.

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### 2.6 Personnel Capability

This work will be implemented by utilizing qualified OPG staff, contractors and subcontractors in accordance with N-TQD-901-00001, Nuclear Refurbishment Training and Qualification Description.

OPG has contracted a number of Engineering, Procurement and Construction Contractors for portions of the project scope. Consistent with OPG-POL-0033, OPG Business Model, all Contractors are on OPG's Approved Supplier's List (ASL).

### 2.7 Project Interfaces

The refurbishment project interfaces will occur between various organizations and contractors. The project shall develop a project execution plan, specific procedures, instructions, and guides, etc. to control the interfaces.

Interfaces will occur between:

- Refurbishment Project Team
- Darlington Station Organization
- OPG Nuclear Engineering
- Contractors
- Regulator (CNSC, TSSA, MOE, MOL etc.)
- Other utilities (Bruce Power, New Brunswick Power, etc.)

In accordance with the Contract Agreement, interface requirements between OPG and the Contractor are outlined in the Contractor Owner Interface Requirements (COIR). The following lists the key COIR documents associated with the DRP:

- N-COIR-00120-0001, Contractor Owner Interface Requirements for Nuclear
- NK38-DAI-09701-10008, Retube Feeder Replacement Project Contractor Owner Interface Requirements
- N-DAI-00150-10000 (Draft), Contractor/Owner Interface Requirements for Nuclear<sup>1</sup>

Any deviations to the interface agreement will be processed in accordance with OPG Nuclear Management System.

Table 1 outlines the contractors supplying services related to the DRP.

<sup>1</sup> This document was issued for bid purposes only.



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## 2.8 Documentation and Data Control

### 2.8.1 Records and Documentation Control

OPG's process for management of nuclear records and documents throughout their life cycle is addressed in N-PROG-AS-0006, Records and Document Control.

The intention is to use existing OPG processes as required. Quality Records prepared by the Contractor will be provided to OPG in accordance with the Contract Agreement. Vendor technical documents will be processed according to N-PROC-MP-0078, Specification Review, Acceptance and Use of Vendor Technical Documents.

### 2.8.2 Information Management

The OPG process for management of OPG's information is addressed in OPG-PROG-0001, Information Management.

## 2.9 Business Planning

OPG-POL-0033, OPG Business Model defines how OPG operates its business. The business planning framework to ensure compliance with OPG Nuclear Management System is identified in N-PROG-AS-0005, Business Planning. This program ensures organization alignment and defines desired results in sufficient detail to support accountability, and ensures constrains, the availability of resources, and business risks are adequately addressed.

## 2.10 Communication

Communication of this plan will be implemented in accordance with the Darlington Refurbishment Program Charter (D-PCH-09701-10000).

## 2.11 Design and Development

The framework for assurance that design and procedure changes are consistent with the plant design and licensing bases is outlined in N-PROG-MP-0009, Design Management.

The process for plant modification from the engineering change request through installation, commissioning and closeout is defined in N-PROG-MP-0001, Engineering Change Control.

The Contractor will conduct design, modification, installation, support commissioning and closeout activities in accordance with the contract agreement.

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### 2.12 Materials Management (including identification and traceability)

For material procured by OPG to meet the DRP scope requirements, the general identification and traceability control is provided in OPG-PROG-0009, Items and Services Management.

For materials procured by the Contractor, the requirements for material identification, shipping and traceability are in accordance with the Contract Agreement.

### 2.13 Corrective Action

The process to ensure that deficiencies, nonconformance, weakness with a process, document or service or conditions that adversely impact, or may adversely impact plant operation, personnel, Nuclear safety, the environment or equipment and component reliability are promptly identified and corrected is addressed in N-PROG-RA-0003, Corrective Action.

This program also provides the process to ensure in-house and external Operating Experience (OPEX) evaluation and assessment including actions to improve plant safety and reliability. Effective self-assessment and benchmarking process are also implemented by this program to promote continuous performance improvement.

Contractors will manage corrective actions in accordance with the Contractor Agreement.

### 2.14 Monitoring and Measurement

Work plans generated from Contractors and OPG, testing requirements, regulatory interface etc. are monitored with sufficient verification and validation to meet project requirements as outlined in this plan (see Section 2.14 for additional details).

### 2.15 Independent Assessments

N-PROG-RA-0010, Independent Assessments provides the processes for performing comprehensive and critical evaluation of all activities affecting Nuclear facilities (i.e., independent assessments performed by Nuclear Oversight and Nuclear Safety Review Board). The Program is owned and implemented on behalf of the Chief Nuclear Officer (CNO) by the Assurance Organization under OPG Business Model, OPG-POL-0033.

External assessments are also performed by groups outside of OPG such as WANO, CNSC, Ministry of Labour (MOL), Ministry of Environment (MOE) etc.

### 2.16 Quality Surveillance

The Project Quality Management Organization will conduct continuous quality surveillance activities on the Refurbishment projects during the following phases (See Figure 5):

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1. Shutdown/Layup
2. Design
3. Procurement
4. Construction
5. Commissioning
6. Available for Service
7. Unit Readiness
8. Closeout

An implementing document will be prepared to outline the details associated with the above surveillance activities.

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### 3.0 ROLES AND ACCOUNTABILITIES

This QP identifies the Director, Quality Manager's role and responsibilities. Further details of project team roles and responsibilities are contained in approved role documents, project execution plan and other project documents.

Contractors will manage responsibilities in accordance with their contract agreement.

#### 3.1 Director, Quality Management

- Responsible for ensuring the quality and management system requirements for the DRP are executed and completed.
- Responsible for ensuring continuous quality surveillance is performed during each phase of DRP.
- Responsible for providing assurance through the quality surveillance activities that Project Completion Assurance is obtained.
- Can escalate and implement corrective actions for critical issues.
- Responsible for the interfaces with other DRP internal and external assessment activities to coordinate and optimize the required quality surveillance activities for DRP.
- Responsible for establishing metrics and reporting requirements that assess effectiveness of the DRP Quality Plan and surveillance activities performed.
- Can direct specific quality surveillance activities to prevent incidences based on risk and OPEX.
- Oversee management of records of changes to the units during refurbishment.

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## **4.0 DEFINITIONS & ACRONYMS**

### **4.1 Definitions**

None

### **4.2 Acronyms**

ALARA	As Low as Reasonably Achievable
ASL	Approved Supplier's List
CNO	Chief Nuclear Officer
CNSC	Canadian Nuclear Safety Commission
COIR	Contractor Owner Interface Requirements
CSA	Canadian Standards Association
DNGS	Darlington Nuclear Generating Station
DRP	Darlington Refurbishment Program
ESMSA	Extended Services Master Service Agreement
ISO	International Organization for Standardization
LC	Licence Condition
LCH	Licence Conditions Handbook
MOE	Ministry of Environment
MOL	Ministry of Labour
OPEX	Operating Experience
OPG	Ontario Power Generation
OPGN	Ontario Power Generation Nuclear
PROL	Power Reactor Operating Licence
QP	Quality Plan
TSSA	Technical Standards and Safety Authority

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WANO

World Association of Nuclear Operators

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## 5.0 REFERENCES

### 5.1 Performance References

1. N-COIR-00120-0001, Contractor Owner Interface Requirements for Nuclear.
2. NK38-DAI-09701-10008 R001, Retube Feeder Replacement Project Contractor Owner Interface Requirements.
3. N-DAI-00150-10000 (Draft), Contractor/Owner Interface Requirements for Nuclear.<sup>2</sup>
4. OPG-PROG-0001, Information Management.
5. N-LIST-08130-10023 R003, CSA N286-05 to OPGN Governance Cross Matrix.
6. N-TQD-901-00001, Nuclear Refurbishment Training and Qualification Description.

### 5.2 Developmental References

1. OPG-POL-0033, OPG Business Model.
2. N-POL-0001, Nuclear Safety Policy.
3. N-CHAR-AS-0002, Nuclear Management System.
4. D-PCH-09701-10000, Darlington Refurbishment Program Charter.
5. CAN/ISO 10005:2005, Quality Management – Guidelines for quality plans.
6. OPG-PROG-0009, Items and Services Management.
7. N-PROG-AS-0006, Records and Document Control.
8. N-PROG-AS-0005, Business Planning.
9. N-PROG-MP-0009, Design Management.
10. N-PROG-MP-0001, Engineering Change Control.
11. N-PROG-RA-0003, Corrective Action.
12. N-PROG-RA-0002, Conduct of Regulatory Affairs.
13. N-PROG-RA-0010, Independent Assessment.

<sup>2</sup> This document was issued for bid purposes only.

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## Appendix A: Figures

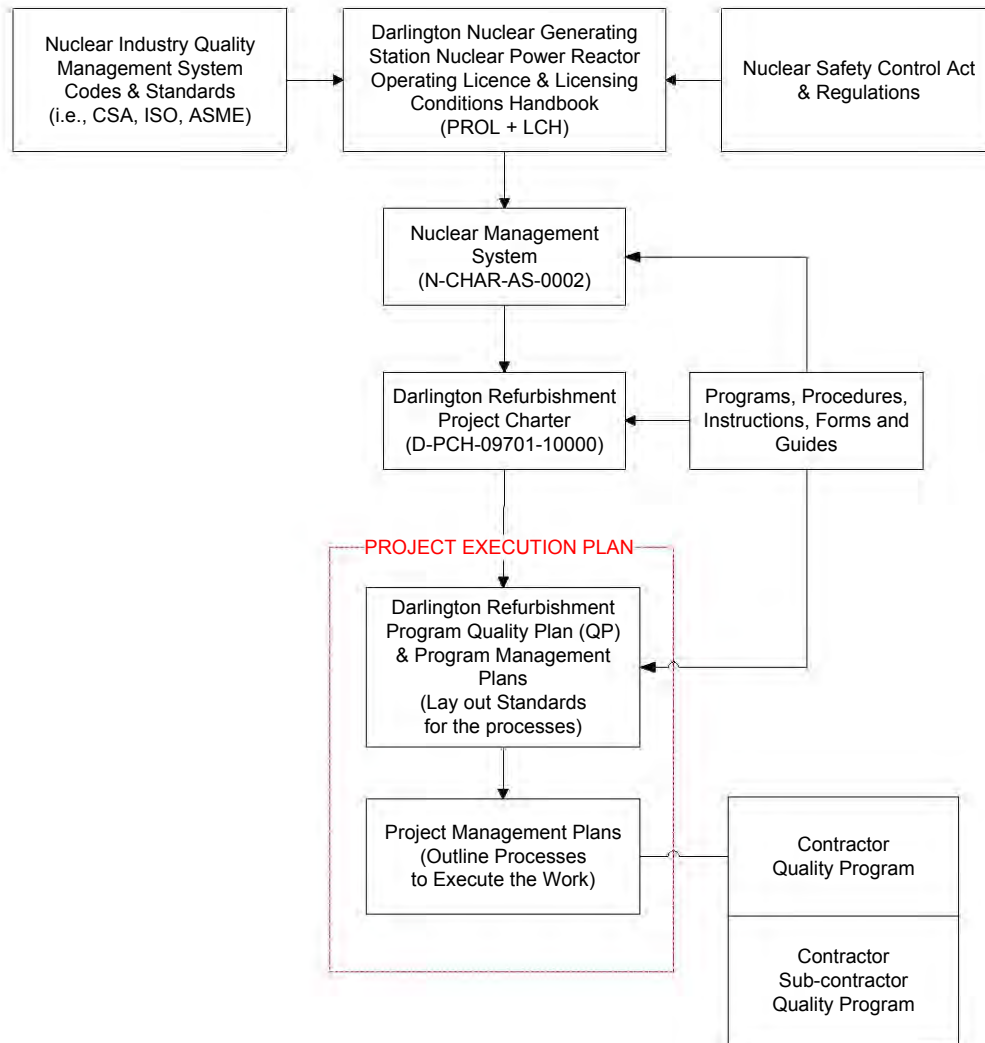


Figure 1: DRP Quality Management System Hierarchy



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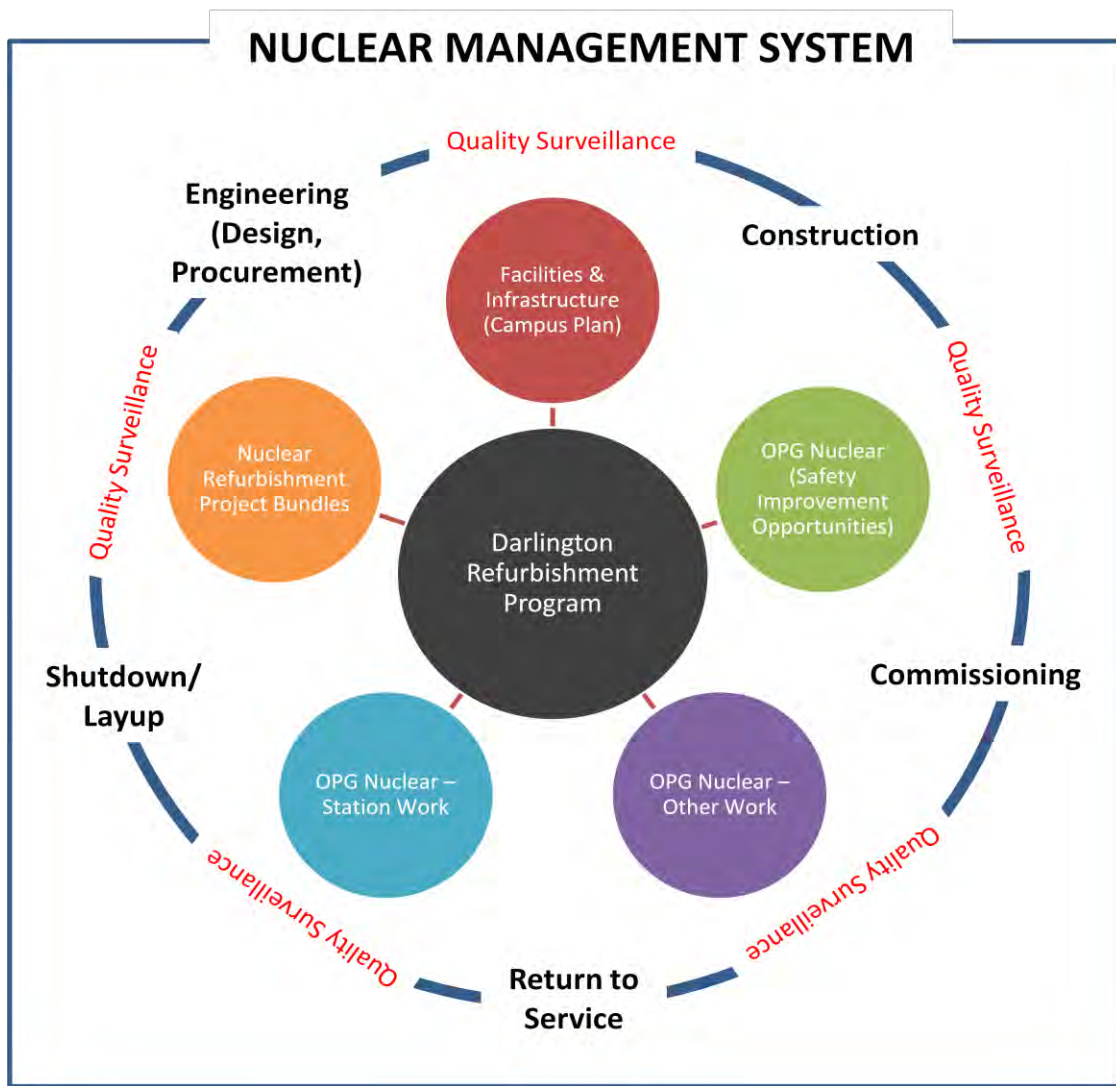


Figure 2: DRP Quality Management Overview

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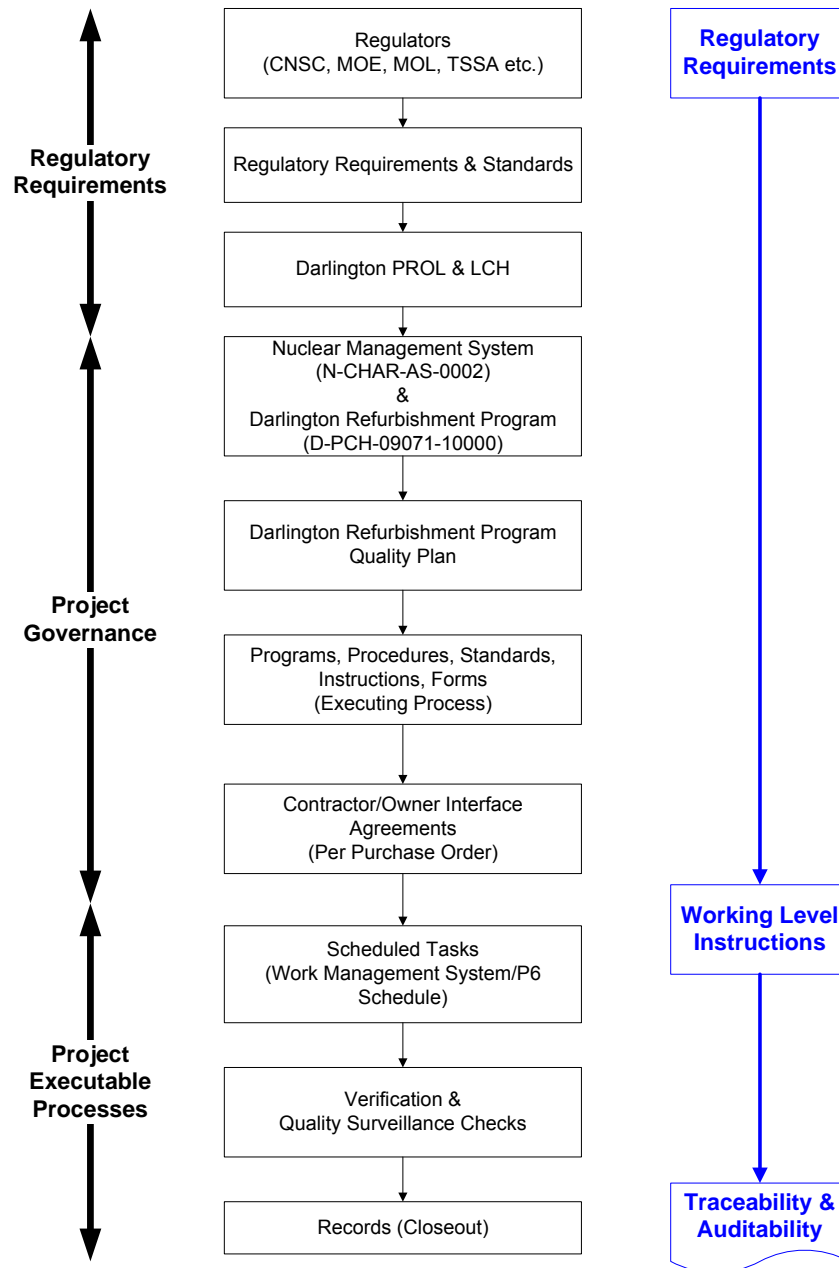


Figure 3: Overview of Regulatory Requirements to Executable Processes

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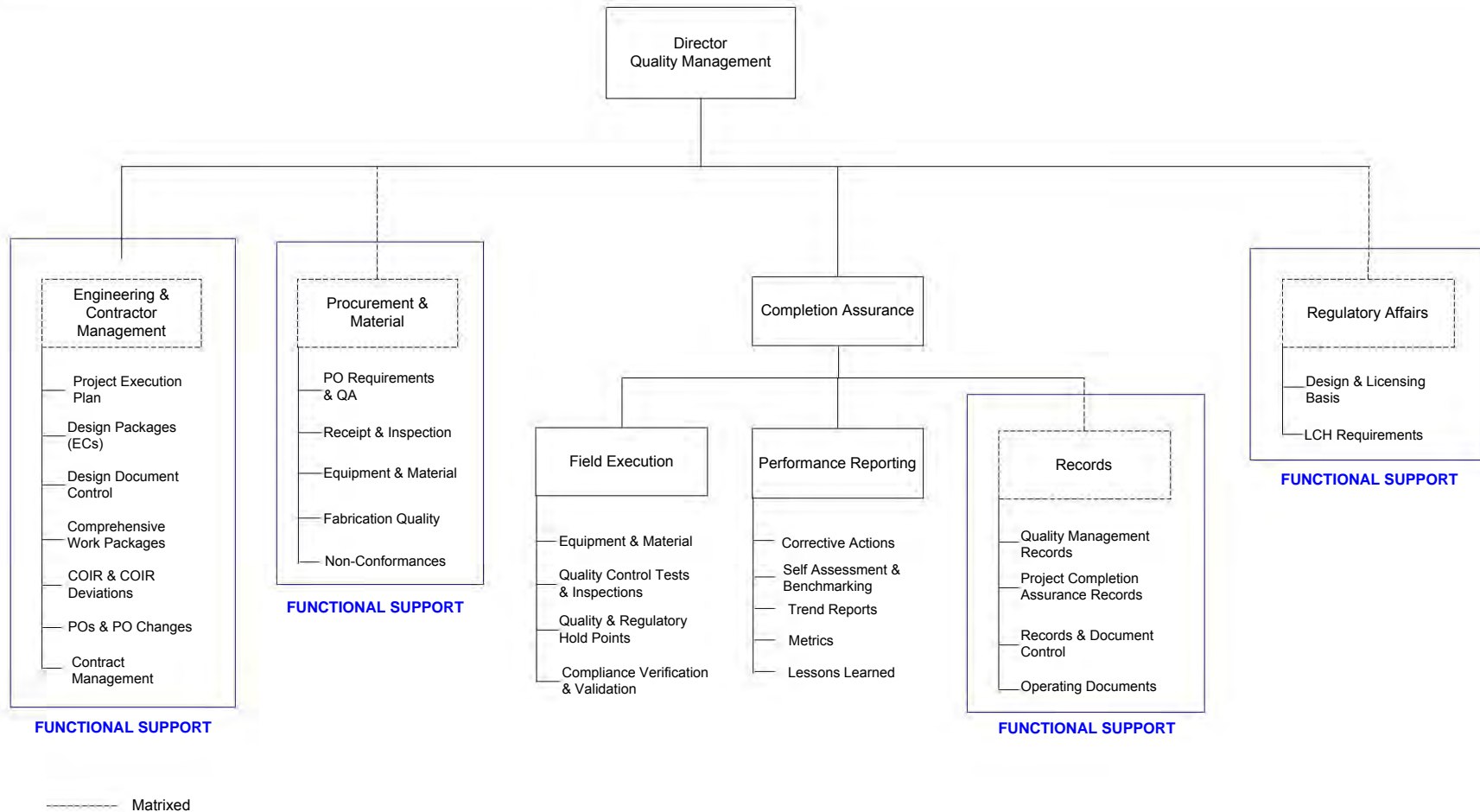


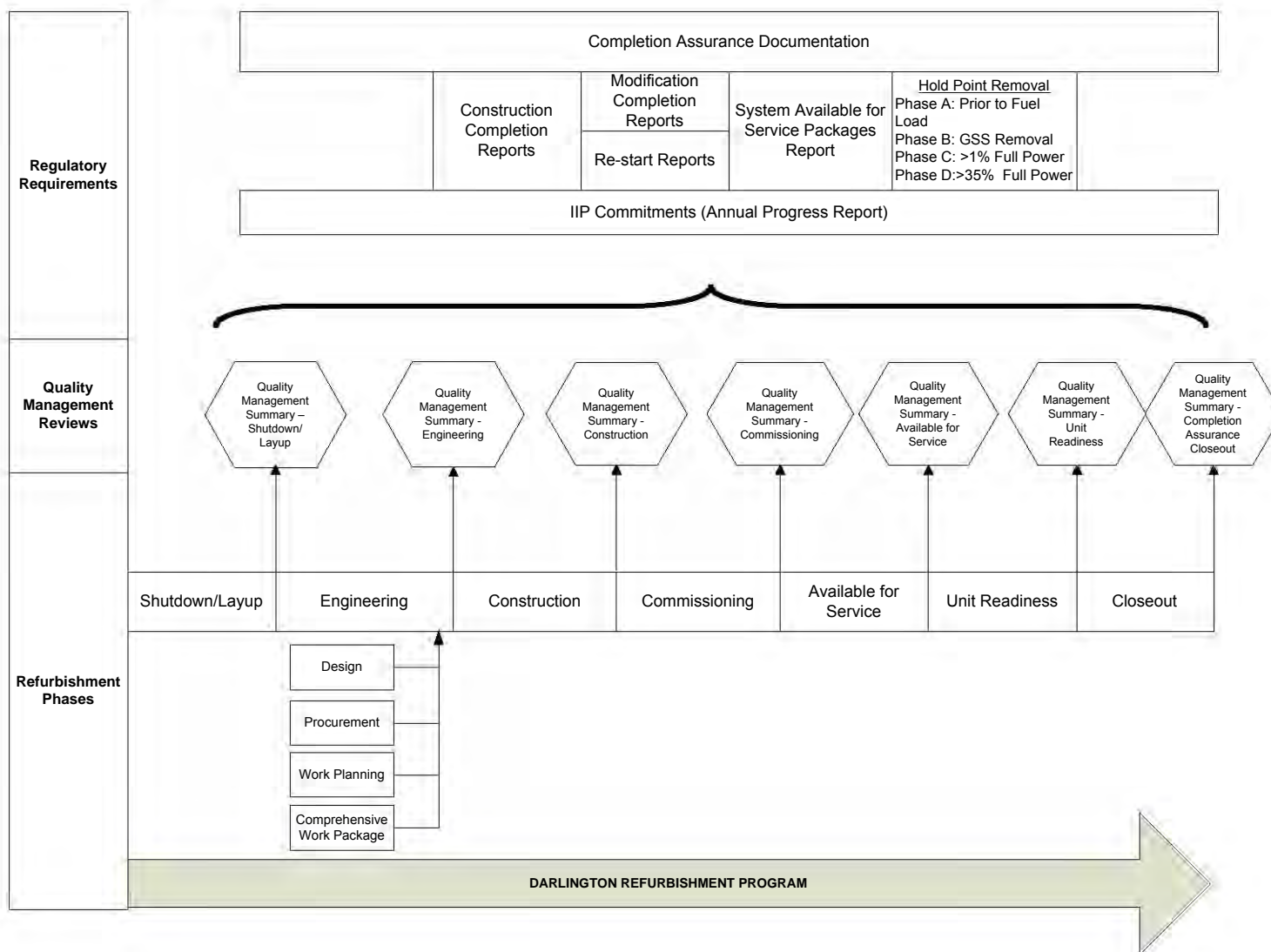
Figure 4: Project Quality Management Organization

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**Figure 5: Quality Surveillance for Regulatory Compliance**

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## Appendix B: Tables

The following table lists the contractors involved in the various phases of the DRP. Note, this list is subject to change.

**Table 1: Summary of Contractors**

Contractor	Project Bundle							
	Cyclic Maintenance	RFR	Fuel Handling	Turbine	Steam Generator	Unit Islanding	Shutdown Layout	Balance of Plant
<b>Engineering</b>								
CANDU Energy		X						
SNC-Lavalin Nuclear Inc.		X						
General Electric Hitachi			X					
Alstom				X				
SNC-Lavalin Nuclear Inc./Aecon				X		X	X	
Babcock & Wilcox					X		X	X
ESMSA (ES Fox or Black & MacDonald)						X	X	X
Areva								X
AMECFW								X
<b>Procurement</b>								
General Electric Hitachi			X					
Alstom				X				
SNC-Lavalin Nuclear Inc./Aecon		X	X	X		X	X	
Babcock & Wilcox					X		X	X
ESMSA (ES Fox or Black & MacDonald)						X	X	X
Areva								X
AMECFW								X
<b>Construction</b>								
Aecon		X				X		
SNC-Lavalin Nuclear Inc./Aecon			X	X			X	
Babcock & Wilcox					X		X	
ESMSA	X		X			X	X	X
<b>Commissioning (support as needed)</b>								
Aecon		X				X		
SNC-Lavalin Nuclear Inc./Aecon			X	X			X	
Babcock & Wilcox					X		X	
ESMSA (ES Fox or Black &			X			X	X	X

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Contractor	Project Bundle							
	Cyclic Maintenance	RFR	Fuel Handling	Turbine	Steam Generator	Unit Islanding	Shutdown Layout	Balance of Plant
MacDonald)								
<b>Operation (support as needed)</b>								
SNC-Lavalin Nuclear Inc./Aecon		X	X	X		X	X	
Babcock & Wilcox			X		X		X	
ESMSA (ES Fox or Black & MacDonald)						X	X	X



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RETUBE FEEDER REPLACEMENT PROJECT CONTRACTOR\OWNER INTERFACE REQUIREMENTS

Prepared by: MCCABE, GREGG



**Deliverables and Activities  
Interface Agreement**

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**RETUBE FEEDER REPLACEMENT PROJECT  
CONTRACTOR/OWNER INTERFACE REQUIREMENTS**

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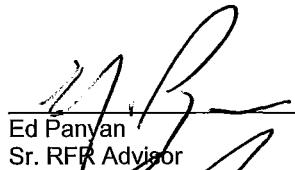
**RETUBE FEEDER REPLACEMENT PROJECT  
CONTRACTOR/OWNER  
INTERFACE REQUIREMENTS**

**(Purchase Order 213497)  
2015-05-08**

Associated Project Number: 73100

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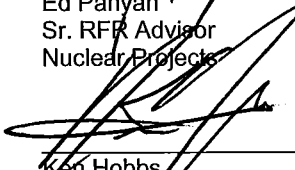
Prepared by:

  
Ed Panyan  
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Date:

JUNE 8 2015


Approved by:

  
Ken Hobbs  
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8-JUNE-2015

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Date

8 JUN 2015



## Contractor/Owner Interface Agreement

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### RETUBE FEEDER REPLACEMENT PROJECT CONTRACTOR/OWNER INTERFACE REQUIREMENTS

#### Revision Summary

Revision No.	Description of Revision:
R000	Initial Issue
R001	Obsolete. All subsequent revisions are made against the R000 version of the document
R002	<ul style="list-style-type: none"> <li>Incorporation deviation list previously agreed to in September 2013; <ul style="list-style-type: none"> <li>Item 3.25: Reference updated</li> <li>Item 4.11: Contractor's procurement activities to be in accordance with the EPC agreement. Where sub-contractors are not on OPG ASL, the Contractor shall follow the agreements submittal process. Appendix E added to clarify.</li> </ul> </li> <li>Updates since September 2013</li> <li>General: <ul style="list-style-type: none"> <li>replaced 'PassPort' with 'Asset Suite'</li> <li>replaced 'SDH' with 'VenDM'</li> <li>replaced 'OPG Project Representative' with 'OPG'</li> <li>replaced 'Contractor Project Representative' with 'Contractor'</li> </ul> </li> <li>Section 2.1 Process: <ul style="list-style-type: none"> <li>Deleted text qualifying the scope of application; i.e., limiting scope to only 'nuclear related' work. Included explanation of the use of deviation list.</li> <li>Removed engineering and procurement gap analysis reference.</li> </ul> </li> <li>Section 2.2; added "and Project Quality Assurance Plan"</li> <li>Section 2.2.1: <ul style="list-style-type: none"> <li>Text updated to align COIR with OPG/JV RFR project agreement.</li> <li>Clarified applicability of Category 1 tooling.</li> <li>Included reference to N-PROC-MP-0105</li> <li>OPG Enterprise Asset Management – Asset Suite 7</li> <li>Identified N-GUID-08133-10072 as a new reference</li> </ul> </li> <li>Section 2.2.2: revised wording with respect to PEO Act and removed reference to Bounded Set.</li> <li>Section 2.3 OPG Roles and Accountabilities <ul style="list-style-type: none"> <li>Item (e) removed; "OPG shall be involved in developing Commissioning work plans (or comprehensive work packages) for OPG approval." Accountabilities are now detailed in Section 5.</li> </ul> </li> <li>Section 2.4: Added 'It is expected the Contractor will retrieve the latest version of OPG forms, templates and procedures etc. at the beginning of each Contractor activity.'</li> <li>Section 2.5 Deviations from the IR: <ul style="list-style-type: none"> <li>Identified the use of N-FORM-11070</li> </ul> </li> <li>Engineering (Section 3) updates <ul style="list-style-type: none"> <li>Section 3.0: deleted 'All Category 1 tooling and' from introductory</li> </ul> </li> </ul>

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	<p>sentence.</p> <ul style="list-style-type: none"> <li>○ Item 3.2; Removed 'Business Services (where not otherwise specified in this document as required to support OPG's QA program.</li> <li>○ Item 3.5 'Reports' reitemized as 3.5 a). Clarified that OPG accountability includes Review in the title. Added 3.5 b) 'Certified Design Report' to distinguish the OPG and Contractor references to be used for each.</li> <li>○ Item 3.9; added N-FORM-11524 as reference and deliverable.</li> <li>○ Item 3.13: deleted 'or equivalent' from deliverable.</li> <li>○ Item 3.17; updated to reflect OPG is accountable for Master EC preparation. Contractor to support as required. Added N-GUID-08133-10072.</li> <li>○ Item 3.28, 3.37, 3.39, 3.72, 3.76, 3.77, 3.88; Clarified use of N-GUID-08133-10072.</li> <li>○ Item 3.19; clarified OPG to support as required.</li> <li>○ Item 3.20: 'Modification Design Requirements': Title changed to Package Design Requirements. Accountabilities updated; Modification Design Requirements are to be prepared by OPG. Package Design requirements are to be developed by the Contractor. Contractor references added.</li> <li>○ Item 3.21; Cross reference corrected to 3.87.</li> <li>○ Item 3.23; Changed 'Field Verifies' to 'Verifies' in Contractor Accountability. Contractor references updated.</li> <li>○ Item 3.25: Changed reference from 2206-07-20-TF0001 to -TF0038.</li> <li>○ Item 3.27: specified that Issue Tracking File deliverable will be included in Section 4 of the Design Plan and that a copy will reside in the working files folder.</li> <li>○ Item 3.32: Item titled changed from 'Design Manuals – New' to 'Design Manuals'.</li> <li>○ Item 3.34: added N-PROC-MP-0089 reference.</li> <li>○ Item 3.37: OPG APPROVE Accountability removed. Provided clarity on support role.</li> <li>○ Item 3.39: Replaced 'N-INS-03561-10007' with 'N-GUID-03651-10002'</li> <li>○ Item 3.44; added NK38-GUID-50000-10001 reference</li> <li>○ Item 3.46: clarified OPG accountability is ACCEPT</li> <li>○ Item 3.47; added 2206-07-WI-0003 reference and HF Engineering Program Plan and HF work sheets as deliverables.</li> <li>○ Item 3.51; editorial – ACCEPT added to title to reflect existing text.</li> <li>○ Item 3.52: added NK38-GUID-01900-10001, Darlington Refurbishment: Design Completion Assurance to references</li> <li>○ Item 3.54; reference N-GUID-01900-10001 replaced with NK38-GUID-01900-10001.Verification 'Report' deliverable changed to Verification 'Package'</li> <li>○ Item 3.58: changed reference 'N-PROC-MA-0095' to 'N-INS-</li> </ul>
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	<p>08125-10001'</p> <ul style="list-style-type: none"> <li>○ Item 3.64: editorial – ACCEPT added to title to reflect existing text. Cross reference to items 3.66 and 3.67 corrected to 3.65 and 3.66</li> <li>○ Item 3.65; changed reference list to include Contractor references only. Deleted 'per an OPG approved process for controlling change' from Contractor Accountability.</li> <li>○ Item 3.70; added Derived Requirements to contractor accountability.</li> <li>○ Item 3.71; cross reference corrected to identify item 3.72</li> <li>• Procurement (Section 4) updates <ul style="list-style-type: none"> <li>○ Item 4.3: Reference to '3.78' corrected to '3.77'.</li> <li>○ Item 4.7: Clarified Procurement Evaluation is for Maintenance Spare Parts and added N-PROC-MP-0098.</li> <li>○ Item 4.13: removed text 'if disposition suggests use as is or requires repair/rework'. Contractor reference updated.</li> <li>○ Item 4.14 a) retitled as 'Non Conformances (Not applicable to OSM Tooling). Contractor reference updated.</li> <li>○ Item 4.14 b) retitled as 'Non Conformances (Applicable to OSM)' and added accountabilities. Previous item listed as 4.14 b), 'Non-conformance post execution' reitemized as 4.14 c)</li> </ul> </li> <li>• Construction (Section 5) updates <ul style="list-style-type: none"> <li>○ Items 5.1; added Reference. Specified that deliverable is a Construction Quality Assurance Plan.</li> <li>○ Item 5.2; separated into a) Safety Program and b) Environmental Program. No change in accountabilities.</li> <li>○ Item 5.4 'Control of Field Changes'; clarified work to be performed under a) ECC - OPG governance and work to be performed under b) Non ECC - Contractor governance. Accountabilities for non ECC changes clarified.</li> <li>○ Item 5.5: Contractor References Added. Removed OPG accountability to approve the schedule.</li> <li>○ Item 5.6: clarified 'Work Order Assessing/Planning' to be performed under a) OPG governance and b) Contractor governance.</li> <li>○ Item 5.7: retitled 'Work Plans'; clarified work to be performed under OPG governance. Update OPG references.</li> <li>○ Item 5.8: retitled 'Preparation of Comprehensive Work Package'. Preparation and content clarified in 5.8 a) thru 5.8 j). Contractor references added.</li> <li>○ Item 5.9: specified readiness/challenge meeting and work release to be performed under a) OPG governance and b) Contractor governance.</li> <li>○ Item 5.10: specified permitry planning for a) OPG equipment and b) Contractor Tools and Equipment.</li> <li>○ Item 5.11: specified permitry execution for a) OPG equipment and b) Contractor Tools and Equipment</li> <li>○ Item 5.12; clarifies OPG is the approving authority. Updated</li> </ul> </li> </ul>
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	<p>references and deliverables.</p> <ul style="list-style-type: none"> <li>○ Item 5.13: specified Calibration for a) permanent station equipment and b) Contractor Equipment. Replaced reference 'N-INS-01516-10009' to 'N-INS-09100-10012'.</li> <li>○ Item 5.13 a) Changed reference 'N-INS-01983.1-10012' to 'N-MAN-01983-10000'.</li> <li>○ Item 5.13 a) OPG accountability changed from Support to Review and Accept.</li> <li>○ Item 5.14: title changed from 'Construction Completion Certificate' to 'Construction Completion Declaration (Return to Service)'. OPG References replaced with Contractor References.</li> <li>○ Item 5.15: retitled 'Contract Construction Completion'; updated to reflect contract requirements</li> <li>○ Item 5.16: Added N-GUID-09701-10020</li> <li>○ Item 5.17: modified to reference Item 3.69</li> <li>○ Item 5.18: modified to reference Item 3.70</li> <li>○ Item 5.19 'Vault Access'; New. Accountabilities clarified.</li> <li>○ Item 5.20 'Plant Status Control'; New. Added to reflect OPG governance.</li> </ul> <ul style="list-style-type: none"> <li>• Appendix A updates <ul style="list-style-type: none"> <li>○ Replaced 'N-INS-01516-10009' with 'N-INS-09100-10012' which superseded it. It was a duplication of work reporting requirements for M&amp;TE.</li> <li>○ Removed reference to N-INS-08132-10000 as it has been obsoleted as this legacy document under N-PROG-MP-0001 was rarely used.</li> <li>○ Replaced 'N-PROC-MA-0095' with 'N-INS-08125-10001' which superseded it. N-INS-08125-10001 gets direct authority from N-PROC-MP-0034 under N-PROG-MA-0026.</li> <li>○ Removed reference to FIN-MAN-CM-001 as it has been obsoleted as each BU developed governance for management of contractors which replaces OPG wide FIN-MAN documents.</li> <li>○ Replaced 'N-INS-01983.1-10012' with 'N-MAN-01983-10000' which superseded it. The governing document framework specified in N-PROG-AS-0007 has been changed.</li> <li>○ Replaced 'N-PROC-AS-0069' with 'N-MAN-01983-10000' which superseded it. The governing document framework specified in N-PROG-AS-0007 has been changed.</li> <li>○ Reference 'N-GUID-08130-10008' removed as it has been replaced by the Assessing On-Line Guide.</li> </ul> </li> </ul>
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### RETUBE FEEDER REPLACEMENT PROJECT CONTRACTOR/OWNER INTERFACE REQUIREMENTS

## 1.0 INTRODUCTION

### 1.1 Scope

This Interface Requirements (IR) outlines the specific responsibilities and interfaces between OPG and the SNC Lavalin-Aecon Joint Venture ("the Contractor") while performing activities in support of the Retube Feeder Replacement (RFR) Project for the Darlington Refurbishment.

### 1.2 Purpose

The purpose of the IR is to facilitate the successful implementation of the RFR Project by ensuring that Engineering, Procurement, and Construction activities are in conformance with OPG and other regulatory requirements.

### 1.3 Safety

Safety is the paramount priority when conducting any business activity in OPG Nuclear.

Safety includes Nuclear, Conventional, Environmental, and Radiological safety aspects. Our business needs to comply with all applicable Federal and Provincial regulatory requirements.

## 2.0 DESCRIPTION

### 2.1 Process

This IR is to be used for any work conducted under the RFR project.

Specific work packages including modifications, replacement and repair activities may be required to use only some portions of this document. These will be documented in a deviation list (see section 2.5), signed by OPG and the contractor. Contractor steps may not apply to all work and are illustrative to support the OPG/Contractor Interface Requirements. The items in this IR are intended to outline the interface with OPG and the Contractor, and may or may not be sequential or reflective of business processes within OPG.

A gap analysis (NK38-REP-09701-10121) was completed to determine what processes and procedures under the Contractor's quality assurance program were deemed equivalent to OPG standards and requirements. Those processes and procedures acceptable to OPG are cited in Sections 3 and 4. A summary of both OPG and SLN-A governance has been provided in section Appendix A. Sections 3 to 5 of this document details typical deliverables or items related to projects where there is an OPG/Contractor interface in the delivery of work.

### 2.2 Contractor Responsibilities

The Contractor shall have and maintain full working knowledge of OPG's Design and Configuration Management standards and procedures to ensure that design basis and plant configuration management standards are maintained throughout the project life cycle.

The Contractor has responsibility for maintaining accuracy of technical content and compliance with the Contractor's Quality Assurance Program and Project Quality Assurance Plan.

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#### 2.2.1 Governing Procedures

All design packages will be performed in accordance with the Contractor's Quality Assurance Program, the Scope of Work which includes OPG Specification for each project, and any related Engineering Plans as defined in this IR.

All modifications will follow OPG Risk Based Modification Process N-PROC-MP-0090, with the exception of Category 1, 2, 3 and 4 Tooling engineering and Mock-ups engineering. With respect to procurement activities, in case of conflict, the provisions in Exhibit 2.11- Procurement Work, shall take precedence over the interface requirements set out in this document.

Category 1 Tooling tie-ins to the station follow N-PROC-MP-0090.

Category 1, 2 and 3 Tooling follows N-PROC-MP-0105.

Category 1, 2, 3 and 4 Tooling will follow Tooling Quality Design Plan NK38-DP-31110-10001 and are not subject to these interface requirements.

Mock-ups engineering will follow the Contractor's Quality Assurance Program and Project Quality Assurance Plan (SLN 509407-000-00D00-38QP-0001).

Tooling design will follow the requirements set out in section 4.6 of NK38-DR-31110-10000 (Contract Exhibit 1.1 (hhhhhhh) - Tooling Design Requirements).

Mock-up design will follow the requirements in Darlington Energy Complex (DEC) Mockup Scope of Work (Schedule 1.1 (oo) -Mock-Ups Scope of Work within Contract Exhibit 1.1 (www) - Mock-Ups Contract).

The Preparer, Verifier, and Approver of the Design Packages must be qualified to the Contractor's quality assurance program.

#### **OPG Enterprise Asset Management - Asset Suite 7 (Formerly PassPort)**

Asset Suite will remain as a repository for EC changes and to control modification packages as per the CNE Directive.

Population of Asset Suite will not be sequential with modification progression. Rather only relevant Asset Suite panels will be populated as needed to progress work and maintain configuration management (per N-GUID-08133-10072). The Contractor will be required to populate the relevant Asset Suite panels at the end of the following modification phases:

- At the start of **Scoping** to register Master ECs.
- At the end of **Modification Planning** to populate Master ECs, register Design ECs and flag the Associated Document List (ADL)/Associated Equipment List (AEL).
- At the end of **Design Completion** and prior to **Available for Service** to incorporate all field, and non-intent changes.
- Prior to **Closeout** to launch the AEL, and populate closeout related panels.

A scanned version of the approved Master EC Binder and/or Design Package shall be uploaded to VenDM. When the opportunity arises to populate Asset Suite, the EC packages shall be attached to the RDL of the relevant Master or Design EC.

Approval of the EC resides with the scanned copies of the packages in VenDM or Asset Suite.

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### 2.2.2 Professional Engineers of Ontario (PEO)

The Contractor shall comply with the Professional Engineers Act, R.S.O. 1990 and any applicable regulations and guidelines.

### 2.3 OPG Roles and Accountabilities

OPG shall appoint single points of contact for project related work utilizing this document.

**NOTE:** OPG does not accept accountability for the accuracy of technical content of any document produced by the Contractor, including verifications of any assumptions regarding existing condition of the equipment/system interfacing with the new modification.

OPG roles / accountabilities as defined in sections 3 to 5 of this document are defined as follows:

#### (1) Review

Review means that when stated in the Design Plan or in the approved IR document or in the agreement between OPG and Contractors, a signed copy of the specific Engineering Document will be transmitted to OPG for comments, and an acknowledgment of receipt is to be recorded by the Contractor.

An OPG review is to ensure that the deliverable satisfies the project scope & design requirements, and procedural compliance to the specified governance within this IR. OPG reserves the right to conduct a further detailed review of the deliverable if OPG feels necessary.

#### (2) Accept

Accept means that the document or deliverable is suitable for its intended use, and meets process, format and content per Section 3.0, 4.0, and 5.0 as required for its input into the OPG's Enterprise Asset Management System (Asset Suite).

#### (3) Authorize

Means to permit or allow the use of the engineering product by others.

#### (4) Support

As applicable, Support means to lend the Contractor verbal and process guidance by:

- Attending and contributing at meetings.
- Participating in discussions and providing informal undocumented comments.

#### (5) Approve



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- (a) Engineering Approval is conducted by the Contractor under the Contractor's QA program. Approval of engineering design documentation may require a Professional Engineer's (P. Eng) signature and seal. Such approval means taking professional design responsibility for the engineering document. P. Eng. Signature requirements are specified in N-LIST-01300-10000, Bounded Document Set.
- (b) OPG or Design Authority (DA) approval shall be performed by OPG to signify OPG's acceptance that the product(s) is prepared, reviewed, and verified by competent persons and that appropriate processes/procedures including codes and standards were applied. In addition, the approval shall ensure that the document or deliverable is suitable for its intended use, and meets process, format and content requirements as required for its input into the OPG Records Management system.
- (c) Director of Operations & Maintenance (DOM) approval signifies the deliverable has no significant impact on Plant Operations and License obligations (e.g., Safety, Environmental, Production etc.).
- (d) OPG shall be actively involved and have ownership of the development of the Modification Design Requirements and Commissioning Specifications for OPG approval.

## **2.4 Forms and Template Revisions**

It is expected the Contractor will retrieve the latest version of OPG forms, templates and procedures etc. at the beginning of each Contractor activity.

If a revision to an EC or document is required, the forms and templates originally used in preparation of the initial EC or initial document shall not need to be updated to the most current form or template revision unless required to do so by the Design Authority.

## **2.5 Deviations from the IR**

Deviations from this IR will be documented via N-FORM-11070, the Scope of Work or Applicable Master EC Package.

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### 2.6 Abbreviations and Acronyms

ADL	- Affected Document List
AEL	- Affected Equipment List
AFS	- Available for Service
ANI	- Authorized Nuclear Inspector
ANIA	- Authorized Nuclear Inspection Agency
BOM	- Bill of Materials (Spare Parts for Equipment)
CCD	- Computer & Control Design Specialist
CD	- Control Document
CNSC	- Canadian Nuclear Safety Commission
COMS	- Constructability, Operability, Maintainability and Safety
DA	- Design Authority, Darlington Nuclear of Darlington Refurbishment
DBOM	- Drawing Bill of Materials
DE	- Design Engineer
DO	- Drawing Office
DOM	- Director of Operations and Maintenance
DP	- Design Plan
DLA	- Designated Licensing Authority
DR	- Design Requirements
EBOM	- Equipment Bill of Materials (Spare Parts)
EC	- Engineering Change
EQ	- Environmental Qualification
FIC	- Field Initiated Change
HFE	- Human Factor Engineering Specialist
JHSC	- Joint Health and Safety Committee
LOTO	- Lock Out Tag Out
MDR	- Modification Design Requirements
MEL	- Master Equipment List
MO	- Modification Outline
MR	- Material Request
OHSA	- Occupational Health and Safety Act
OLW	- On-Line Wiring
P. Eng	- Professional Engineer (Licensed in Ontario)
PMID	- Preventative Maintenance ID
PSR	- Pre-Start Health and Safety Review
QA	- Quality Assurance
RFP / Q	- Request for Proposal / Quote

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RDL	- Reference Document List
SCL	- System Classification List
SPOC	- Single Point of Contact
SRE	- System Responsible Engineer
SM	- Section Manager
SME	- Subject Matter Expert
SPMP	- System Performance Monitoring Plan
SSC	- System, Structure or Component
TPAR	- Technical Procedures Action Request
TSSA	- Technical Standards and Safety Authority
VenDM	- Vendor Document Management

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### 3.0 ENGINEERING INTERFACE MATRIX

*Modifications associated with the project shall be carried out in accordance with the N-PROC-MP-0090. The Preparer, Reviewer, Verifier, and Approver of the Design Packages shall be qualified to the Contractors quality assurance program.*

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.1	Reservation, Superseding & Obsolescence of Controlled Document / Record Numbers	N-PROC-AS-0003 N-FORM-10027	<b>SUPPORT</b> OPG to provide support if required	<b>ACCOUNTABLE</b> Prepare Controlled Document Request Form as per procedure and template and forward electronically to OPG Controlled Documents inbox.  For Superseding and Obsoleting, obtain concurrence from OPG Document Owner prior to submission.	N-FORM-10027
3.2	Submission of Controlled Documents / Records to OPG	N-PROC-AS-0003 N-FORM-10027 N-FORM-10653	<b>ACCOUNTABLE</b> OPG to receive approved documents in VenDM and submit necessary documents to into Asset Suite.	<b>ACCOUNTABLE</b> Submit documents to OPG for acceptance via VenDM and flag if the documents are to be kept as permanent record in Asset Suite.	Accepted Documents in VenDM  Issued Documents or Records into Asset Suite.
3.3	Comment & Disposition Document		<b>SUPPORT</b> OPG to provide comments as required to the Contractor.	<b>ACCOUNTABLE</b> Submit signed documents to OPG for Review and Comment.  One (1) Review Cycle will be the target (complete when Dispositions have been concurred by OPG)	Comment and Disposition Sheet
3.4	Station Condition Records (SCR)	SCR Database N-PROC-RA-0022	<b>ACCOUNTABLE</b> OPG to submit SCRs documenting the OPG related adverse condition or issue.  OPG to process the SCR's to completion including the development and completion of Corrective Action Plan identified	<b>SUPPORT</b> Adverse conditions or issues related to OPG (eg. Safety, Configuration Management, Delays) are communicated to OPG.  Design errors and non-conformances related to the Contractors own QA program are to be resolved by the	

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
			through the OPG SCR Process.	Contractor corrective action program outside the OPG SCR Process.	
<b>REPORTS</b>					
3.5 a)	Reports (As required) [eg. Technical / Design Review Report, Assessment Report / Assumption Validation Report , Miscellaneous Reports, Conceptual Design /Value Engineering Report etc.]	SLN 2206-07-20-OP-0001 2206-07-20-TF-0012 2206-07-20-TF-0013 2206-07-20-TF-0001	<b>SUPPORT / REVIEW/ ACCEPT</b> OPG to provide stakeholder input and review (as required), and accept.	<b>ACCOUNTABLE</b> Prepare, Verify / Review, Approve and P. Eng. seal the report and submit to OPG.	Report
3.5 b)	Certified Design Report	SLN 2206-07-20-OP-0001 2206-07-20-TF-0012 2206-07-20-TF-0013	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to review (as required), and accept.	<b>ACCOUNTABLE</b> Prepare, Verify / Review, Approve and P. Eng. seal the report and submit to OPG.	Report
3.6	Pre-Start Health & Safety Report (If required)	Section 7 of O. Reg. 851/90 under OH&S Act. N-FORM-10853 N-INS-08121.3-10000  2206-07-20-TF-0001	<b>SUPPORT / ACCEPT</b> OPG to provide stakeholder input (as required) and accept.	<b>ACCOUNTABLE</b> Where a review is required per N-FORM-10853, prepare PSR report if required based on the assessment.  Perform any required pre-start inspections as required by the review before the apparatus, structure, or protective element is operated or used, and confirm the report has been provided to OPG JH&SC.  Submit PSR Report to OPG.	PSR Report
<b>REGULATORY APPROVALS</b>					
3.7	CNSC Code Classification	N-PROC-MP-0040			
3.8	Preparation / Revision of System Classification List	N-PROC-MP-0040 N-FORM-10250	<b>ACCEPT</b> OPG to accept.	<b>ACCOUNTABLE</b> Prepare, Verify, & Approve, applicable Flow Diagram (Change Paper Format).  Prepare, Verify, & Approve, applicable	N-FORM-10250

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
				System Classification List (Change Paper Format)  Submit to OPG as part of design package.	
3.9	Code Classification Approval and Exemptions Form	N-PROC-MP-0040 N-FORM-11003 N-FORM-11045 N-FORM-10250 N-FORM-11524	<b>ACCEPT</b> OPG to accept.	<b>ACCOUNTABLE</b> Prepare, Review, & Approve N-FORM-11003 Code Class Approval and Exemption per Contractor CofA.  Prepare, Review / Verify, & Approve Code Class Exempt Assessment (if applicable).	N-FORM-11003  N-FORM-11045 Code Class Exempt Assessment (if applicable)  N-FORM-11524 Code Class Exempt Assessment (if applicable) and Portable Assembly Exclusions
3.10	CNSC Code Class Approval Submission (if required)	N-PROC-MP-0040	<b>SUPPORT/APPROVE</b> If CNSC submission is required as per N-FORM-11003, OPG will review the CNSC submission package as per N-PROC-MP-0040.  Designated OPG Licensing Authority to approve and submit to CNSC.  OPG to notify Contractor upon classification approval by the CNSC.  OPG to submit record to Business Services.	<b>ACCOUNTABLE</b> Provide a draft CNSC submission letter with technical details to OPG for review with Regulatory Affairs.  Incorporate Reviewer Comments.  Route final CNSC submission packages to Designated OPG Licensing Authority (Regulatory Affairs) for submission to CNSC.  Confirm CNSC approval has been obtained.	Standard Submission Package
3.11	ANIA Registration and associated Documents	N-PROC-MP-0082 SLN 2206-07-30-OP-0013			

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.12	ANIA Registration Submission and Associated Documentation (if TSSA registration is required as per N-FORM-11003)	SLN 2206-07-30-OP-0013  N-FORM-11003 Code Classification Registration Approvals And Exemptions	<b>SUPPORT</b> OPG to issue Letter of Authorization to Contractor to process ANIA submission on OPG behalf for CofA.  OPG will coordinate resolution of legacy issues related to registered systems.	<b>ACCOUNTABLE</b> Prepare/assemble design registration packages and submit to the ANIA for registration on OPG's behalf.  Consult with OPG re resolution of legacy issues if necessary.  Resolve any issues raised by ANIA during the Registration Process.	Registration Package
3.13	ANIA (TSSA) Registration Exemption (as per N-FORM-11003)	SLN 2206-07-30-OP-0013  N-FORM-11003 Code Classification Registration Approvals And Exemptions	<b>SUPPORT</b> As required.	<b>ACCOUNTABLE</b> Prepare, review and approve N-FORM-11003.	N-FORM-11003
3.14	ANIA (TSSA) Reconciliation Statement	SLN 2206-07-30-OP-0013 Standard Reconciliation Statements from CSA N285.0	<b>SUPPORT</b> As required.	<b>ACCOUNTABLE</b> If required, prepare Reconciliation Statement for the system and for material.  Include signed Documentation as required.  Coordinate registration of Reconciliation Package with ANIA (TSSA), if required.	Standard Reconciliation Statements from CSA N285.0
3.15	CNSC Modification Notification or Approval, and other Correspondence		<b>SUPPORT/APPROVAL</b> Review CNSC letter. Designated OPG Licensing Authority to approve and submit to CNSC.  OPG to notify Contractor upon approval or concurrence by the CNSC.  OPG to submit record to Business Services.	<b>ACCOUNTABLE</b> Prepare CNSC correspondence letter and submit to OPG for review.  Route final CNSC submission packages to Designated OPG Licensing Authority (Regulatory Affairs) for submission to CNSC.  Confirm CNSC approval has been obtained.	Submission Package

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.16	Other Regulatory Approval correspondence (e.g. Ministry of Labour, Ministry of Environment, Coast Guard, Bldg Permits Electrical Safety Authority, etc.)		<b>SUPPORT/REVIEW</b> Review Regulatory letter.	<b>ACCOUNTABLE</b> Prepare Regulatory correspondence letter and submit to OPG.  Once letter has been reviewed by OPG proceed to obtain approval.  Submit to OPG Records.	Submission Package
<b>Master EC RELATED ACTIVITIES</b> Note: all forms, checklists and assessments identified in this section shall be the Contractor's accountability unless stated otherwise. OPG should be copied on Contractor correspondence with stakeholders.					
3.17	Master EC: General	N-PROC-MP-0090 N-GUID-00700-10000 N-GUID-08133-10072	<b>APPROVE</b> Create Master EC package and obtain approval as noted in the Modification Outline.	<b>ACCOUNTABLE</b> Support as required	



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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.18	Modification Outline	N-PROC-MP-0090 N-GUID-00700-10000 N-FORM-10958	<b>SUPPORT / APPROVE</b> OPG to support as required.  OPG Design Authority and DOM to approve Modification Outline.	<b>ACCOUNTABLE</b> Contractor to prepare, verify and approve the Modification Outline.  Complete all associated forms required by Modification Outline.  Contractor to route for all required OPG signatures and submit to OPG for Approval.	N-FORM-10958
3.19	Design Scoping Checklist (Is Optional but Recommended)	N-PROC-MP-0090 N-GUID-00700-10000 N-FORM-10959	<b>SUPPORT</b> OPG to support as required.	<b>ACCOUNTABLE</b> Contractor to prepare Design Scoping Checklist.  Coordinate with input from Subject Matter Experts and Stakeholders.	N-FORM-10959
3.20	Package Design Requirements	509407-0000-00000-38QP-0001 509407-0000-00000-40EP-0001  2206-07-20-TF-0039	<b>SUPPORT / ACCEPT</b> Modification Design Requirements (MDR) will be prepared by OPG.	<b>ACCOUNTABLE</b> Package Design Requirements will be prepared by Contractor on Contractor Template. Package level (MEC) derived requirements will be a subset of the contractual terms (and implicitly the MDR) to assist with requirements traceability. Requirements Traceability Matrix will be submitted as part of DCAVR.	Package Design Requirements
3.21	Design Plan	SLN 2206-07-10-OP-0001 2206-07-20-TF-0032	<b>AUTHORIZE</b> OPG to attach coversheet and DA to Authorize.	<b>ACCOUNTABLE</b> Prepare, Review, and Approve Design Plan.  Maintain Status & Accuracy of Design Plan and submit updated plans to OPG as part of EC approval or releases.  Refer to Item 3.87 for update of Design Plan upon completion of applicable EC(s).	Design Plan

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.22	Constructability Operability, Maintainability, and Safety (COMS) Stakeholder Declaration	N-PROC-MP-0083 N-FORM-10007 N-FORM-10480 N-PROC-MP-0090	<b>SUPPORT</b> Provide stakeholders to participate in COMS meetings and walkdowns.  Sign-off COMS declaration form as required.	<b>ACCOUNTABLE</b> Contractor to coordinate and lead COMS meetings, walkdowns and stakeholder input (Construction, Operations, Maintenance, Engineering, etc.)  Chair, take minutes, record actions and distribute to stakeholders.  Disposition any Design related issues identified during COMS with the Stakeholder.  Participate and lead COMS walkdowns.	N-FORM-10007 N-FORM-10480
3.23	Field Verification of existing plant configuration prior to start of design	SLN 2206-07-30-OP-0006  2206-07-30-CF-0002 2206-07-20-CF-0030 2206-07-20-TF-0031	<b>SUPPORT</b> OPG to provide Field Assistance if requested (e.g. Radiation Sponsorship etc)  OPG to review the discrepancies and resolutions. File SCR if required regarding any field conditions not in alignment with plant documentation.	<b>ACCOUNTABLE</b> Verifies all field conditions related to modifications.  Communicate adverse conditions or configuration management deficiencies to OPG.  Where practical incorporate configuration management issues as part of the design.	Walkdown Report  Field Walkdown Package
3.24	Review of Pending Changes Impacting Project Scope	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT</b> OPG to support as required.	<b>ACCOUNTABLE</b> Contractor to review Asset Suite databases (impacted drawings, AEL etc.) for other modifications that might impact on this modification, and coordinate activities with other organization (e.g. Terminal Points).	List of pending changes impacting project scope and their disposition.
3.25	OPEX (Operating experience) Search	SLN 2206-07-30-OP-0003 2206-07-20-TF-0038 OPEX Website and SCR database WANO & INPO database Stakeholder Interviews	<b>SUPPORT</b> Upon request, OPG to provide known internal OPEX to Contractor.	<b>ACCOUNTABLE</b> Review OPEX and SCR databases to ensure past operating experience has been taken into consideration.  Obtain OPEX from OPG and other	OPEX Report

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				Stakeholders (direct from stakeholders).  Prepare OPEX report and use as input for Design Scoping Checklist and Master EC.  Record actions in Issues Tracking File.	
3.26	Design EC Release Plan	SLN 2206-07-10-OP-0001	<b>SUPPORT/ ACCEPT</b> OPG DA to accept via Design Plan (Item 3.21)	<b>ACCOUNTABLE</b> Prepare as part of Design Plan (Item 3.21)	Design EC Release within Design Plan
3.27	Issue Tracking File		<b>SUPPORT</b> OPG to communicate potential issues to Contractor	<b>ACCOUNTABLE</b> Contractor to maintain an up to date Issue Tracking File and provide to OPG as requested.  The ITF should be provided to OPG as part of any ECC submittals such as Design Package or Master EC Package.	Issue Tracking File (included in the Design Plan, Section 4 – Assumptions and Open Items)  A copy will reside in the working files folder (Sharepoint)
	<b>Design EC Related Activities</b> Note: all forms, checklists and assessments identified in this section shall be the Contractor's accountability unless stated otherwise. OPG should be copied on Contractor's correspondence with stakeholders				
3.28	Design EC: General	N-PROC-MP-0090 N-GUID-00700-10000 N-GUID-08133-10072	<b>ACCEPT</b> OPG to Accept and Release as required in the modification outline.	<b>ACCOUNTABLE</b> Prepare, Verify, Approve Design EC Package.  Contractor to submit approved Design EC Package to OPG.  Upon registering the Design EC in Asset Suite, Contractor to populate the appropriate milestones and add "DNREFURB" in the Mod Number field.  In addition, the Contractor to populate the ADL and AEL to flag equipment and documents requiring changes under the EC.	Release Plan as per Item 3.21 Design Plan

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				Contractor to follow N-GUID-08133-10072 for Asset Suite requirements.	
3.29	Associated Documents List (ADL)	N-PROC-MP-0090 N-GUID-00700-10000	<b>ACCEPT</b> OPG to Accept as part of the Design EC.	<b>ACCOUNTABLE</b> Populate ADL in Asset Suite.  Review any Pending Changes on Affected Documents for potential conflicts.  Prepare, Verify, and Approve as part of Design EC.	ADL Populated
3.30	Change Papers  Including Non-drawing change papers of existing OPG documents (Existing DM, Safety Report, Operational Safety Requirements, Instrument Uncertainty Calculations, Reliability Report, Fire Safe Shutdown Analysis, Lists etc.)	N-PROC-MP-0090 N-GUID-00700-10000  Drafting procedure: N-ST-01161-10000  Non-Drawing References: N-PROC-MP-0086 N-ST-08131.02-10000 N-STI-03602-10000 N-STD-RA-0033 N-STD-RA-0038  SLN 2206-07-60-OP-0001	<b>ACCEPT</b> OPG to Accept Change Papers as part of Design EC.  OPG to scan Change Papers into Asset Suite prior to AFS.	<b>ACCOUNTABLE</b> Review Document Scoping Checklist and other related ECC Screens to identify OPG documents which are impacted by Design Change.  Prepare list of drawings required for the Design EC and send to OPG.  Prepare, Verify and Approve Change Papers as per the Contractor's QA program.  Where applicable prepare AutoCAD (version as identified in P.O) drawings	Change Papers

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
		SLN 2206-07-20-OP-0001		as change papers.  Prepare, Verify, and Approve Change Papers.  Submit Change Papers to OPG via Design EC submittal.  Prior to AFS confirm all Change Papers have been scanned into Asset Suite.	
3.31	Drawing Bill of Materials (DBOM)	2206-07-20-OP-0001 2206-07-20-TF-0024	<b>ACCEPT</b> OPG to Accept DBOM .	<b>ACCOUNTABLE</b> Prepare, Review, and Approve DBOM for each drawing / group of drawings for associated Design EC.  See 3.37 for selection and use of existing CatIDs.	Design Bill of Material
3.32	Design Manuals	N-PROC-MP-0065 N-INS-00700-10002 N-TMP-10143 N-TMP-10188 N-TMP-10189	<b>ACCEPT</b> OPG to Accept Change Papers as part of Design EC.	<b>ACCOUNTABLE</b> New Design Manual Change Paper: Prepare Design Manuals as per procedure.  Submit signed document, as part of Design EC.  For existing Design Manual process as Change Papers as per 3.30.	Design Manual Change Paper
3.33	Reference Document List / RDL Items	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT</b> OPG to support as required.	<b>ACCOUNTABLE</b> Populate RDL in Asset Suite Prepare, Review, and Approve as part of Design EC  Ensure all RDL items are in OPG Records system (forward with required Controlled Documents paperwork to facilitate) prior to EC approval.	Asset Suite Action
3.34	Engineering Specifications for new equipment (including	N-PROC-MP-0089 SLN 2206-07-20-OP-0001	<b>ACCEPT</b> OPG to Accept.	<b>ACCOUNTABLE</b> Prepare, Review, and Approve.	Engineering Specifications

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
	Tech Spec Data sheets and Design Specifications)	2206-07-20-TF-0003 2206-07-20-TF-0029		Submit specification for OPG acceptance as part of Design EC.  Create a Procurement Specification.	
3.35	Engineering Calculations	SLN 2206-07-20-OP-0001  2206-07-20-TF-0004 2206-07-20-TF-0013	<b>ACCEPT</b> OPG to Accept	<b>ACCOUNTABLE</b> Prepare, Verify, and Approve.  Any Engineering Tooling or Analytical Software used shall meet the applicable requirements of CSA N286.7.  Submit to OPG as part of Design EC.	Design Reports and Calculations
3.36	Vendor Technical Documents  -Drawings -Operating & Maintenance Manuals -Inspection Test Plans -Factory Acceptance Procedures -Recommended spare parts lists  This includes documents submitted by Equipment Sub-Contractors or their representative and excludes documents produced by the Contractor.	2206-01-20-OP-0003 2206-01-20-CF-0011	<b>ACCEPT</b> OPG to Accept.	<b>ACCOUNTABLE</b> Verify sub-contractor/vendor technical documents for accuracy of technical content and meeting design requirements.  Resolve comments with sub-contractor/ Vendor and accept documentation on behalf of OPG acceptance.  Submit accepted sub-Contractor/Vendor Technical Documents to OPG.	Vendor Technical Documents
3.37	Creation of New Cat IDs for Modifications and OSM.	N-PROC-MP-0090 N-PROC-MP-0098 N-GUID-00700-10000 N-PROC-MM-0008 N-GUID-08133-10072	<b>SUPPORT</b> OPG will provide new CatID.  As required, OPG will set CATID to "Ready", "BOMONLY", and "NOPURCH" status in Asset Suite.	<b>ACCOUNTABLE</b> Select CatIDs from OPG inventory where required.  If CatID does not exist in OPG inventory initiate creation of Cat IDs for new items	CatID at "Ready". "BOMONLY", and "NOPURCH" Status as required.

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
				for Design EC / DBOM.  Submit Action Request Process to initiate new CatIDs.  OR  Prepare, verify and provide to OPG Asset Suite panel mandatory information requirements for building new Cat-ID or modifications to existing Cat-IDs' as per Appendix B.	
3.38	Inventory CatID Reconciliation	N-PROC-MP-0090 N-GUID-00700-10000 N-PROC-MM-0008	<b>ACCEPT</b> OPG to accept recommendations.	<b>ACCOUNTABLE</b> Contractor to identify CatIDs to be retired and current materials to be surplus as required.  Provide recommendations following AFS.	Inventory CatID Reconciliation Report.
3.39	Affected Equipment List (AEL) Updates  And  Reserve New Equipment Codes	N-PROC-MP-0090 N-GUID-00700-10000 N-MAN-08135-10000 N-PROC-MA-0077 N-PROC-MP-0077 D-ED-01520-10001 N-INS-08135-10116 N-INS-03651-10025 N-GUID-08133-10072	<b>SUPPORT / APPROVE</b> OPG to support review process and provide comments as required.  OPG Plant Status Control approve new equipment AEL tagging.  OPG Equipment Reliability Group & Reactor Safety to review / approve new equipment criticality codes.  OPG to provide serial code number for equipment.  OPG Drawing Office to reserve Equipment Codes.	<b>ACCOUNTABLE</b> Contractor to coordinate and disposition of review comments on AEL updates as required.  Obtain Plant Status Control input on new AEL tags.  Identify Q List requirements and obtain OPG Reactor Safety support/input as required (refer to N-INS-08135-10116).  Identify EQ requirements (refer to N-INS-03651-10025 & N-GUID-03651-10002)  Identify Criticality code requirements per N-PROC-MA-0077.  Identify Seismic requirements.	Asset Suite AEL EQ, Q-List, Seismic and Criticality Code Requirements Defined

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
				<p>Populate AEL panel in Asset Suite with required information and formatting (including Q-list, Criticality Codes, and EQ requirements).</p> <p>Prepare, Verify, and Approve as part of Design EC.</p> <p>Request reserved equipment codes from OPG Drawing Office. Obtain OPG Plant status Control acceptance of new AEL tags prior to submission of EC for acceptance.</p>	
3.40	Spare Parts List / Equipment Bill of Material / Maintenance Strategies	N-PROC-MP-0090 N-GUID-00700-10000 N-PROC-MP-0058 N-PROC-MM-0008 N-INS-00680-10000	<p><b>SUPPORT / ACCEPT</b>  OPG Equipment Reliability, SRE, Maintenance Assessing, Supply Chain, stakeholder review of Spare Parts list &amp; Maintenance Strategies.</p> <p>OPG to update Spare Part CatIDs and ROP/TMAX and Auto-Reorder/and or Critical Spare Flags.</p> <p>OPG to accept the Spare Parts List, Maintenance and Stocking Strategy</p>	<p><b>ACCOUNTABLE</b>  Prepare Spare Parts List for new parent</p> <p>Identify all Spare Parts to new parent</p> <p>Prepare spare parts list, maintenance and stocking strategy for OPG Acceptance.</p> <p>Solicit stakeholder input.</p> <p>Incorporate stakeholder feedback into Maintenance Strategy.</p> <p>Spare Parts List and EBOM to be prepared as a paper based for submission to OPG for acceptance.</p>	<p>Spare Parts List Maintenance Strategy Stocking Strategy</p> <p>Equipment Bill of Materials</p> <p>Asset Suite spare parts CatIDs update with ROP/TMAX and Auto-reorder and/or Critical Spare flags.</p>
3.41	Lube List (For Permanent Modifications Only)	N-PROC-MP-0090 N-GUID-00700-10000 N-PROC-MP-0058 N-PROC-MM-0008	<p><b>SUPPORT</b>  OPG Components and Equipment Group to update station lube list.</p>	<p><b>ACCOUNTABLE</b>  Provide information for Lube List Update to OPG Components and Equipment Group and confirm lube list updated.</p>	Lube List Update
3.42	Design Review Meetings (DRM)		<p><b>SUPPORT</b>  Support and participate as required to provide stakeholder input at each</p>	<p><b>ACCOUNTABLE</b>  As required facilitate review meetings throughout the Conceptual, Modification</p>	Design Review Meetings



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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
			meeting.	Planning and Detailed Design Phases.	
<b>Miscellaneous Items – Electrical Design EC</b>					
3.43	Online Wiring updates (OLW) Note: Accountability items includes numbering for sequence clarity.	N-PROC-MP-0076 N-INS-60110-10000 N-PROC-MP-0090  D-STE-60110-10001	<b>SUPPORT / ACCEPT</b> OPG Drafting Office or delegate to update OLW based on change papers and provide the printouts to Contractor.  OPG to accept as part of Design EC.	<b>ACCOUNTABLE</b> For each Design EC that affects On-Line Wiring (OLW) information, Contractor to initiate a request to OPG DO to prepare an OLW Package and Independent Verification (IV) Report (if applicable) in accordance with the Design EC's change paper.  Ensure walkdowns / field inspections are completed re proposed OLW changes prior to Design EC approval.  Obtain OPG DA Approval for separation/channelization standard deviations.  Verify, Approve, and issue OLW updates as part of Design EC.	OLW Package  Independent Verification Report for Safety Related Modifications.
3.44	Electrical Distribution System analysis	NK38-GUID-50000-10001	<b>SUPPORT / ACCEPT</b> OPG to provide most current Station electrical distribution system model to Contractor.  OPG to accept as part of Design EC acceptance.	<b>ACCOUNTABLE</b> Prepare, Verify and Approve Electrical distribution system analysis using ETAP.  Provide any updated models to OPG along with Design EC.	ETAP Analysis (Calculation Report and Updated Model)

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3.45	Protective Relay Setting Lists (PRLs) and Relay coordination study.	N-PROC-MA-0068 N-PROC-MA-0070 Templates as per OPG Field Equipment Calibration Program	<b>ACCEPT</b> OPG to Accept relay coordination study and pre-install ICS or legacy PRL change paper as part of Design EC acceptance.  (Refer to 3.35 and 3.46)	<b>ACCOUNTABLE</b> Relay coordination study to be submitted as a design calculation (see 3.35).  Where legacy PRLs are to be superseded by ICSs enter new ICS data into ICS program (pre-install ICS) per Section 3.46, and prepare Controlled Docs form to supersede legacy PRL with new ICS document number, submitting both to OPG as part of Design EC.  When installation commences and legacy PRL is no longer valid submit Controlled Document form for superseding legacy PRL to OPG Business Services.  Where legacy PRLs are to be retained, Prepare, Verify and Approve PRL change paper as part of Design EC.	Legacy PRL Change Paper or Pre-Install ICS  (Form to be developed)
<b>Miscellaneous Items – Instrumentation and Control Design EC</b>					
3.46	Instrument Calibration Sheets (ICS)	N-PROC-MA-0068 N-PROC-MA-0070 Templates as per OPG Field Equipment Calibration Program	<b>SUPPORT / ACCEPT</b> OPG or delegate to Update pre-install ICS into the ICS Program.  OPG to Accept pre-install ICS as part of Design EC acceptance.	<b>ACCOUNTABLE</b> Prepare & Verify pre-install-ICS (Paper Based) and submit to OPG or delegate  Print out hard copy of preinstall ICS and submit as part of Design EC.  After installation is complete, ICS is to be revised and submitted to OPG for acceptance.	Pre-install ICS

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3.47	Human Factors Engineering	N-INS-06700-10000 N-PROC-MP-0090 N-FORM-10580 N-FORM-10221 2206-07-WI-0003	<b>ACCEPT</b> OPG to accept HFE report / Forms	<b>ACCOUNTABLE</b> Provide HFE Plan and HFE preliminary report during engineering phase. Where Contractor HFE and CCD specialists require input, interface with OPG HFE and CCD Specialist as required.  Provide HFE final report during commissioning stage.  Incorporate OPG HFE and CCD Specialist comments relating to HFE and Software.	HFE Report (For OPG Permanent Modifications)  HF Validation Plan 2206-07-20-TF-0101  HFE Assessment Plan 2206-07-20-TF-0102  HF Engineering Program Plan 2206-07-20-TF-0001  HF Worksheet 2206-07-20-TF-0103
3.48	Software Review	N-PROC-MP-0049 N-PROC-MP-0090 N-FORM-10445 N-FORM-10446 N-FORM-10408 N-FORM-10409	<b>ACCEPT</b> OPG to accept SQA report /Forms	<b>ACCOUNTABLE</b> Where Contractor CCD specialists require input, interface with OPG CCD Specialist as required.  Ensure Software Quality Assurance (SQA) requirements are met.  Incorporate OPG CCD Specialist comments relating to Software.	Software Report
3.49	Software Maintenance Plan	N-STI-69000-10001 Software Maintenance	<b>ACCEPT</b> OPG CCD Specialists to provide oversight reviews. OPG to accept.	<b>ACCOUNTABLE</b> Prepare/revise/issue Software Maintenance Plan and Software Release for any new or revised software that requires it.	Software Maintenance Plan
<b>Miscellaneous Items – Mechanical Design EC</b>					
3.50	Over Pressure Protection Report	SLN 2206-07-20-OP-0001 2206-07-20-TF-0001 2206-07-20-TF-0013	<b>ACCEPT</b> OPG to Accept.	<b>ACCOUNTABLE</b> Prepare, Verify, and Approve Over Pressure Protection Report.	Over Pressure Protection Report
3.51	Mechanical Piping	STANPIPES or	<b>SUPPORT/ACCEPT</b>	<b>ACCOUNTABLE</b>	QA'd piping model in

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
	Analysis	equivalent. SLN 2206-07-20-OP-0001 2206-07-20-TF-0001 2206-07-20-TF-0004 2206-07-20-TF-0013	OPG to provide latest piping model/report where available. [Note: this will in most cases be a legacy non-QA'd model].  Provide guidance regarding acceptable software/versions for piping model to be used (to ensure future usability by OPG).  OPG to accept analysis calculation/report and model.	Perform, verify and approve piping analysis in support of design ECs. Submit QA'd model(s) and associated analysis calculations/reports for acceptance along with associated design EC(s)	usable format (Software/Version). Associated Calculations/Reports
<b>Miscellaneous Items – Cross Functional</b>					
3.52	Review of Design EC prior to EC Release	N-PROC-MP-0090 NK38-GUID-01900-10001 SLN 2206-07-20-TF-0032	<b>SUPPORT/APPROVE</b> OPG to provide comments as required, and to communicate issues to Contractor.  Approval by DA/DOM or delegate as required.	<b>ACCOUNTABLE</b> Contractor to coordinate review on Design EC and disposition of comments.  Contractor to coordinate review on Drawing / Change Papers for compliance with OPG Drafting standards, and disposition of comments.  Provide support as requested for resolution of issues communicated by OPG and update Design EC accordingly.  Upon resolution of issues communicated by OPG, Contractor to obtain approval for each Release as required by the Modification Outline and/or per Design Plan.  Contractor to approve release if DA/DOM or additional OPG releases are not required per the Modification Outline.	Approved EC Release

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3.53	Third Party Fire Review Report	N-INS-09076-10004 Template as per Contractor approved Quality Assurance Plan	<b>SUPPORT / ACCEPT</b> OPG to provide comments as required.  OPG to Accept Third Party Fire Review Report.	<b>ACCOUNTABLE</b> Contractor to coordinate with a Third Party the preparation, review and approval of a Third Party Fire Review report and submit to OPG for acceptance.  Contractor to prepare CNSC submission of Third Party Report (refer to Section 3.15) and submit to OPG.  Disposition comments from the CNSC per submission.	Third Party Fire Review Report
3.54	Design Completion Assurance Verification Review.	NK38-GUID-01900-10001	<b>ACCEPT</b> Based on OPG feedback, OPG will request the Contractor to resolve design issues as required including Non-intent revisions until work is ready to be executed.  OPG to accept DCAVR.	<b>ACCOUNTABLE</b> Contractor to provide Design Completion Assurance Verification (DCAVR) reports listing all deliverables submitted with dates as well as any outstanding issues or deliverables if any, complete with dates and path forward to resolve.	Design Completion Assurance Verification Package
<b>Project EC Related Items</b>					
3.55	Safety System Tests Operating Procedures Operator Field Instructions/Rounds Maintenance Procedures Chem. Lab Procedures	N-PROC-AS-0028	<b>SUPPORT/APPROVE</b> OPG to process procedure revisions and approval.	<b>ACCOUNTABLE</b> Initiate TPARs with procedure mark-ups for new or revised procedures.  Support, review and approval process.	TPARs and mark-ups
3.56	Operational Flowsheets, ESM II, Tagging, & Position Assured Components & Registered locks (Not Applicable for Tooling or Permanent Modifications)	N-PROC-MP-0076 (FS) N-PROC-OP-0023 (PAC)	<b>SUPPORT/APPROVE</b> Support master mark-up process and approval.	<b>ACCOUNTABLE</b> Initiate operational flowsheet, ESM II, equipment tagging, and PAC list updates as part of installation and commissioning activities. Complete formal update as part of EC closeout process.  Ensure new registered locks in OPG	Updated Flowsheets, PAC List and Registered Locks

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				Operations' possession and control prior to AFS.  Support, review and approval process.	
3.57	System Performance Monitoring Plans  (As Required)	N-PROC-MA-0024	<b>SUPPORT</b> Finalize / implement SPMP revisions related to applicable systems.	<b>ACCOUNTABLE</b> Notify SRE of required changes needed to issued SPMP(s) in support of AFS process.  Develop new SPMPs for new systems.	Notification to the SRE
3.58	Components Programs / PIP (e.g. pressure vessel, periodic inspection, thermography, vibration monitoring, valve / RV programs, Hangers, Buried Piping, etc.)  (As Required)	N-PROC-MA-0034 (Predictive Mtce) N-PROC-MA-0090 (HX) N-PROC-MA-0092(POV) N-PROC-MA-0093(Check Valves) N-INS-08125-10001 (Lubrication)	<b>SUPPORT</b> OPG to identify Components Program Project Representatives to liaise with Contractor.  OPG to provide guidance re: Information required from Contractor in order to update respective Components Program.	<b>ACCOUNTABLE</b> Provide information requested by OPG to update OPG Components Programs.  Status Components Program Updates at AFS meeting and track updates to completion.	Updated Components Program
3.59	Predefined Mtce Program (Eg. Winterization and Summarization etc.)  (As Required)	N-PROC-MA-0020 N-INS-09100-10012	<b>SUPPORT/ACCEPT</b> SRE to review and accept Change Requests (CRs).  Implement CRs in Asset Suite.	<b>ACCOUNTABLE</b> Contractor to provide input as required to the OPG System Engineer. Ensure implementation of critical change requests prior to AFS.  Initiate PMID Change Requests in OPG Predefined System (PMLP). Provide technical basis for requests and facilitate SRE review and confirm acceptance.	PMLP Request Accepted and Asset Suite PMIDs setup
3.60	Power and Air Supply Lists / IEDS	D-PROC-MP-0011	<b>SUPPORT</b> Support update process.	<b>ACCOUNTABLE</b> Complete air and power supply list updates as part of installation and commissioning activities.	Updated Air and Power Supply Lists

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3.61	Simulator Updates	N-PROC-TR-0023 (Simulator QA)	<b>SUPPORT</b> Schedule and complete simulator updates as required.	<b>ACCOUNTABLE</b> Initiate required simulator upgrades through OPG Simulator group.	Request Update to Simulator
3.62	Corrective Mtce / Preventative Mtce Backlogs		<b>SUPPORT</b> Provide concurrence or cancellation / credits.	<b>ACCOUNTABLE</b> Review Corrective Mtce and Preventative Mtce backlog on components impacted by applicable modifications and prior to AFS: 1) Recommendations for cancellation of any no longer required WO's 2) Recommendations to credit any predefined WOs via completed commissioning activities where possible  Provide summary into AFS Report.	WO Cancellation/Credit Recommendations to Work Control.
3.63	Training (for OPG Ops, Mtce, Chemistry and Engineering)	N-GUID-00700-10000	<b>SUPPORT</b> Perform Training needs assessments as required.  Participate in / attend training.	<b>ACCOUNTABLE</b> Initiate Action request for training needs assessments.	SAT Compliant Training as required by Needs Assessment.  Crew Familiarization Training (if required)
<b>INSTALLATION RELATED ACTIVITIES</b> Note: The following activities will be Contractor's accountability unless stated otherwise.					
3.64	Installation Field Technical Support	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT / REVIEW / ACCEPT</b> OPG to review/ accept EC revisions per 3.65 to 3.66 below.	<b>ACCOUNTABLE</b> Provide Field Support during Installation of Design EC.  Review Field Installation issues and provide resolution.  Provide support to Design EC revision (Intent / Non Intent).  Drafting and P.Eng support for scaffolding etc. Assess and process work planning holds for the project including but not limited to Engineering Scaffolding, Pressure Boundary Item	Engineering Support for Field Installation

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				Releases, Valve Block approvals etc.	
3.65	Non-Design Intent, (Including Field) Changes	509407-0000-00000-40WI-0002 509407-0000-00000-40TF-0001	<b>SUPPORT</b> Support as required.	<b>ACCOUNTABLE</b> Contractor to initiate, review and approve and executes procedural and non-intent design changes	Approved Non Design Intent Changes
3.66	Design Intent Revision	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT / ACCEPT / APPROVE</b> Process same as Section 3.17 to 3.42 Master and Design EC related activities.	<b>ACCOUNTABLE</b> Process same as Section 3.17 to 3.42 Master and Design EC related activities.	Revised EC
3.67	Workplans / Installation Instructions (Prerequisites, Pre-testing/Calibration)		Refer to Item 5.7.	Refer to Item 5.7.	Refer to Item 5.7.
3.68	Construction Completion Declaration		Refer to Item 5.14.	Refer to Item 5.14.	Refer to Item 5.14.
<b>COMMISSIONING RELATED ACTIVITIES</b> Note: The following activities will be Contractor's accountability unless stated otherwise.					



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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.69	Commissioning Technical Field Support		<b>SUPPORT/ACCEPT</b> OPG will support Commissioning Technical Field Support  OPG will accept commissioning results.	<b>ACCOUNTABLE</b> Contractor to provide Commissioning Technical Field Support and arrange, schedule OPG support as required.  Provide Commissioning Support, fix outstanding issues when identified.  Provide qualified staff knowledgeable of the installation status to support Commissioning program and rectify outstanding issues when identified	Field Support
3.70	Commissioning Specifications and Pre-Commissioning Site Acceptance Test (SAT)	N-INS-00960-10000 N-PROC-MP-0090 N-GUID-00700-10000 N-TMP-10010	<b>SUPPORT/APPROVE</b> OPG to provide support as required.  OPG to approve Commissioning Specifications  OPG Reactor Safety to provide concurrence only if required.	<b>ACCOUNTABLE</b> Identify Critical Attributes as per Section 1.4.9 of N-PROC-MP-0090 & the Modification Design Requirements and Derived Requirements.  Prepare, Verify, Review, and Approve Commissioning Specifications.	Approved Commissioning Specification
3.71	Commissioning Reports and Pre-Commissioning Site Acceptance Tests (SAT)	N-INS-00960-10000 N-PROC-MP-0090 N-GUID-00700-10000 N-TMP-10010	<b>SUPPORT / ACCEPT</b> OPG to provide support as required. OPG to accept and sign Commissioning Report. OPG Reactor Safety to provide concurrence only if required.	<b>ACCOUNTABLE</b> Prepare, Verify, and Approve Commissioning Reports.  Contractor to provide documented evidence of design acceptance of commissioning results (See Section 3.72).  Contractor to issue Commissioning Report in Asset Suite after OPG Acceptance.	Approved Commissioning Report.
3.72	Acceptance of Installation / Commissioning Results	N-PROC-MP-0090 N-GUID-00700-10000 N-GUID-08133-10072	<b>SUPPORT/ACCEPT</b> OPG to accept Commissioning Results as required.	<b>ACCOUNTABLE</b> Contractor to complete the DSGN I/C ACCEPT milestone for each Design EC, adding notes as required.	Asset Suite Action

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3.73	EQ Completion Assurance Process Commissioning	N-FORM-10649	<b>SUPPORT</b> Provide support as required.	<b>ACCOUNTABLE</b> Complete EQ Completion assurance as part of AFS process.  Submit to Records to file under EC in Asset Suite.	N-FORM-10649
3.74	Work plans / Commissioning Instructions and Pre-Commissioning Site Acceptance Test (SAT)		Refer to 5.16	Refer to 5.16	Refer to 5.16
3.75	Available For Service (AFS) Strategy		<b>SUPPORT / APPROVE</b> DA or delegate to approve the AFS Strategy Memo.	<b>ACCOUNTABLE</b> Prepare and obtain approval for AFS strategy memo/plan as required.	AFS Strategy Memo
	<b>AVAILABLE FOR SERVICE AND RELATED ACTIVITIES</b> Note: The following activities will be Contractor accountability unless stated otherwise.				
3.76	Available For Service (AFS), Walkdown, Declaration / OPS Acceptance	N-PROC-MP-0090 N-FORM-10091 N-GUID-00700-10000 N-TMP-10209 N-GUID-08133-10072	<b>SUPPORT / ACCEPT / APPROVE</b> OPG to participate in the AFS walkdown and meeting as required per Mod Outlines / Design Plan.  OPG to accept AFS report.  OPG to approve AFS declaration or OPS acceptance FORM.	<b>ACCOUNTABLE</b> Where required based on the approved Modification Outline, Contractor to prepare, review & approve for OPG acceptance the: - AFS Declaration/ Ops Acceptance and - Report (as required)  Contractor to sign AFS Declaration.  Contractor to coordinate and chair the AFS walkdown and meeting as required.  Contractor to manage and track open item list and closeout process.  Contractor to update Asset Suite milestones to reflect completed AFSs	N-FORM-10091  AFS Report  Asset Suite EC Milestone Update

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
				(final or partial) and / or Ops Acceptances.  Submit documents to Business Services for issuance in Asset Suite.	
3.77	Update Status of Master Equipment List	N-PROC-MP-0090 N-GUID-00700-10000 N-GUID-08133-10072	<b>SUPPORT</b> OPG to provide support as required.	<b>ACCOUNTABLE</b> Review AEL for accuracy prior to AFS and make any changes required.  Initiate launch of Asset Suite AEL / MEL to "Operating" status and confirm successful.  Contractor DE to complete "MEL Update" milestone and resolve any MEL conflicts encountered during the launch process	Asset Suite Action
3.78	As Built Change Papers	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT/ACCEPT</b> Review & Accept Design EC Revisions as required.	<b>ACCOUNTABLE</b> Prior to AFS Meeting, review latest Design EC & Change Papers to confirm they reflect the As-Built Field Condition, and initiate Design EC Revision as required.	Change Papers  Approved EC Revision
3.79	Status On Line Wiring as "Currently Built"	N-PROC-MP-0090 N-GUID-00700-10000	<b>SUPPORT</b> OPG Drawing Office to status OLW to currently built status following Contractor request.	<b>ACCOUNTABLE</b> Review OLW for accuracy and completeness, request OPG Drafting Office to status OLW to currently built status. Confirm OLW status update is successful.  Contractor DE to complete "OLW Stated" milestone in Asset Suite.	Asset Suite EC Milestone  OLW Status to Currently Built Status.
	<b>CLOSEOUT RELATED ACTIVITIES</b> Note: The following activities will be Contractor's accountability unless stated otherwise.				
3.80	Design EC/ Project EC/ Master EC Close Out phase	N-FORM-10653	<b>SUPPORT/ACCEPT</b> OPG will coordinate final acceptance of Contractor produced drawing and document revisions	<b>ACCOUNTABLE</b> Review ADL / Change Papers of Final Design EC revisions for accuracy / completeness of final as-built	Final Documents and electronic records.

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			including issuing final deliverables in Asset Suite.	<p>configuration.</p> <p>Review Pending Changes of Affected Documents and notify OPG of any other EC's in "Modified" status which may impact Close Out of Design EC (e.g. DCRs, other installed Design EC's).</p> <p>DE to coordinate any other Signatures for other</p> <p>Issue original drawings/documents (electronic and paper format) to OPG with QA transmittal form (N-FORM-10653) filled in.</p> <p>Electronic documents will be in editable format in compact discs with labelling and identifying the contents.</p> <p>Pending Changes that may have been Incorporated into the same document revision.</p>	
3.81	Drawings: Incorporation of Change Papers to existing OPG Drawings	N-PROC-MP-0076 N-PROC-MP-0090	<p><b>SUPPORT/ACCEPT</b></p> <p>OPG Drawing Office to revise OPG Drawings and route to Contractor for Review &amp; Signature.</p> <p>OPG to Accept Drawings.</p> <p>If other EC Closeouts are included in this revision, coordinate signatures.</p>	<p><b>ACCOUNTABLE</b></p> <p>Review latest Design EC Change Papers in Asset Suite for completeness and accuracy and provide As-Built Design EC revision as required.</p> <p>For each ADL item, review "Pending Changes" in Asset Suite, and identify any other Engineering Changes which require incorporation (i.e.</p> <p>Asset Suite status of "Installed or Modified") to OPG Drafting Office. Notify OPG that Change Papers are ready for Close Out and provide any AutoCAD files as required.</p>	Final Documents and electronic records.

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
				<p>Prepare, Verify, and Approve OPG Drawings upon revision by OPG Drawing Office.</p> <p>Prepare Control Document Form N-FORM-10027 to issue documents.</p> <p>Submit to OPG for Review &amp; Acceptance.</p> <p>If other EC Closeouts included in this revision, are not related to the Contractor, submit to OPG for coordination of other signatures. P.Eng sealing of final record drawings/documents is not required if the changes are related to the original Design EC's prepared by the Contractor.</p> <p>Contractor to submit documents to OPG Business Services for Issuing.</p>	
3.82	Drawings: Incorporation of Change Papers of – Contractor Drawings	N-PROC-MP-0076 N-PROC-MP-0090	<b>SUPPORT/ACCEPT</b> OPG to Review & Accept Drawings.	<p><b>ACCOUNTABLE</b> Incorporate Change Papers as required. Prepare, Verify, and Approve.</p> <p>Prepare Control Document Form N-FORM-10027 to issue documents.</p> <p>Submit to OPG for Review &amp; Acceptance.</p> <p>P.Eng sealing of final record drawings / documents is not required if the changes are related to the original Design ECs prepared by the Contractor.</p>	Final Documents and electronic records.

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
				Contractor to submit documents to OPG Business Services for Issuing.	
3.83	Drawing Bill of Material	2206-07-20-OP-0001 2206-07-20-TF-0024	<b>SUPPORT/ACCEPT</b> OPG to Accept Bill of Material.	<b>ACCOUNTABLE</b> Incorporate Change Papers and revise Drawing Bill of Material as required. Prepare, Verify, & Approve.  Prepare Control Document Form N-FORM-10027 to issue document. P.Eng sealing of final record drawings/documents is not required if the changes are related to the original Design ECs prepared by the Contractor.  Contractor to submit documents to OPG Business Services for Issuing.	Updated Design Bill of Materials
3.84	Design Manuals – New / Revision of Existing Design Manual	N-PROC-MP-0065 N-TMP-10143	<b>SUPPORT/ACCEPT/AUTHORIZE</b> OPG to Accept.  OPG Design Authority to Authorize.	<b>ACCOUNTABLE</b> Review Change Paper version of Design Manual and revise if required based on As-Built information.  <b>Existing Design Manual Change Paper:</b> Request electronic copy of existing Design Manual from OPG Word Processing via Control Document Form N-FORM-10027.  If Word-editable version does not exist, convert paper copy to word editable version. Review outstanding DCRs against DMs. Revise electronic version, incorporating outstanding DCRs, and submit to OPG for review  <b>New Design Manual:</b> Use OPG Template for new Design Manual	Updated/New Design Manual

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
				<p>Review formatted document and submit to OPG for review.  Return reviewed document back to OPG for revision if required and sign Prepared, Verified, and Approved Design Manual.  Route to OPG for remaining signatures.</p> <p>Issue approved final document to OPG Business Services/Asset Suite and confirm issued.</p>	
3.85	Documents with Defined Revision Cycles (as per Section 1.4.4.1 of N-GUID-00700-10000) e.g. Safety Report, Fire Safety Shutdown Analysis etc.	N-GUID-00700-10000 N-LIST-01300-10000 Bounded Document Set	<b>ACCOUNTABLE</b> To be discussed with Document Owners on a Case by Case Basis. In cases where there is an assigned OPG Document Owner (e.g. Safety Report), Contractor to liaise with OPG Document Owner.	<b>SUPPORT</b> To be discussed on a Case by Case Basis. In cases where there is an assigned OPG Document Owner (e.g. Safety Report), Contractor to Support Document Owner as required when document is to be revised.	Updated Documents with Defined Revision Cycles.
3.86	Instrumentation Calibration Sheets (ICS)	N-PROC-MA-0068	<b>SUPPORT / ACCEPT</b> Accept completion as part of Design EC closeout process.	<b>ACCOUNTABLE</b> Convert pre-install ICS to permanent ICS as part of EC closeout.	Approved ICS Updated ICS Program
3.87	Design Plan (Final rev for design completion assurance)	2206-07-10-OP-0001	<b>SUPPORT / REVIEW/ACCEPT / AUTHORIZE</b> OPG will coordinate review and providing comments.  OPG to Accept. OPG Design Authority to Authorize.	<b>ACCOUNTABLE</b> Prepare, review, approve Close out. Design Plan upon completion of Project.  Contractor to submit authorized documents to OPG Business Services for Issuing.	Final Design Plan Updated

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
3.88	Asset Suite Update	N-GUID-00700-10000 N-GUID-08133-10072	<b>SUPPORT</b> As required.	<b>ACCOUNTABLE</b> Contractor to follow N-GUID-08133-10072 for Asset Suite requirements	Asset Suite Actions



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### 4.0 PROCUREMENT INTERFACE MATRIX

Contractor is responsible for the management, planning, execution, progress, monitoring and reporting of all Owner or Contractor Specified Materials, Goods and Services procurement functions and activities during the life of the Project, including preparation of procurement and contracting strategies and the Procurement Plan as applicable. Procurement and contracting strategies will be reflected in the Procurement Plan if required.

#	Items	Reference Documents, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
<b>PROCUREMENT PLANNING</b>					
4.1	Materials/Procurement Management Plan  (Including Storage, Logistics, Security Screening, Warehousing etc.)	Refer to Appendix C for Elements to be Considered within a Procurement Plan  Materials/Procurement/ Management Plan 509407-0000-00000-50IM-0001  2206-06-30-OP-0008  N-STM-03651.03-10000	<b>REVIEW</b> OPG will provide feedback on the Materials/Procurement Management Plan and review the plan when comments are incorporated.	<b>ACCOUNTABLE</b> Develop a Materials/ Procurement Management Plan for procurement of the Owner or Contractor Specified materials and Services required for implementation of the specified OPG Specification. The plan shall include requirements for storage, security screening, maintenance and shelf life.  Provide any deviations of mandatory criterion from the Materials/ Procurement Management Plan for OPG review	Materials/ Procurement Management Plan
<b>ENGINEERING DELIVERABLES</b>					
4.2	Update Master Catalogue / Create CATID	Refer to Item 3.37	Refer to Item 3.37	Refer to Item 3.37	Refer to Item 3.37
4.3	Changes or updates to Master Equipment List (MEL) Records	Refer to Item 3.77	Refer to Item 3.77	Refer to Item 3.77	Refer to Item 3.78
4.4	Technical Specifications or Tech Spec Data Sheets	Refer to Item 3.34	Refer to Item 3.34	Refer to Item 3.34	Refer to Item 3.34
4.5	Approved Equipment	Refer to Item 3.39	Refer to Item 3.39	Refer to Item 3.39	Refer to Item 3.39

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#	Items	Reference Documents, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
	Bill of Materials				
4.6	Spare Parts List	Refer to Item 3.40	Refer to Item 3.40	Refer to Item 3.40	Refer to Item 3.40
4.7	Procurement Evaluation  (for Maintenance Spare Parts Only)	Contractor Specific N-PROC-MP-0098  Contract Exhibit 2.11, sections 1.2, 1.3, & 2.2 PMMP 509407-0000-00000-50IM-0001 2206-06-30-CF-0005 2206-06-10-OP-0004  2206-06-30-OP-0003 2206-06-00-OP-0001 2206-07-30-OP-0010	<b>ACCEPT</b> OPG will accept procurement evaluations. Input into Asset Suite Provide Asset Suite approval (as required)	<b>ACCOUNTABLE</b> Contractor to prepare, verify and approve procurement evaluations as per the Contractor's process.  Contractor to provide information in prescribed format per Appendix B for OPG to populate Asset Suite.	Procurement Evaluation
4.8	Drawing Bill of Materials	2206-07-20-OP-0001 2206-07-20-TF-0024	Refer to Item 3.31	Refer to Item 3.31	Refer to 3.31
<b>IDENTIFICATION REQUIREMENTS</b>					
4.9	Additional Requirements to Support OPG Business Processes and Requirements	509407-0000-00000-50IM-0001  Appendix B	<b>SUPPORT/ACCEPT</b> For elements that are in addition to the standard CSA N286 QA Standard, OPG to specify the specific content and format requirements for information and documentation required to support operation of the plant. Appendix B provides a representative list. OPG to accept requirements to populate into Asset Suite  OPG to input into Asset Suite	<b>ACCOUNTABLE</b> Apart from the requirements of N286-05 and Z299.1 and the Contractor's processes, OPG specific business processes and requirements are to be provided by the Contractor as per Appendix B.	Material Information to Support OPG Databases Asset Suite Action
<b>PURCHASING ACTIVITIES</b>					
4.10	Establish Terms and Conditions	509407-0000-00000-50IM-0001  2206-06-00-OP-0001 2206-06-30-CF-0013	<b>REVIEW</b> OPG to provide feedback and accept terms and conditions.	<b>ACCOUNTABLE</b> Contractor to provide their commercial terms and conditions to OPG for review and acceptance prior to RFP issuance.	Commercial Terms and Conditions

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#	Items	Reference Documents, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
4.11	OPG Approved Suppliers List (ASL)	N-PROC-MM-0010 N-FORM-10170 2206-06-30-OP-0003 2206-06-30-CF-0003	<b>SUPPORT</b>  At Contractor's request, and periodically OPG to provide a list of vendors qualified on OPG's ASL complete with specific QA data when requested.  OPG to respond to submittal as per 2.9 of the RFR EPC Agreement.	<b>ACCOUNTABLE</b>  The Contractor shall engage only Sub Contractors listed on OPG's ASL and/or the Contractor's ASL.  When using OPG's ASL, the Contractor shall select Suppliers only if the Contractor determines that the information provided is sufficient and meets the requirements of applicable standards and the Contractor's own quality program.	Submit documentation on suppliers including audit report & checklist
4.12	Commercial Grade Dedication (if required)	2206-01-50-CF-0062 2206-01-50-OP-0002 2206-06-40-OP-0002 2206-06-40-OP-0001	<b>ACCEPT</b> OPG to accept the CGD plan.  OPG to accept the inspection and test results for CGDs.	<b>ACCOUNTABLE</b> SLN shall submit CGD plan to OPG for acceptance.  SLN shall submit completed CGD package to OPG for acceptance.	Commercial Grade Dedication Plan  Inspection and test Report
4.13	Concessions and Exceptions Process	509407-0000-00000-38QP-001	<b>ACCEPT</b> Accept Concession.	<b>ACCOUNTABLE</b> Submit concession for OPG acceptance.	Accepted Concession
4.14 (a)	Non Conformances (Not applicable to OSM or Tooling)	509407-0000-00000-38QP-001	<b>ACCEPT</b> Accept Non conformance disposition.	<b>ACCOUNTABLE</b> Submit non-conformance disposition for OPG acceptance if disposition suggests use as is or requires repair/rework.	Non Conformance Disposition.
4.14 (b)	Non Conformances (Applicable to OSM)	509407-0000-00000-38QP-001	<b>APPROVE</b> Approve Non Conformance	<b>ACCOUNTABLE</b> Contractor to submit non-conformance recommendation for OPG approval if disposition suggests use as is or requires repair/rework. For Contractor vendor NCRs, a separate form will be	Non Conformance Disposition

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#	Items	Reference Documents, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
				used in accordance with the project quality plan.	
4.14 (c)	Reporting of Non-Conformance Post Execution	RFR EPC Agreement Article 13.8	<b>ACCEPT</b> Accept reporting of non conformance.	<b>ACCOUNTABLE</b> Notify OPG in writing when a known or suspected defect or non-conformance is discovered that affects, or may affect, a product that has already been turned over to OPG as per Appendix D.	Notification of Non Conformance on the Contractor's Letterhead
4.15	Source Surveillance & Factory Testing	CSA N285 CSA N286 2206-06-40-OP-0002 2206-06-40-OP-0001 2206-06-40-CF-0004 2206-01-30-CF-0010	<b>SUPPORT</b> OPG may elect to witness factory testing  Accept per item 3.36 Vendor Technical Documents	<b>ACCOUNTABLE</b> Contractor to advise OPG of any Source Surveillance/Factory Testing activities.  Accept documents on OPGs behalf per Item 3.36 Vendor Technical Documents	Refer to item 3.36
<b>RECEIVING AND INSPECTION</b>					
4.16	Receipt and Inspection Transfer for Spare Parts	N-PROC-MM-0021, Receiving QC Inspection 2206-06-40-OP-0002 2206-01-30-OP-0009 2206-01-30-CF-0010	<b>SUPPORT/ACCEPT</b> OPG to accept parts into inventory.  Refer to item 3.40.	<b>ACCOUNTABLE</b> Establish a process for the transfer of spares from the Contractor to OPG.  Contractor receiving documents shall accompany the materials transferred to OPG stock.  Refer to item 3.40.	Parts accepted into OPG Inventory.
4.17	Materials Management  (Storage, Logistics, Security Screening, Warehousing etc.)		Refer to Item 4.1	Refer to Item 4.1	Refer to Item 4.1
<b>DOCUMENTATION CONTROL AND RECORDS MANAGEMENT</b>					
4.18	History Docket	N-PROC-MM-0021, N-FORM-10396, N-TS-08173-10001,	<b>REVIEW / ACCEPT</b> OPG to accept History Docket as a permanent record.	<b>ACCOUNTABLE</b> Contractor is accountable to prepare and verify the History docket for Owner or Contractor Specified Materials and Goods purchased and received.	History Docket N-FORM-10396
<b>CONTRACT COMPLETION (CONTRACTS BETWEEN CONTRACTOR AND SUB-SUPPLIERS)</b>					

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#	Items	Reference Documents; Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverable
4.19	Performance OPEX Evaluation / Continuous Improvement	2206-06-70-OP-0002	<b>REVIEW</b> OPG to review Non Conformance OPEX.	<b>ACCOUNTABLE</b> The Contractor will provide OPG with Non Conformance OPEX of suppliers.	Non Conformance OPEX Report of Suppliers

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### 5.0 CONSTRUCTION INTERFACE MATRIX

#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.1	Construction Quality Assurance Plan	509407-0000-00000-38QP-0001: Project Quality Plan	<b>SUPPORT/ACCEPT</b> OPG provide feedback to Contractor and accept QA Plan.	<b>ACCOUNTABLE</b> Contractor to prepare and approve QA Plans for Construction activities and execute per its QA program.  Submit approved construction QA plan to OPG for acceptance.	Construction Quality Assurance Plan
5.2 a)	Safety Program	N-GUID-09701-10011: DN Refurbishment Safety Management Essentials	<b>SUPPORT/ACCEPT</b> As Owner/Constructor, OPG is to establish Health and Safety standards, expectations, measures and targets for the Contractor.  OPG to accept Contractor Safety Program, Plan, Safe Work Practices and Processes.	<b>ACCOUNTABLE</b> The work will be executed by the Contractor and sub-contractors under the Contractor's safety management program and project specific safety plans.  Contractor to submit program, plans for acceptance.	Safety Program & Plans to manage worker safety including sub-contractors. Job Safety Analysis
5.2 b)	Environment Program	N-GUID-09701-10013: Nuclear Projects – Environmental Requirements Guideline	<b>SUPPORT/ACCEPT</b> As Owner/Constructor, OPG is to establish Environmental standards, expectations, measures and targets for the Contractor.  OPG to accept Contractor's Environment Management Program and Environmental Protection Plans and Processes.	<b>ACCOUNTABLE</b> The work will be executed by the Contractor and sub-contractors under the Contractor's Environmental management program and project specific Environmental Protection plans.  Contractor to submit program, plans for acceptance.	Environmental Management Program & Environmental Protection Plans
5.3	Construction Management	Labour Agreements	<b>SUPPORT</b> As required	<b>ACCOUNTABLE</b> The Contractor is to manage construction staff in accordance with the applicable project labour agreements	Mark-up Meeting

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
5.4 a)	Control of Field Changes (ECC)		Refer to items 3.65-3.66	Refer to items 3.66-3.67	Refer to items 3.65-3.66
5.4 b)	Control of Field Changes (non-ECC)	2206-07-60-OP-0001: Design Change Control	<b>SUPPORT</b> OPG to support as required	<b>ACCOUNTABLE</b> Prepare, Review, Approve	Engineering Change Request
5.5	Project Construction Plan/Schedule	P6 Schedule  509407-0000-00000-32IM-0001: Schedule Management Plan	<b>SUPPORT</b> OPG to provide support to integrate station/project and Contractor schedules.	<b>ACCOUNTABLE</b> The Contractors to prepare and submit to OPG field execution schedule.	Integrated Schedule
5.6 a)	Work Order Assessing / Planning (for work impacting operating systems or units)	N-PROC-MA-0022  N-GUID-08130-10008 NK38-MAN-09701-10005	<b>SUPPORT</b> OPG to review WO and provide support as required.	<b>ACCOUNTABLE</b> The Contractor is to prepare and assess WO's in Asset Suite, and insert OPG support tasks.	Assessed Work Order
5.6 b)	Work Order Assessing / Planning (for work not impacting operating systems or units)	QCP 309.67	<b>SUPPORT</b>  OPG to review WO as required and provide support	<b>ACCOUNTABLE</b> The Contractor is to prepare and assess Work Orders.  Contractor is to insert required OPG support tasks into Asset Suite.	Assessed Work Order
5.7	Workplans (required for work impacting operating systems or units)	N-INS-08120-10011 N-TMP-10208 N-GUID-09701-10019	<b>SUPPORT / AUTHORIZE /APPROVE</b> Provide SME reviews for particular subject areas.  OPG to approve and authorize Workplans.	<b>ACCOUNTABLE</b> Prepare and verify workplans (including Prerequisites, Pre-testing/Calibration) where required to coordinate field activities.	Workplan, CMP, MMP, CTP and/or Installation Instructions
5.8	Preparation of Comprehensive Work Package	QCP 309.67	<b>SUPPORT/REVIEW</b> OPG to support and review.	<b>ACCOUNTABLE</b> Prepare, review and approve	Comprehensive Work Package
5.8 a)	Work Instruction	Form G084	<b>SUPPORT</b> OPG to support and review.	<b>ACCOUNTABLE</b> Prepare, review and approve.	Work Instruction

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5.8 b)	Inspection and Test Plan	QCP 510.8 Form Q040	<b>REVIEW</b> OPG to review ITPs OPG to indicate OPG witness/hold points as required	<b>ACCOUNTABLE</b> Prepare review and approve ITPs. (Refer to Check and Test as a guide to develop the ITP)	Inspection Test Plan
5.8 c)	Job Safety Analysis	Redbook - JSA Section Form EHS_RBF_107	<b>SUPPORT</b> OPG to provide support as required	<b>ACCOUNTABLE</b> Prepare, review and approve	JSA
5.8 d)	Foreign Material Exclusion Plan (if required)	509407-0000-00000-60IM-0062 Form N051	<b>SUPPORT/REVIEW</b> OPG to Review FME program OPG to provide support on job FME planning as required.	<b>ACCOUNTABLE</b> Prepare, review and approve	FME Job Plan
5.8 e)	Lifting and Material Handling Plans (if required)	Redbook – Lifting and Rigging Safe Work Practices Section 34, Hoisting, Rigging and Materail Handling	<b>SUPPORT/REVIEW</b> OPG to Review and provide support as required.	<b>ACCOUNTABLE</b> Prepare, review and approve.	Complex/ Critical/ Common Lift Plan Material Handling Plan
5.8 f)	Welding (if required)	Procedure Qualification Record Welding Procedure Specification Form Q12 Form W08	<b>REVIEW</b> OPG to Review welding procedure.	<b>ACCOUNTABLE</b> Prepare, review and approve.  Contractor to engage Authorized Inspection Agency.	Weld Map Procedure Qualification Record Welding Procedure Specification
5.8 g)	Non Destructive Examination (if required)	QCP 310.21 QCP 410.4 QCP 410.5 QCP 310.6 QCP 310.7	<b>SUPPORT</b> OPG to support as required.	<b>ACCOUNTABLE</b> Qualify and perform work as per Contractor's QCPs.  If the work is subcontracted out, then the subcontractor will be audited and procedures will be accepted by the Contractor.	NDE Report
5.8 h)	Non-conformances	QCP 501.1 Form Q001 Form Q002	<b>REVIEW</b> OPG to review as required	<b>ACCOUNTABLE</b> Prepare, Verify, Approve NCRs per Contractor program  Submit non-conformance disposition to	NCR



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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
				OPG as required	
5.8 i)	Open Items	Form G008	<b>SUPPORT</b> OPG to provide support as required	<b>ACCOUNTABLE</b> Prepare and reconcile open items list.  Open items that remain unresolved at CWP completion, shall be compiled and submitted to OPG with the Construction Completion Declaration package (refer to 5.14)	Form G008
5.8 j)	Records	QCP 505.21	<b>SUPPORT</b> OPG to provide support as required	<b>ACCOUNTABLE</b> Contractor is responsible to ensure records are maintained and are available upon request.  Turnover of history docket will be completed as per Construction Completion Declaration process (refer to 5.14)	History Docket
5.9 a)	Readiness/Challenge Meeting and Work Release (for any work impacting operating units or systems)	N-PROC-MA-0022 N-PROC-MA-0013, NK38-MAN-00120-10001	<b>SUPPORT/AUTHORIZE</b> OPG to attend review meeting and challenge Contractor readiness.  OPG to authorize contract work release form.	<b>ACCOUNTABLE</b> Contractor to conduct readiness/challenge review meeting with appropriate stakeholders.  Contractor to respond to challenge comments and disposition or incorporate into Work Release.	Readiness/Challenge Meeting, Contract Work Release FORM
5.9 b)	Readiness/Challenge Meeting and Work Release (for any work not impacting operating units or systems)	N-MAN-00120-10001	<b>SUPPORT/AUTHORIZE</b> OPG to attend review meeting and challenge Contractor readiness.  OPG to authorize contract work release form.	<b>ACCOUNTABLE</b> Contractor to conduct readiness/challenge review meeting with appropriate stakeholders.  Contractor to respond to challenge comments and disposition or incorporate into Work Release.	Readiness/Challenge Meeting, Contract Work Release FORM
5.10	Permitry Planning – OPG Equipment	N-PROC-MA-0012	<b>ACCOUNTABLE</b> OPG to prepare and integrate	<b>ACCOUNTABLE</b> Contractor is to initiate the request of	Request for Permit

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
			permitry into OPG plan.  OPG to determine terminal & boundary point locations.	permitry for OPG equipment.  Contractor to identify test planning activities	PC1  PC14
5.10b	Permitry Planning – Contractor Provided Tools and Equipment	Redbook Lock Out-Tag Out Safe Work Procedures	<b>ACCOUNTABLE</b> OPG to integrate contractor permitry into OPG plan.  OPG to verify contractor LOTO procedures meet OHSA requirements.  OPG to review contractor LOTO procedures to verify equivalency.  OPG to determine terminal & boundary point locations.	<b>ACCOUNTABLE</b> Contractor to identify isolating points. Contractor to prepare permitry for Contractor provided equipment per Contractor procedures. Contractor to identify test planning activities.  Contractor to identify locations for temporary equipment.	LOTO Work Instruction (Project Specific)
5.11	Permitry Execution – OPG Equipment	N-PROC-MA-0012 N-NR-PROC-09701-10001	<b>ACCOUNTABLE</b> OPG to apply the permits and provide Controlling Authority and Issuing Authority.  OPG to operate terminal points at contractor request	<b>ACCOUNTABLE</b> Contractor to provide Holder of Record and Holder of Record Coordinator, to support the permitry application.  Contractor shall follow NR Work Protection Procedure on all OPG equipment.  Contractor to identify additional testing, as required.  Contractor to initiate permit termination as per OPG governance.	Applied Permit  PC14
5.11 b	Permitry Execution – Contractor Provided Tools & Equipment	Redbook Lock Out – Tag Out Safe Work Procedure	<b>ACCOUNTABLE</b> OPG to operate terminal & boundary points at contractor request.	<b>ACCOUNTABLE</b> Contractor to apply permits for Contractor provided equipment downstream of terminal points as per	Contractor LOTO permits

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
			OPG to terminate and remove permits on OPG owned equipment.	Contractor procedures. Contractor to operate Isolating points as required.  Contractor to isolate/operate all in vault equipment downstream of identified Terminal Points, including but not limited to: Vault Cranes, RTP (including equipment used on the RTP), AGVs, and power distribution equipment.	
5.12	Radiation Protection	N-PROG-RA-0013 N-FORM-11047  QCP 509.11	<b>SUPPORT/APPROVE</b> OPG to provide approved Radiation Protection Program and procedures to support unit refurbishment activities including; RPC resourcing, organization & administration, office facilities, portable RP instrumentation, bioassay and dosimetry supply, teledosimetry system, RP training & facilities, laundry and RPPE. OPG to review and approve Contractor ALARA plans and dose estimates to ensure compliance with OPG radiation protection programs and implementing procedures.	<b>ACCOUNTABLE</b> Contractor to prepare, verify and submit ALARA plans and dose estimates for approval.	ALARA Plans  Dose Estimates
5.13 a)	Calibration (Permanent Station Equipment)	N-PROC-MA-0070 (Field Cal'n) N-INS-09100-10012 (UTC) N-INS-01516-10003 (Software) N-MAN-01983-10000 (FE Cal'n)	<b>REVIEW/ACCEPT</b> OPG to review and accept.	<b>ACCOUNTABLE</b> Maintain calibration records of all instruments calibrated and specific calibration equipment used to required standards (UTC & Field Calibration Process or accepted equivalents).  Forward calibration records to OPG prior to AFS. Calibration records to be compiled in the History Docket	Calibration Records
5.13 b)	Calibration	QCP 311.0	<b>SUPPORT</b>	<b>ACCOUNTABLE</b>	Calibration Records

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
	(Contractor Equipment)	Form G006 Form G026 Form G063 Form G064 Form G006A	As required	Maintain calibration records of all instruments calibrated and specific calibration equipment used to required standards.	
5.14	Construction Completion Declaration (Return to Service)	QCP 511.2 QCP 505.21	<b>SUPPORT/REVIEW/ACCEPT/APPROVE</b> OPG to review and approve Construction Completion Declaration Package. OPG to accept QA records.	<b>ACCOUNTABLE</b> Contractor to prepare Construction Completion Declaration Package. Contractor to provide completed CWPS, History Dockets and as built construction QA records.	Construction/Installation Completion Assurance Certificate  Form G008
5.15	Contract Construction Completion		<b>REVIEW/APPROVE</b> OPG to review and approve Unit Mechanical Completion	<b>ACCOUNTABLE</b> Contractor to prepare and submit Notice of Unit Mechanical Complete for OPG Approval.	Notice of Unit Mechanical Complete
5.16	Work plans / Commissioning Instructions and Pre-Commissioning Site Acceptance Test (SAT)	N-INS-08120-10011 N-GUID-09701-10020	<b>SUPPORT / APPROVE</b> OPG support reviews for particular subject areas.  OPG to Approve  OPG to authorize Workplan/Commissioning Instructions	<b>ACCOUNTABLE</b> Prepare, verify and approve commissioning work plans /Instructions where required to coordinate field activities.  Prepare and obtain approval for Commissioning Work Plan/Instructions as required.	Commissioning Work Plan/Instructions
5.17	Pre-Commissioning Activities		Refer to item 3.69	Refer to item 3.69	Refer to item 3.69
5.18	Commissioning Activities		Refer to item 3.70	Refer to item 3.70	Refer to item 3.70
5.19	Vault Area Co-ordination	NK38-MAN-09327-00003 N-PROC-RA-0011	<b>ACCOUNTABLE</b> OPG to co-ordinate vault activities when bulkhead	<b>ACCOUNTABLE</b> Contractor to co-ordinate vault activities when bulkhead containment boundary	NA

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#	Items	Reference Document, Forms, and Templates	OPG Accountability	Contractor Accountability	Deliverables
		D-INS-09071-10010	containment boundary is not established. During this time OPG to co-ordinate all vault activities such that Contractor critical path is not delayed. OPG to mentor Contractor Construction Field Integration Officer (CFIO) prior to establishing bulkhead containment boundary.	is established. Incorporate windows for integration of other contractors and OPG staff to maximize productivity during critical path. Contractor CFIO will, in compliance with the Unit P6 Outage schedule, will work collaboratively with the Unit Outage Manager to determine on a daily basis work streams in the vault when bulkhead containment boundary is established.	
5.20	Plant Status Control	D-INS-09110-10013 N-PROC-OP-0034	<b>ACCOUNTABLE</b> OPG will make and verify tags.	<b>ACCOUNTABLE</b> Contractor will request new or replacement tags. Contractor will hang tags.	N-FORM-10407

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APPENDIX A: REFERENCED DOCUMENTS IN THE INTERFACE REQUIREMENTS

OPG Engineering Related References

D-ED-01520-10001 Darlington Equipment Identification

D-PROC-MP-0011 Power Supply List Change Control

D-STE-60110-10001 Computer Wiring Applications And Wiring Practices

N-FORM-10007 COMS Stakeholder Declaration

N-FORM-10091 Available For Service Declaration Or Operations Declaration Acceptance Declaration

N-FORM-10221 Human Factors Worksheet

N-FORM-10250 System Classification List

N-FORM-10408 Software Procurement Planning

N-FORM-10409 Software Quality Assurance Requirements

N-FORM-10446 Software Categorization Results

N-FORM-10480 COMS Checklist

N-FORM-10580 Identifying Human Factors Level Of Activity

N-FORM-10649 Environmental Qualification (eq) Completion Assurance

N-FORM-10653 Document Transmittal Request

N-FORM-10853 PSR Determination Checksheet For OPG Nuclear

N-FORM-10958 Modification Outline

N-FORM-10959 Design Scoping Checklist

N-FORM-11003 Code Classification\registration Approvals And Exemptions

N-FORM-11045 Code Classification Exemption Assessment

N-FORM-11070 Scope of Work or Applicable Master EC Package

N-FORM-11128 Field Initiated Change Cover Sheet

N-FORM-11524 Code Class Exempt Assessment

N-GUID-00700-10000 Guide To Modification Process

NK38-GUID-01900-10001 Darlington Refurbishment: Design Completion Assurance

N-GUID-08133-10072 Asset Suite Responsibilities for EPC Suppliers on the Darlington Refurbishment Project

NK38-GUID-50000-10001 DNGS ETAP Model Update Guidelines

N-INS-00680-10000 Identification Of Critical Spares

N-INS-00700-10007 Preparation Of Modification Design Requirements

N-INS-00960-10000 Detailed Commissioning Specifications And Commissioning Reports

N-INS-03651-10025 Environmental Qualification Evaluations (eqe)

N-INS-06700-10000 Preparation Of Human Factors Worksheet

N-INS-08120-10011 Workplan Preparation And Development Process

N-INS-08121.3-10000 Implementation Of Pre-start Health And Safety Reviews (psr)

N-INS-08135-10116 Determining Risk Critical And Safety Significant Equipment And Components For The Q-list

N-INS-09076-10004 Fire Protection Third Party Review

N-INS-09100-10012 Maintenance Work Reporting And Feedback

N-INS-60110-10000 On-line Wiring Updating And Design

N-LIST-01300-10000 Bounded Document Set

N-MAN-08135-10000 Ontario Power Generation Nuclear Data Dictionary For Passport Master Equipment List Configuration Data

N-PROC-MA-0020 Predefined Process

N-PROC-MA-0024 System Performance Monitoring

N-PROC-MA-0034 Predictive Maintenance Program Requirements

N-PROC-MA-0068 Engineering Requirements Supporting The Calibration Process

N-PROC-MA-0070 Calibration Of Field Equipment

N-PROC-MA-0077 Critical Equipment Identification And Categorization

N-PROC-MA-0090 Heat Exchanger Program Requirements

N-PROC-MA-0092 Power Operated Valve Program

N-PROC-MA-0093 Check Valves

N-INS-08125-10001 Lubrication Selection Process

N-PROC-MM-0008 Create And Maintain Catalog Information

N-PROC-MP-0040 System And Item Classification

N-PROC-MP-0049 Procurement Of Software And Products Containing Software

N-PROC-MP-0058 Equipment Bill Of Materials

N-PROC-MP-0065 Preparation And Revision Of System Design Manuals

N-PROC-MP-0076 Preparation Review And Approval Of Engineering Drawings Design Flow Diagrams And Operational Flow Sheets

N-PROC-MP-0083 Constructability Operability Maintainability And Safety

N-PROC-MP-0086 Safety Analysis Basis And Safety Report Updates

N-PROC-MP-0089 Design Specifications Design Reports And Overpressure Protection Reports

N-PROC-MP-0090 Modification Process

N-PROC-MP-0098 Procurement Engineering Activities

N-PROC-MP-0105 Quality Design Plans

N-PROC-OP-0008 Use And Control Of Plant Status Tags

N-PROC-OP-0023 Position Assured Components

N-PROC-OP-0027 Temporary Change Records

N-PROC-TR-0023 Simulator Quality Assurance

N-ST-01161-10000 Drafting Presentation Standard And Practices

N-ST-08131.02-10000 Preparation Of Operational Safety Requirements

N-STD-RA-0033 Reliability Monitoring And Reporting Of Systems Important To Safety

N-STD-RA-0038 Requirements Of Fire Safety Assessments

N-STI-03602-10000 Soe Instrument Uncertainty And Allowable Value Calculations

N-STI-69000-10001 Software Maintenance

N-TMP-10010 Controlled Document Or Record

N-TMP-10143 Preparation And Revision Of System Design Manual

N-TMP-10187 Modification Design Requirements

N-TMP-10189 Darlington Design Manual

N-TMP-10209 Available For Service (afs) Report

OPG Procurement Related References

N-FORM-10170 ASL Action Request

N-FORM-10396 History Docket/Nuclear Material

N-FORM-11524 Portable Assembly Exclusions

N-PROC-MM-0010 Establishing and Maintaining OPGM ASL

N-PROC-MM-0021 Receiving QC Inspection

N-PROC-MM-0021Receiving QC Inspection

N-STM-03651.03-10000, Shelf-Life Requirements

N-TS-08173-10001 History Docket/Nuclear Material Documentation Release

OPG Construction Related References

N-INS-09100-10012 - Recording Field Calibration Equipment UTC Numbers

N-MAN-01983-10000Field Engineering Quality Control Manual

N-NR-PROC-09701-10001 - Work Protection Nuclear Refurbishment

N-MAN-01983-10000 Field Engineering Quality Control Manual

N-PROC-MA-0012 Work Protection

N-PROC-MA-0013 Planned Outage Management

N-PROC-MA-0022, Integrated On-line Work Schedule

N-PROC-MA-0070 Calibration Of Field Equipment

N-PROC-OP-0034 Equipment Labeling

N-PROC-RA-0011 Radiation Protection Coordinator Protection Assistant And Access Controller

D-INS-09071-10010 Radiation Protection Access Control

D-INS-09110-10013 Operations Manager Expectations - Plant Status Control

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N-PROC-RA-0027 Radioactive Work Planning Execution And Close Out

N-PROG-RA-0013 Radiation Protection

N-GUID-09701-10011 DN Refurbishment Safety Management Essentials

N-GUID-09701-10013 Nuclear Projects – Environmental Requirements Guideline

N-GUID-09701-10019 Nuclear Refurbishment Construction Check And Test Requirements N-GUID-09701-10020 Nuclear Refurbishment Commissioning Process

N-FORM-11047 Alara Planning And Post Work Review

NK38-MAN-09701-10005 Nuclear Refurbishment Planned Outage Management

NK38-MAN-00210-10001

NK38-MAN-09327-00003 Darlington Outage Manual - Vault Coordinators Activities

N-TMP-10208 Work Plan

RFR Joint Venture - Engineering Related References

2206-01-00-QM-0001 Quality Assurance Manual

2206-07-10-OP-0001 Design Planning

2206-07-20-OP-0001 Preparation of Engineering Documents

2206-07-20-TF-0001 HF Engineering Program Plan

2206-07-20-TF-0012 Design Report - Study

2206-07-20-TF-0013 Design Report - Analysis

2206-07-20-TF-0024 Bill of Materials

2206-07-20-TF-0026 Field Walkdown Package

2206-07-20-TF-0031 Walkdown Report Design Plan

2206-07-20-TF-0032 Design Plan

2206-07-20-TF-0038 OPEX

2206-07-20-TF-0039 Package Design Requirements

2206-07-20-TF-0040 Certified Design Specifications

2206-07-20-TF-0101 Human Factors Validation Plan

2206-07-20-TF-0102 Human Factors Assessment – Major

2206-07-20-TF-0103 HF Worksheet

2206-07-30-OP-0003 Feedback Information for Design Input

2206-07-30-OP-0005 Acceptance of Design Inputs

2206-07-30-OP-0006 Field Walkdown Procedure

2206-07-30-OP-0013 Registration of Pressure Retaining Systems and Components

2206-07-50-OP-0001 Design Verification

2206-07-60-OP-0001 Design Change Control

2206-01-20-OP-0003 R5 Document Control Routines

2206-01-20-CF-0011, Vendor Document Coordination Cover Sheet

2206-07-30-CF-0002 Walkdown Checklist

2206-07-20-CF-0030 Field Condition Report2206-07-WI-0003

509407-0000-00000-40WI-0002 Field Change Notice Instruction

509407-0000-00000-40TF-0001 Field Change Cover Sheet

509407-0000-00000-38QP-0001 Project Quality Plan

509407-0000-00000-40EP-0001 Engineering Plan

RFR Joint Venture - Procurement Related References

2206-01-20-OP-0002 Control of Quality Records

2206-01-30-CF-0002 Nonconformance Report

2206-01-30-CF-0003 Deviation Disposition Request

2206-01-30-CF-0010 Receiving Report

2206-01-30-OP-0002 Control of Nonconforming Items and Services

2206-01-30-OP-0009 Receiving Inspection

2206-01-50-CF-0062 Dedication Plan Commercial Grade Items

2206-01-50-OP-0002 Dedication of Commercial Grade Items

2206-06-00-OP-0001 Purchasing Strategy

2206-06-10-OP-0004 Quality Assurance Evaluation of Tenders

2206-06-30-CF-0003 Supplier Qualification Record

2206-06-30-CF-0005 Recommendation and Authorization to Purchase

2206-06-30-CF-0013 General Purchasing Conditions Nuclear Mat'ls

2206-06-30-OP-0003 Evaluation and Selection of Suppliers

2206-06-30-OP-0008 Logistics and Material Control

2206-06-40-CF-0004 Surveillance Plan

2206-06-40-CF-0006 Quality Assurance Release

2206-06-40-CF-0007 History Docket/History File Acceptance

2206-06-40-OP-0001 Preparation of Surveillance Plans

2206-06-40-OP-0001 Preparation of Surveillance Plans

2206-06-40-OP-0002 Performance of Quality Surveillance

2206-06-70-OP-0002 Supplier Performance Evaluation

2206-07-30-OP-0010 Tender Technical Evaluation

509407-0000- 00000-50IM-0001Procurement Mgmt Plan

509407-0000-00000-38QP-0001 Project Quality Plan

RFR Joint Venture – Construction Related References

509407-0000-00000-38QP-0001 Project Quality Plan

509407-0000-00000-32IM-0001: Schedule Management Plan

509407-0000-00000-40AG-0001

Aecon CSA N286 QA Manual – EPC Contracts

Procedure Qualification Record

Welding Procedure Specification

QCP 310.21

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QCP 410.4	Form G008
QCP 410.5	Form G026
QCP 310.6	Form G063
QCP 310.7	Form G064
QCP 311.0	Form G084
QCP 309.67	Form Q040
QCP 501.1	Form N051
QCP 505.21	Form Q001
QCP 509.11	Form Q002
QCP 510.8	Form Q12
QCP 511.2	Form W08
Form EHS RBF 107	Redbook JSA Section
Form G006	Redbook – Lifting and Rigging Safe Work Practices
Form G006A	Redbook Lock Out-Tag Out Safe Work Procedures



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APPENDIX B: PROCUREMENT ASSET SUITE TEMPLATE

In addition to the following table, Contractor to also prepare/approve and submit to OPG details of evaluation of Cat Ids. These details may include but not limited to “PE Request Log Disposition” (Asset Suite Panel Q102), “PE Safety Basis Summary” (Asset Suite Panel Q120), “PE Item Equivalency Evaluation and Configuration” (Asset Suite Panel Q150). Copies of templates for these panels will be provided by OPG.

No.	Cat ID	Cat ID Level (Level 1/Level X)	QL	Description	PB (Yes/No)	EQ (Yes/No)	SQ (Yes/No)	QA Program	Applicable Code	TSSA REGISTRATION (CRN) X Number	Vendor Documentation Requirements	End Use (Equipment Code)	SR/NSR	Applicable Specification Number	Drawing Number	Item # in Drawing	Manufacturer	Manufacturer Location	Model and/or Part Number	Quantity	Manufacturer ASL Qualification (Y/N)	Vendor	Suggested ROP/TMAX	Trade Type	Material Safety Data Sheet MSDS (Y/N)	Limited Shelf Life (Y/N)	REMARKS (e.g. obsolescence of parts, item equivalency, safety basis)
Example	123866	III	1	VALVE, GAIN, G1 300LB, BUTTWELD, ANSI, NCI	Y	N	A	Z299.3	ASME SEC. III	NP012345	CMTR, HDOC, SEISMIC REPORT, INP	5/5/7/8-33221A/B					VELCAN				Y	VELCAN	1/3	S	N	N	
1																											
2																											
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**PB** Pressure Boundary  
**EQ** Environmental Qualification  
**SQ** Seismic Qualification  
**Code** B51, B31.1, ASME - NB, NC, ND, etc.  
**ASL** OPG Approved Supplier List

Vendor Documentation

C OF C Certificate of Compliance  
CMTR Certified Material Test Report  
HDOC History Documentation  
C OF A Certificate of Analysis

Legend

Required Information  
 Provide information if available

Level X Spare Parts List (L2, L3, L4)

**Applicable Code**  
ASME SECTION III (EXAMPLE) NC1  
ASME SECTION VIII  
B51

QA Program

CSA Z299.1  
CSA Z299.2  
CSA Z299.3  
CSA Z299.4  
ISO 9001

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### APPENDIX C: PROCUREMENT PLAN TEMPLATE

The Procurement Plan shall be prepared and include the Owner or Contractor Specified Materials and Services procurement activities. The Procurement Plan shall be based upon the Contractor's qualified procurement program.

The plan may include, but not limited to, the following elements:

1. Executive Summary
2. Background Information
3. General Description of Product/Services
4. Technical and Regulatory Requirements
5. Historical and Future OPG Usage
6. Vendor/Marketplace Capabilities & Supply Restrictions
7. Existing OPG/Vendor Relationships
8. Bidder Prequalification
9. Competitive Tendering
10. Evaluation/Negotiation & Contract Award
11. Subcontract Management
12. Scheduling.
13. Staffing and Succession Plans
14. Source Surveillance
15. Concessions and Exceptions
16. Sourcing Strategy
17. Success Criteria
18. Risks and Mitigations
19. Commercial/Contractual Requirements
20. Contract Administration Considerations
21. Quality Assurance
22. Quality Control
23. Expediting
24. Transportation/logistics,
25. Site Receipt of Goods, Warehousing
26. Claims Resolution
27. Invoice Approval
28. Contract Closeout
29. Post Contract Considerations
30. References

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### APPENDIX D: NON-CONFORMANCE POST-INSTALLATION REPORTING

The Contractor shall submit a notification on company letterhead endorsed by Senior Quality Management addressing the following as a minimum:

- (a) A clear description of the defect or non-conformance.
- (b) An assessment on the impact of the defect or non-conformance to the product form, fit or function. Also address the potential impact on safety if known.
- (c) Identify OPG CatID numbers(s) that are affected including OPG PO and line item numbers, ship date, quantity, manufacturer product identification / traceability (i.e. serial number, lot number, batch number, manufacturing date, etc.).
- (d) Immediate short term actions to be taken to remedy the situation at OPG (address the availability of replacement item(s) and delivery time lines).
- (e) Long term corrective action plan to address the root cause for the defect or non-conformance, including completion / implementation commitments.

Contractor to submit notification by email to: [scgs.suppliers@opg.com](mailto:scgs.suppliers@opg.com)

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### APPENDIX E : OPG APPROVED SUPPLIER LIST

(a) **Use of OPG's ASL.**

Subject to the other requirements of the Agreement, the Contractor will be able to utilize vendors on OPG's Approved Supplier List (ASL). All vendors which are active on OPG's ASL are maintained up to date and their qualification is current. OPG's ASL is maintained using OPG's QA Program.

OPG will provide to the Contractor a list of vendors qualified on OPG's ASL periodically or as requested by the Contractor. The list will contain the following information: the Asset Suite Vendor Code, Vendor name, supplier web page – when available, Quality level (QL1 or QL3), qualification result (SAT or UNSAT), detailed scope of qualification, including scope restrictions, if the vendor has Corrective Actions issued or restrictions and warnings (only Yes or No – no additional details), qualification effective date and expiry date, scope of supply – manufacturer, services, distributor, etc, Pressure Boundary (PB), non PB flag, and quality standard used. The Contractor may use the list for the sole purpose of work to be performed for OPG.

Vendors on OPG's ASL may be used by the Contractor only if the Contractor determines that the information provided is sufficient and meets the requirements of the applicable standards and the Contractor's own quality program. The Contractor is responsible to use the vendors on OPG's ASL only for the specific purpose(s) for which they have been approved on OPG's ASL. The Contractor is solely responsible for taking all necessary actions to ensure that its sub-suppliers have the technical and quality assurance capability for the scope of work they are utilized for, and the ability to provide the required product or service. This includes obtaining assurance that the sub-suppliers have an appropriate and effective quality program implemented in accordance with the Contractor's own quality program and applicable standards requirements.

The use of vendors on OPG's ASL does not preclude or limit in any way the Contractor's responsibility for and obligation to provide OPG with quality parts and services meeting all requirements under the Agreement.

(b) **Use of sub-contractors not on OPG ASL**

If the Contractor's requirement is not satisfied by vendors on the OPG's ASL, or the scope of qualification for a vendor on OPG's ASL needs to be changed, the Contractor shall submit to OPG notification to use a new sub-contractor when required as identified below:

(i) **A submittal to OPG is required for the use of sub-Contractors only when:**

The contractor acts a procurement organization as per CSA N286-05 for the purchase of items and services:

- For QL1 and QL3 items only when a quality program is specified
- For QL1 and QL3 items, when the specified quality program is for CSA Z299.3 or higher (e.g. CSA Z299.1/2/3, NCA 3800 Material Organizations)

## Contractor/Owner Interface Agreement

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- When a primary CSA N286-05 engineering, procurement or construction is subcontracted in its entirety

**(ii) A submittal to OPG is not required for sub-contractors:**

- When the contractor purchase materials/ components following a CSA Z299 program as part of their manufacturing process (i.e. the contractor is the manufacturer or the manufacturer of record)
- When there is no quality program specified
- When the specified quality program is CSA Z299.4 or ISO 9001
- Service suppliers (other than those primary N286-05 engineering, procurement, or construction service suppliers identified above in (i))
- Software suppliers
- Related to the Mock-up Scope of Work
- Tooling Suppliers

The Contractor shall evaluate, audit as appropriate, and approve the new supplier, according to the Contractor's own quality program. When a submittal to use a supplier is required, the Contractor shall provide the audit report, checklist, corrective action requests and certificates to OPG. The Contractor should assist OPG in providing business justification as to why OPG should accept using these potential Sub-Contractors.

When a submittal is not required, the Contractor shall maintain the audit report and checklists according to their own quality program requirements and provide it to OPG upon request.



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**DARLINGTON REFURBISHMENT PLANNING AND CONTROLS PROGRAM  
MANAGEMENT PLAN**


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**Darlington Refurbishment Planning And  
Controls Program Management Plan**

**NK38-NR-PLAN-09701-10001-0002-R001**  
2015-03-13

Order Number: N/A  
Other Reference Number:

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### Revision Summary

Revision Number	Date	Comments
R001	2015-03-13	Revised to address comments from SA RF14-000625
R000	2014-01-31	<p>This document supersedes NK38-PLAN-09701-10067 Sheet 0002. The changes between NK38-PLAN-09701-10067 Sheet 0002 and this document are as follows:</p> <ul style="list-style-type: none"> <li>The document number has been changed to meet the requirements of NK38-NR-MAN-09701-10001,</li> <li>The security classification has been removed so that the document can be submitted to the CNSC, and</li> <li>References have been updated.</li> </ul>

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## **DARLINGTON REFURBISHMENT PLANNING AND CONTROLS PROGRAM MANAGEMENT PLAN**

### **1.0 PURPOSE**

The Planning and Controls Program Management Plan provides a strategic overview of the various processes and project management activities within the Planning and Controls organization. These processes, in compliance with N-STD-AS-0028 Project Management Standard, are applicable to all projects funded by the Darlington Refurbishment Program (DRP).

### **2.0 PROGRAM REQUIREMENTS**

The Project Planning and Controls Department is an integral part in preparations for the refurbishment program by establishing a solid project management and controls environment to build and support the organization. P&C established, and continues today, following industry best standards for project management to ensure that the latest strategies for effective project management are utilized.

#### **2.1 Scope**

Defining project scope is a critical step to project success as it establishes the basis for project cost, schedule, risk management, contracts, and decisions. Improved scope detail leads to improved estimate and schedule accuracy. As part of the front end planning of the Darlington Refurbishment program, the program will undergo an evolution of scope development. Scope will be presented at a fairly high level (Major Program Level Scope) during the Preliminary Planning phase of the project. During the Detailed Planning phase, the scope will evolve into Master Engineering Changes (MEC's), Design Engineering Changes (DEC's) and detailed work orders (Developmental Scope). Finally, once the work is developed at the detailed level, Refurbishment Cyclical Outage work will be controlled at the Outage Unit execution level and be managed as ongoing work management

N-MAN-00120-10001-SCOPE, Nuclear Projects Scoping Process, outlines the scope principles and requirements for Darlington Refurbishment Program (DRP). The scoping process is integrated with the project phases and gating process. The scope of work for the next project phase should be well defined compared to the scope for the balance of the project in future phases. The scoping process, particularly developing and defining the scope, is a continuous process in the project lifecycle.

#### **2.2 Schedule**

Establishing an accurate and realistic schedule is a critical planning tool for a project. The schedule is the main planning tool used to understand and communicate how a project will be executed and includes the interrelationships and dependencies among project activities and deliverables, and the status of the work. The schedule is critical to properly strategize, plan and prepare for upcoming project work, to determine

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resource requirements, to understand how work is progressing and to apply corrective actions as required.

N-MAN-00120-10001-SCH, Nuclear Projects Schedule Management, outlines scheduling management principles and requirements for DRP which are applicable to both OPG project teams within the DRP and to contractors whom are performing work for DRP. Schedules are to be developed with inputs from all stakeholders and are monitored and updated throughout the project lifecycle. Schedule detail must be developed at an appropriate level to allow the project team to communicate the plan, monitor project progress and as an input into cost performance metrics in order to make accurate forecasts and to strategize and plan for upcoming work.

DRP uses a multi level schedule structure (L0, L1, L2 and L3) and a standardized Work Breakdown Structure in accordance with best practices. The Program Milestones for Darlington Refurbishment are identified and maintained in the Program Integrated Master Schedule (PIMS). The schedule is maintained regularly and activities are tracked to a baseline. Variances are tracked, reported and mitigating and/or recovery plans developed when required. Critical path to Breaker Open and Breaker Open to Breaker Closed are identified, monitored and reviewed for potential impacts.

The Control & Coordination schedule (CCL2) is the level of detail that integrates all program work for all units and all bundles. The work packages, (the lowest level in the WBS structure) are represented in the CCL2 schedule by at least 1 activity and tied to the level 1 milestone schedule. All activities in the CCL2 schedule are logically tied according to the sequence of work. The Darlington Nuclear Refurbishment Co-Ordination & Control Schedule guide is currently under development.

Functional Schedules are prepared in accordance to the Functional Schedule guide (currently under development).

Contractors prepare schedules in accordance with N-MAN-00120-10001-SCH-09, Nuclear Projects Scheduling Requirements from EPC Contractors. Level 3 schedules are integrated and aligned to CCL2 and the PIMS. Vendors will self perform their schedule updates and maintenance with oversight from the OPG Master Scheduler.

The integrated Level 3 Schedule provides further breakdown of the work below the work package level and shows all interfaces and shared resources between contractors and OPG. All activities in the level 3 schedules are logically tied according to the sequence of work and summarized to the CCL2 activity level.

Milestones are baselined in accordance with N-MAN-00120-10001-SCH-06, Nuclear Refurbishment Milestone Definition Framework. The Milestones are grouped by tiers based on the authority to approve changes.

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### **2.2.1 Schedule Update and Monitoring**

On a regular basis according to the reporting cycle plan, all Level 3 Schedules shall be updated by the person or group who is performing the work (i.e. contractors or OPG). As a product of these updates, schedule progress at the Work Package level for all scheduled work is translated into the cost management system for the purposes of calculating earned value.

The progress data is verified and reviewed by OPG. Once reviewed, a variance analysis is produced to provide reasons for any schedule slippages and to determine necessary corrective action/recovery plans when needed. A critical path analysis is also produced using level 3 schedule details.

On a regular basis, according to the reporting cycle plan, all CCL2 schedules are updated by OPG based on contractor's level 3 schedules and an overall program critical path is produced.

### **2.2.2 Schedule and Cost Integration**

The Work Package is the lowest level of the WBS that integrates cost and schedule. Once the schedule updates are progressed and statused by work package, the physical percent complete, actual start, actual finish, forecast start and forecast finish is prepared and integrated into the cost system used for earned value calculation (Proliance) in accordance with N-MAN-00120-10001-SCH-07, Nuclear Refurbishment Earned Value Management.

### **2.2.3 Schedule Reporting**

When the monthly updating cycle is complete, all schedules /layouts are posted in SharePoint and accessed by all OPG staff through the Scheduling Link. Reporting requirements will be established based on the phase of the Program and the nature of the work being performed by the vendor.

## **2.3 Cost Management**

Cost management includes the processes required for planning, managing, recording, and controlling costs at the program and project/function levels within approved budgets.

The Program's cost management process is defined in N-MAN-00120-10001-PC, Project Controls, with detailed guidance established below the manual level in the areas of cost management, change control, and forecasting.

Program level budgets are established via Program Releases. Funding for the current release period is allocated directly to functional groups (both DRP and Centre-led) upon release approval. Project funding is allocated from the program via the Gated Process and the Gate Review Board in accordance with N-MAN-00120-10001-GRB, Nuclear Projects Gated Process.

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Estimated funding requirements for the program life cycle beyond the current release are documented as unreleased funds at the project and functional levels.

Program releases will also establish program level Contingency and Management Reserve funding. The program strategies for managing Contingency and Management Reserve are detailed in Sections 2.4 and 2.5 of this document. Release of Contingency and Management Reserve funding is controlled via the change control process as described in sections 2.3.3.

The program has established and will maintain a systematic and hierarchical Cost Breakdown Structure (CBS) that identifies all the Control Accounts used by the Program. The CBS mirrors the Program Work Breakdown Structure (WBS) and includes cost only elements not contained in the WBS (e.g. Contingency, Interest). Each Control Account contains one or more Work Packages (WP). Budgets for all work are established at the WP level and associated actual costs are collected at the WP level to support cost performance monitoring.

The program life cycle funding, budgets, forecasts and incurred costs are recorded, tracked, and managed within the Proliance cost management tool.

### **2.3.1 Earned Value Management**

Earned Value Management methodology, as defined in N-MAN-00120-1000-SCH-07, Nuclear Refurbishment Earned Value Management is utilized as the primary architecture for cost management. Planned Value (PV) is established at the Work Package level, recorded as a dollar value in Proliance, and rigorously controlled via the Change Management practices as outlined in Section 2.3.3. Earned Value (EV) is derived via schedule progress and recorded as a dollar value in Proliance. Actual Cost (AC) is exported from the financial ledger (NFRA) to Proliance at the Work Package level.

Standard earning rules are defined for all phases of work (Engineering, Procurement and Construction) and shall be rolled out to each contractor before baselining the Level 3 schedule.

### **2.3.2 Estimating**

Cost estimating is the process of determining the expected total cost of labour, materials, equipment, professional fees, and other resources required for the execution of a project. Detailed guidance on estimating for Darlington Refurbishment is provided in N-MAN-00120-10001-EST, Nuclear Projects Cost Estimating.

Project cost estimates for Engineer/Procure/Construct scopes of work are prepared internally to support the following processes:

- EPC contract Request for Proposal (RFP) and bid evaluation
- Program life cycle and release planning

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In addition, once EPC vendor contracts are in place, internal estimating expertise is utilized to:

- Review vendor Estimate Plans
- Provide independent review and validation of vendor Class 4/3/2/1 estimates supplied to OPG as projects progress from definition through execution phases

### **2.3.3 Change Management**

Change Management is the Project Management tool used to identify and record the effect of changes to the *baseline* and impacts on scope of work, costs, and schedules in DRP. This helps to maintain the integrity of the project *baseline* and manage *funding* requirements.

In accordance with N-MAN-00120-10001-SCH, Nuclear Projects Schedule Management, the **Project Infrastructure Master Schedule (PIMS)** establishes the cost and performance *baseline* for managing DRP Projects. Manual N-MAN-00120-10001-SCH, Nuclear Projects Schedule Management provides the principles to be followed in establishing cost and schedule change control for DRP projects as they are developed.

Cost and schedule alignment is maintained via the change control process outlined in N-MAN-00120-10001-PC-01, Nuclear Refurbishment Cost and Schedule Change Control.

Changes are rigorously identified, categorized, and recorded in the Proliance cost management tool in order to effectively maintain project and program baselines and track cost performance against approved plans and budgets.

### **2.3.4 Performance Measurement**

Cost performance is measured using standard industry metrics at the program, project, and functional levels. Utilizing the Earned Value data structure, the following standard metrics are calculated from the Proliance cost management tool and reported via the Business Intelligence (BI) reporting tool:

- **Schedule Performance Index (SPI):** SPI is a measure of progress achieved compared to planned progress (EV/PV).
- **Cost Performance Index (CPI):** CPI is a measure of the value of work completed compared to actual cost incurred (EV/AC).
- **Cost Variance:** The difference between the budgeted value of work performed and the actual cost of that work. (AC - EV).
- **Budget Variance:** The difference between the budgeted value of work planned and the actual cost of work performed. (AC - PV).

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Cost performance is monitored for various program periods, including life-to-date (LTD), life cycle, current gate, and annual release. Standard BI reports are produced at the program and project levels for these periods.

SPI, CPI, and variance metrics are all past-performance oriented. The program also utilizes forecasts at the program and project levels against approved life cycle estimates in order to proactively assess future success and take early corrective action where required.

## 2.4 Risk

N-MAN-00120-10001-RISK, Nuclear Projects Risk Management Process, provides direction on risk management; ensuring risks are identified, assessed, analyzed for risk response, and monitored to a robust and consistent standard to ensure that project objectives are achieved.

Risk management provides projects with forward-looking actions and metrics to reduce the likelihood and minimize the impact of undesirable events during the project life cycle. The goal of risk management is to remove obstacles to project success before they occur in order to minimize their consequential effect on project costs, schedule, quality, and safety targets.

Proactive risk management is used to understand the characteristics of the risk, how to manage them, and plan for *contingency* based on the *residual risks*. As such, risk management can have a significant impact on the financial health of the project.

N-MAN-00120-10001-RISK-04, Nuclear Refurbishment Risk Management, provides guidance on how to use the risk register to identify, update and close risks in the program and project risk registers. It also defines the Darlington Refurbishment risk assessment criteria and scales, risk assessment heat map and minimum risk review frequency. It sets the expectations for preparing Project Risk Management Plans (RMP) by contractors and refurbishment projects. Risks that only apply to the contractor are the responsibility of the contractor to manage. Oversight is provided by OPG to ensure an effective RMP is in place.

### 2.4.1 Risk Register Administration

- (a) Program RADAR, the DRP program risk register, is managed by the Risk Section, P&C. It contains risks that apply to the entire DRP program and risks that are related to the DRP Functions, e.g. Planning and Control, Supply Chain, etc.
- (b) Project RADAR, the DRP project risk register, is managed by each individual bundle in Project Execution. It contains risks that apply to project work within a bundle, e.g. Balance of Plant, Fuel Handling, etc.

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### 2.4.2 Risk Reporting

(a) As part of the monthly reporting cycle, risks are reported in:

- Top Risks from each Bundle and Function in the Monthly Quad Charts
- Key DRP Program Risks

**Note:** For each risk being reported on quad charts or program risk reports, the following information should be communicated:

- Risk ID
- Risk Title
- Risk Description
- Risk Response Strategy and Status
- Current Risk Score
- Post-Risk Response Risk Score
- Target Completion Date of reaching Post-Risk Response Risk Score

(b) The following reports are communicated to senior management:

- Top DRP Risks reported quarterly in the Nuclear Oversight Committee (NOC) and Executive Advisory Committee (EAC) reports.
- Key Program risks are reported to ERM using the BURSA template. See OPG-PROC-0094, Enterprise Risk Management Report.
- Risks that are jointly being addressed by the Darlington Station and DRP are presented and discussed on a quarterly basis at the Darlington & Darlington Refurbishment Common Risk Challenge Meeting.

### 2.5 Contingency

N-MAN-00120-10001-RISK-05, Nuclear Refurbishment Contingency, Development and Management, provides direction for contingent funds development. For the purposes of contingency determination, projects utilize quantitative analysis based on their identified risks.

Contingency development is an integral part of estimating, scheduling and risk management processes. Contingent funds to address uncertainties in a project should be proportionate to the project size, duration and complexity, risk exposure and tolerance, organization's prior experience with the work, and confidence levels set by management. At DRP, there are two main classifications of contingent funds to address different types of uncertainties – contingency and management reserve.

Contingency at DRP is further sub-divided into Project Contingency and Program Contingency to address uncertainties in project bundles and functional groups, respectively. It is not intended for changes in scope or extraordinary major social or natural events such as war, strikes, flood and earthquakes, which are addressed by Management Reserve.



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### **2.6 OPEX**

Darlington Refurbishment Operating Experience (OPEX) will be managed in accordance with OPG Nuclear N-PROC-RA-0035, Operating Experience Process. This identifies, evaluates, and takes action based on internal and external industry lessons learned in order to improve project and plant safety, reliability and performance.

In addition, N-MAN-00120-10001-RISK-06, Nuclear Refurbishment Processing Operating Experience, and Key Lesson Learned, provides guidance on the process to integrate relevant Project and Contract Management OPEX and Key Lessons Learned into the planning and execution phases of the Darlington Refurbishment program.

This will enable the NR program to use the above lessons learned information to improve project planning and execution phases, their processes, procedures, training, and system/equipment design to the fullest.

DRP OPEX SPOC creates specific communication to various stakeholders in the organization monthly and also maintains DRP OPEX events list located on the DRP SharePoint team site for all employees to use.

### **2.7 Documentation and Project Closure**

Records, documents and data collectively form the memory of the Darlington Refurbishment Program. They constitute the business and intellectual assets of critical importance, and must be managed to meet both regulatory and business requirements.

Documents shall be managed throughout their life cycle e.g. project planning, execution and program closure in accordance with N-PROG-AS-0006, Records and Document Control.

In addition to the standards and procedures described in N-PROG-AS-0006, Nuclear Refurbishment has developed electronic document control processes in conjunction with the implementation of an Electronic Document Management System (EDMS). N-MAN-00120-10001-RDM, Nuclear Project Records and Document Management, provides the direction related to electronic management of information.

Scope ID represents the contracting strategy, identifying the relationship with the DSR line items and the scope of work to maintain integrity and traceability of the data (Project Control data structure map is in Appendix B).

#### **2.7.1.1 Document Creation**

Requirements for creating, reviewing, approving and issuing Darlington Refurbishment process support controlled documents will be documented in NK38-NR-MAN-09701-

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10001, Darlington Refurbishment – Requirements for Process Support Controlled Documents (pending issuance).

Process support controlled documents are those documents which support the definition or implementation of a process (e.g. Program Management Plans, Manuals, Guides, Instructions and refurbishment-specific technical documents/procedures developed under N-PROC-AS-0028).

#### **2.7.1.2 Filing and Retention of DRP Records**

All records generated as a result of executing work under the DRP Program, must have a documented plan for filing and retention. It is the responsibility of the process owner to confirm the filing and retention requirements. These requirements are documented in a "Records Table" (see sample below), which must be included in the applicable process support document.

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (PassPort Type/Sub-Type)
Program Risk Identification Form	N-FORM-11306	N	File locally by department.

#### **2.7.1.3 Submission**

All Supplier documentation deliverables must be submitted electronically to OPG using EDMS. Exceptions apply when the format of the deliverable does not support electronic submission. EDMS has replaced the Supplier Document Hub, which will be phased out in early 2014.

#### **2.7.1.4 Review and Acceptance or Approval**

Submittals are routed electronically within EDMS for review. Reviews will be conducted by the appropriate stakeholders in accordance with the Gate Review Process described in N-MAN-00120-10001-GRB. Review comments are stored within EDMS, and returned to the submitter within contractually agreed due dates. OPG Records and Document Management (RDM) staff workflow, track, and report on processing dates.

Documents are routed electronically for acceptance or approval (with some exceptions). Once accepted, a document becomes an official project record at which time it is processed by RDM staff into an Approved Information Management System (e.g. Asset-suite).

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DRP employs SharePoint team sites for collaboration and storage of OPG internal project documentation and non QA records.

#### **2.7.1.5 Communicating OPG Requirements to Suppliers**

Project Managers are accountable to prepare and issue a formal Communication Protocol document to successful Suppliers immediately after contract award. The Communication Protocol document provides direction on how project correspondence and documentation deliverables are managed, and points to the process support documents and tools that the Supplier must reference in order to be compliant.

#### **2.8 Project Management Logs**

Actions, Issues, Decisions, and Key Assumptions (AIDA) of Darlington Refurbishment will be managed in accordance with N-STD-AS-0028, Project Management Standard.

AIDA is a data base, a repository for Actions, key issues, decisions and assumptions for Darlington Refurbishment Program that will be managed throughout the project lifecycle. The purpose of documenting Actions, Issues, Decisions, and Key Assumptions is to ensure that they are relevant to Darlington Refurbishment and are widely accessible by staff and to maintain an auditable trail for review, reference and monitoring.

N-MAN-00120-10001-Risk 07, Nuclear Refurbishment Actions, Issues, Decisions and Key Assumptions Management, provides guidance on how to document, review, approve and manage Actions Issues, Decisions, and Key Assumptions (AIDA) associated with Darlington Refurbishment.

#### **2.9 Reporting**

##### **2.9.1 Reporting Approach**

Timely and effective reporting supports the successful execution of the Darlington Refurbishment Program. Specifically, reporting will support management decision processes, measure progress against established business objectives, and flag any performance gaps that require management attention.

Further guidance on cost reporting is provided in N-MAN-00120-10001-PC-13, Nuclear Refurbishment Cost Management and Reporting. The overall approach to Program reporting will be defined in a new guide for Darlington Refurbishment Metrics and Reporting Projects Controls (to be developed).

Reporting will follow the same principles for all phases of the program, though the specific metrics and reports may vary to align to the business needs of each phase.

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A comprehensive, tiered metrics infrastructure has been established and will be maintained at program, project, and functional levels to measure progress in the areas of:

- Environment, Health, and Safety
- Scope
- Schedule
- Cost
- Quality

The program has established a repository within the DRP Data Warehouse for metrics and reporting data. Microsoft Business Intelligence (BI) is being used as the program report generation engine to the extent possible.

#### **2.9.2 Standard Reports**

A set of standard reports are produced for communicating program and project level performance to suit various stakeholder needs. Generally, these reports are differentiated by the intended audience, level of detail required, and the metrics reported. Standard reports include the following:

- (a) Board Update is a high level program status report prepared for the Ontario Power Generation (OPG) Board of Directors (BOD).
- (b) Periodic program level performance reports are prepared for senior OPG management audiences (e.g. Nuclear Oversight Committee, Nuclear Executive Committee).
- (c) Major Darlington Refurbishment milestones and performance targets are included in corporate, Nuclear, Nuclear Projects, and Darlington Refurbishment level Report Cards produced on a monthly basis by the corporate Finance function.
- (d) Program Status Report is prepared monthly for senior Darlington Refurbishment management. This report summarizes safety, schedule, cost, and quality performance at the program level.
- (e) Project and Function level Quad Charts are prepared monthly. These reports summarize safety, schedule, cost, and quality performance.
- (f) Functional Reports are quad charts that highlight the status of major functional organizations supporting the program (e.g., Planning and Controls, Engineering etc).
- (g) The Controllership Financial & Oversight Report is produced monthly by nuclear finance. This report is a comparison of actual and forecast costs against the approved Business Plan.

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- (h) Standard monthly Earned Value performance reports at all levels from the program down to Work Packages are produced by the BI reporting tool for use by line managers to support ongoing monitoring and control of work programs and projects.
- (i) Joint OPG/Vendor scorecards are produced for all major refurbishment contracts. These scorecards assess performance against the terms and conditions of the contracts.

## **2.10 IT Tools and Applications**

For a large project such as Darlington Refurbishment, maintaining and managing project data and Project Information Technology (IT) tools is very important throughout the life of the project. Critical project databases should be in Chief Information Office (CIO) supported data repositories. The purchasing and maintaining of IT tools must involve the CIO. Appendix C displays the IT tools and their interactions.

The demands, priority and business requirements for IT projects and base services and associated benefits of such services are identified by Darlington Refurbishment. For Line of Business (LOB) funded projects, DRP will approve the business case and release funds before CIO undertakes project work. For the CIO funded projects, CIO will approve the business case and release funds after obtaining concurrence of project sponsor. CIO will document the business case in both cases.

In support of Darlington Refurbishment, the CIO will:

- Prepare an annual demand plan for new projects and base service changes for incorporation into the CIO and DRP business plans.
- Develop and maintain longer term systems strategy and roadmap with collaboration and participation from all levels of Nuclear Projects.
- Execute new projects and base services within the agreed scope, schedule and cost while adhering to the established IT Standards/Strategy, IT Business Plan, IT Project Delivery Framework and OPG investment guidelines.
- Establish technology standards and select vendor and technology for specific projects. DRP will provide input into technology standards and vendor/technology selection decisions. CIO will demonstrate that its decision is the most optimal for OPG.

DRP will provide input into the service levels and quality metrics for the base services. Service levels will be jointly developed and agreed upon with regular reviews and adjustments to meet the evolving needs of business and IT.

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## **3.0 ROLES AND ACCOUNTABILITIES**

### **3.1 Director, Planning and Controls, DRP**

Ensures that effective managed systems are in place for the planning, execution, monitoring, and reporting of scope, schedule, cost, risk, Operating Experience, Gated Process and records management.

Accountable for the provision of accurate, timely performance reports to senior OPG management and stakeholders.

Is the owner of this document and is accountable for its definition, implementation and continual improvement.

### **3.2 Manager, Project Reporting, DRP**

Establish the processes, instructions, and tools necessary to execute cost management, cost estimation, and the Gated Process.

Provide expert support to Darlington Refurbishment client groups in the execution of cost management, cost estimation, and the Gated Process.

### **3.3 Manager Project Infrastructure, DRP**

Establish the processes, instructions, and tools necessary to execute risk and contingency management and operating experience.

Provide expert support to Darlington Refurbishment client groups in the execution of risk and contingency management and operating experience.

### **3.4 Manager Project Scheduling, DRP**

Establish the processes, instructions, and tools necessary to execute schedule management.

Provide expert support to Darlington Refurbishment client groups in the execution of schedule management.

### **3.5 DRP Directors and Managers**

Prepare, monitor, and control function/project budgets and ensure costs are appropriately charged to the right budget item.

Provide inputs to scope, schedule, cost, risk, and Operating Experience systems to support effective monitoring, reporting, and control to meet program objectives.

Review performance reports and take corrective action in accordance with established thresholds and business goals.

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#### 4.0 DEFINITIONS & ACRONYMS

**Actual Costs (AC)** is the realized costs incurred for the work performed during a specified time period.

**Budget Variance (BV)** is the difference at a given point in time between the Actual Costs (AC) and Planned Value (PV) (i.e.  $BV = AC - PV$ ).

**Cost Performance Index (CPI)** is a measure of the cost efficiency of budgeted resources expressed as the ratio of Earned Value (EV) to Actual Cost (AC).

**Cost Variance (CV)** is the difference at a given point in time between the Actual Costs (AC) and Earned Value (EV) (i.e.  $CV = AC - EV$ ).

**Earned Value (EV)** is the measure of work performed expressed in terms of the budget authorized for that work.

**Forecast** is the project team's estimate of the most likely outcome for a given element of the project (e.g. cost forecast, schedule forecast etc.).

**Planned Value (PV)** is the authorized budget assigned to scheduled work.

**Schedule Performance Index (SPI)** is a measure of schedule efficiency expressed as the ratio of Earned Value (EV) to Planned Value (PV).

**Work Breakdown Structure (WBS)** is the hierarchical decomposition of the work to be carried out to accomplish the objectives and create the required deliverables. It is a tool used to define and group a project's discrete work elements (or tasks) in a way that helps organize and define the total work scope of the project.

**Work Package (WP)** is the work defined at the lowest level of the Work Breakdown Structure (WBS) for which cost and duration can be estimated and managed.

<b>AIDA</b>	Actions, Issues, Decisions, and Key Assumptions
<b>BI</b>	Business Intelligence
<b>BOD</b>	Board of Directors
<b>BURSA</b>	Business Unit Risk Self Assessment
<b>CBS</b>	Cost Breakdown Structure
<b>CCL2</b>	Control & Coordination Schedule Level 2
<b>CIO</b>	Chief Information Office
<b>DRP</b>	Darlington Refurbishment Program
<b>EAC</b>	Executive Advisory Committee
<b>EPC</b>	Engineer-Procure-Construct
<b>ERM</b>	Enterprise Risk Management
<b>LOB</b>	Line of Business
<b>LTD</b>	Life to Date
<b>NOC</b>	Nuclear Oversight Committee
<b>NR</b>	Nuclear Refurbishment

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**OPG** Ontario Power Generation  
**P&C** Planning and Control  
**PIMS** Program Integrated Master Schedule  
**WBS** Work Breakdown Structure

## 5.0 REFERENCES

- D-PCH-09701-10000, Darlington Refurbishment Project Charter
- N-PROC-AS-0003, Controlled Document Management
- N-PROC-AS-0042, Quality Assurance Records
- N-STD-AS-0028, Project Management Standard
- NK38-NR-PLAN-09701-10001 Sheet 0001, Darlington Refurbishment Program Structure
- OPG-STD-0017, Organizational Authority Register



**DARLINGTON REFURBISHMENT PLANNING AND CONTROLS PROGRAM MANAGEMENT PLAN**

## Appendix A: Projects Controls Documentation

## Nuclear Refurbishment – Planning and Controls Process Support Documents

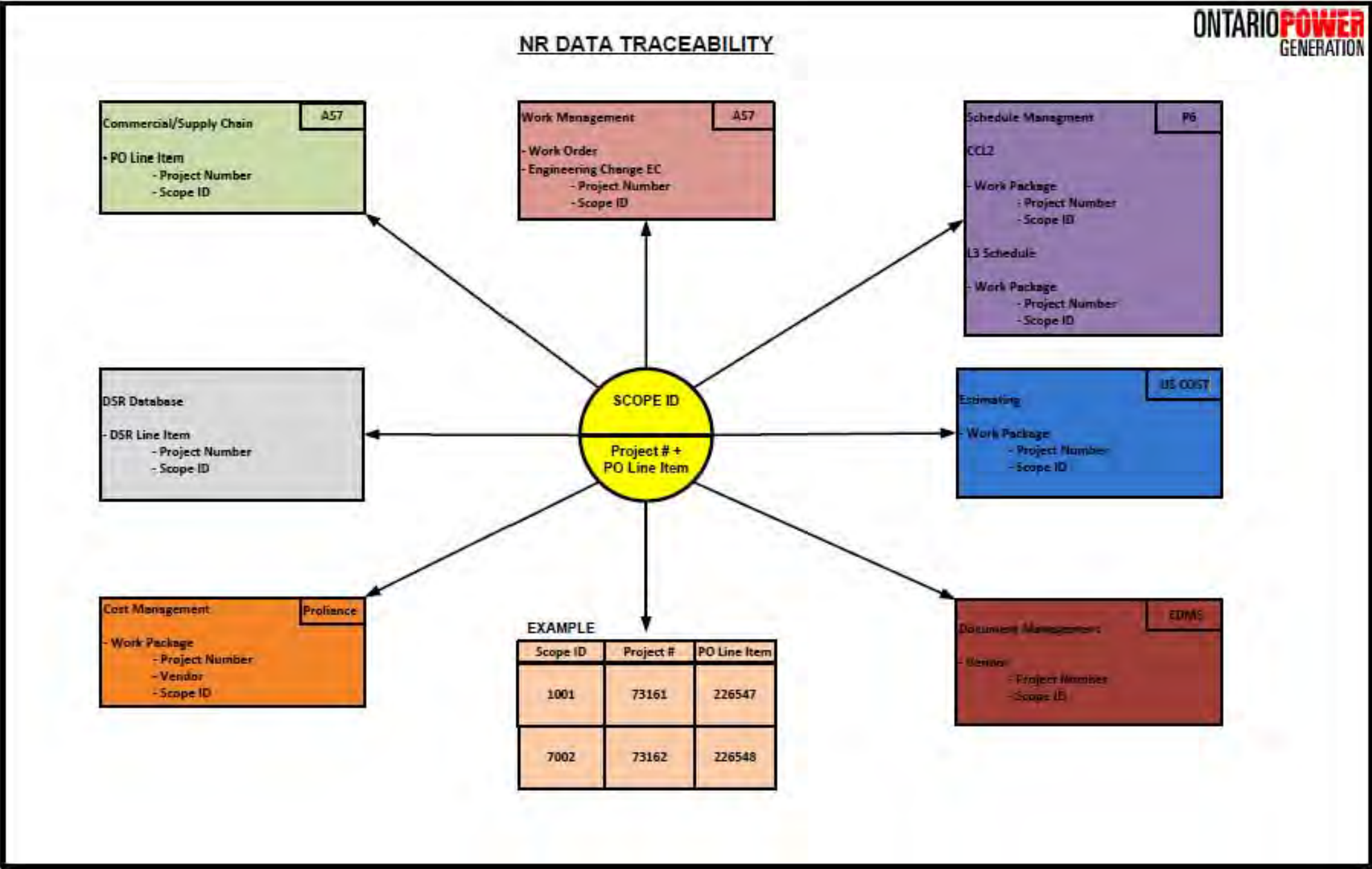




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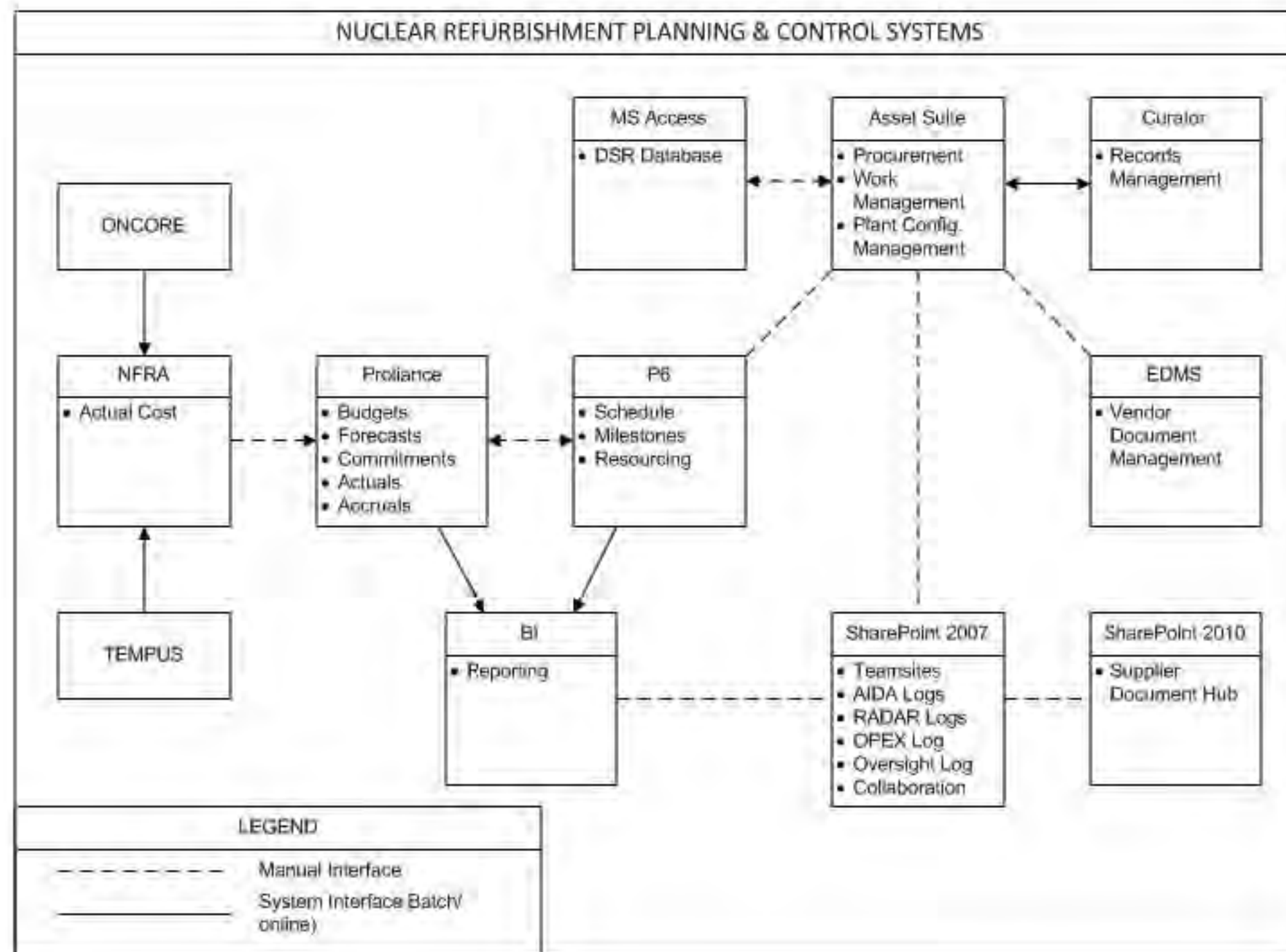
Appendix B: DRP Data Traceability



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Appendix C: DRP IT Tools





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**RQE CONTINGENCY DEVELOPMENT REPORT**

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## RQE Contingency Development Report

NK38-REP-09701-10304

2015-10-28

### Internal Use Only

Prepared By: Donna Flewell  
Process Specialist  
NR Infrastructure And Risk

Reviewed By: Lisa Ren  
Section Manager  
NR Infrastructure And Risk

Approved By: Ryan Smith  
Department Manager  
NR Infrastructure And Risk

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## 1.0 INTRODUCTION

RQE Contingency Development Plan, NK38-PLAN-09701-10006 was prepared and approved in Q1 2015, establishing the approach for developing the RQE contingency estimate and describing the associated contingency development principles and processes.

This report documents the activities and results of the RQE contingency development process, the validation processes undertaken and the summarized outputs of the exercise. Further, this report documents the contingency development objectives, governance, procedures, activities and tools applied, including guiding check sheets, questionnaires, tools, models, and results of a series of focussed workshops that lead to defining the inputs used in the first view of the integrated RQE estimate, as provided in RQE "Total Cost Estimate Milestone Snapshot #3" milestone achieved in October 2015. The intent with respect to the RQE contingency estimate is that the final total reserves estimate (contingency + management reserves) will be subject to refinement after undergoing final executive reviews and will reside in the Master Consolidated File (MCF) and board submission materials. This MCF document will be filed for archiving purposes and shall be accessible to alongside the comprehensive RQE support documentation.

## 2.0 OVERVIEW & BACKGROUND

### 2.1 Objectives

The objective of this report is to describe the activities, actions, and challenges performed by the Risk Management organization and the broader Refurbishment organization, including Nuclear Projects Executive Team (NPET) and the Executive Leadership Team (ELT) to meet the requirements of the risk management process from qualitative and quantitative standpoint during development of RQE contingency estimate and ultimately converge on a high confidence and prudentially assessed total reserves estimate for RQE.

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## 2.2 Background

RQE is the equivalent of the Class III estimate for the 4-unit refurbishment of Darlington Nuclear Generating Station. A robust contingency development process and modelling exercise was undertaken to ensure a high confidence risk and uncertainty based contingency value was prepared as it comprises a major component of the program estimate. The RQE Contingency Development Plan was issued with the expectations regarding the process, timeline, and input quality/requirements to achieve a robust and high confidence contingency estimate. This document was used as the basis for engagement with project/function teams for the challenge workshops.

Risk group members were tasked to follow up and enforce the implementation of the plan including the risk management manual, use of RMO, population of the contingency template, and proper risk qualification and quantification practices throughout. Overall engagement of multiple tiers of oversight groups such as; Ministry of Energy oversight (MODUS), Board of Directors oversight, Enterprise Risk Management, NPET, and NR Program/Functional directors supported the Contingency Development Plan and approved the outcome of the exercise as it related to their scope of work.

In February 2015, Palisade (proprietor of the @RISK Monte Carlo simulation engine) was retained to support a three phase approach to RQE contingency development. A senior consultant was engaged to a multi-phase on site model review and optimization effort. The objective of engagement of palisade was to ensure the model used in the development of the RQE contingency estimate exceeded industry best practice and rigor, and that the outputs of the model are validated and free from user error that may impact the end results. Palisade submitted a Phase one report that reviewed the model run for Release 4D and provided a set of optimizations that were fully incorporated to the RQE model. In June 2015, the RQE Contingency Development Plan was finalized and published and communicated as per the RQE roadmap dates, incorporating a number of process and tool refinements. Upon sufficient maturation of the base estimates for RQE for all bundles of functions, the risk management team developed contingency input templates for the project and functional teams to populate and established a series of challenge workshops to ensure reviewed and balanced inputs were included in the RQE contingency model. The input templates focused on developing 3 point estimates (optimistic, realistic, and pessimistic) for all possible variables associated with discrete risks and cost and schedule uncertainties.

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**RQE Contingency Model development**

Palisade senior consultants were engaged to ensure robustness and use of industry best practice to the RQE Contingency development process and modeling as per the OPG RQE Contingency Model Scope of Work to Palisade (Ref AAA) and OPG NR Contingency Calculation Initial Finding (Ref BBB). Initially onsite February 2015, Palisade implemented a 3 phase model review and update to the Monte Carlo tools used for RQE contingency analysis. The phases of implementation are outlined below:

- a) **Phase 1:** Initial on site review of the NR Release 4D model was completed in Feb 2015, and a report was provided to OPG for evaluation and further implementation, per OPG NR Contingency Calculation Initial Findings Report (Ref BBB). This report included a matrix of recommended optimizations to be applied to the RQE model.
- b) **Phase 2:** Implementation of RQE model recommendations, including integrates schedule risk and uncertainty analysis, consideration of risk reoccurrence on multiple units, and extensive usage of 3 point estimates – Jul 2015. Refer to Detailed Palisade Agenda (Ref CCC), and Disposition of Palisade Recommendation Implementation (Ref DDD)
- c) **Phase 3:** Final implementation and model run, including enhancement to a fully integrated risk model for 4 units, cost uncertainty and discrete risk contingency development and analysis for management decision making to support RQE. Throughout Phase 3 Palisade conducted periodic reviews and model adjustments through remote support – August/September 2015. Weekly Go-to meetings were set up, The FTP site for file sharing was set up, and along with the regular email correspondence with the senior consultant.

The key advancements in the RQE Contingency model in comparison to the modelling exercise used in previous releases include (not limited to):

1. Identification of unit specific risk impacts, efficiency gains, etc.
2. Maximum application of 3 point estimating including ranges of probability, burn rates, risk recurrence, etc.
3. Integration of program schedule with program risks and execution window uncertainties.



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4. Robust and comprehensive reports sets (including contingency breakdown reports) to allow for clear and focused analysis of the outputs.

### **3.0 RQE CONTINGENCY DEVELOPMENT – IMPLEMENTATION DETAILS OF THE DEVELOPMENT PLAN**

#### **3.1 Preliminary Process Activities (Getting the Organization Ready)**

All Risk Register items for the projects and functional groups were uploaded into an expanded RQE template spreadsheet, from the RMO tool and populated with the latest discrete risk and cost uncertainty information provided by projects at their Gate 3 meetings where available. The templates were placed in SharePoint and the link provided to the teams for collaboration, review and update for any deltas in the required RQE contingency development analysis data.

In parallel to the activities to obtain the detailed 3 point estimates for cost uncertainty and discrete risks from the broader NR organization, a number of other contingency input streams were pursued based on the requirements defined by the RQE contingency breakdown structure outlined in the RQE Contingency Development Plan, as follows:

- a) Ryan Smith, Dennis Curley and Derek McAuley led the effort to develop the integrated assessment criteria and initial input data for schedule uncertainty aspects of the integrated model. This was subsequently reviewed by Gary Rose, Roy Brown, Mike Allen, and others to ensure appropriate schedule risks and uncertainty was being applied and that it meshed with the progression of critical program aspects, such as RFR R1 Class 2 submission.
- b) July 10<sup>th</sup>, Ryan Smith requested from Risk Oversight Committee members, the NPET, and external oversight support members a listing of high impact low probability risks (aka black swans) for consideration in the model/management reserves. Feedback was received and elaborated on eventually landing not as contingency contributors but rather a management reserve considerations.
- c) Ryan Smith, Lisa Ren in concert with the PMs and P&C Lead prepared contingency adequacy reviews with the Campus Plan projects to support

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forecasting exercises at the end of June and worked with the P&C Lead to obtain the contingency forecasts for F&IP/SIO projects (having largely “sunk” costs and a very dynamic execution environment required a more deterministic approach with estimates provided by P&M project directors).

- d) Ryan Smith and Steve Wiacek validated the BCS defined insurance uncertainty aspects with feedback from the corporate treasury of the integrated model and ensured these were incorporated into consolidated template. 3 point estimates were obtained and integrated to the model.

These contingency templates were subjected to a rigorous screening and challenge process with a panel of SMEs. Basis for the three point estimates were challenged and actions were taken to correct or clarify the risk content. The objective for these challenge meetings with the project teams (before final submission of their risk registers and 3pt estimates) was communicating that they were in “safe zones” where the Manager of Infrastructure and Risk, and some peer SPOCs from the project team could challenge and calibrate project and functional groups on their risks, conservatism, and bias before it gets to Executive Review for the final contingency calculation.

In conjunction, the latest schedule data was pulled for a systematic and risk based review of programmatic critical path activities as described in section 3.3. This review was performed “off-line” from the workshops described in section 3.2 to ensure the right focus was given by the organization to the right contingency estimate aspects.

### 3.2 Cost Uncertainty and Discrete Risk – Challenge Session Workshops

As per the time line found in Appendix B of this document, NR Risk and Infrastructure set up a series of challenge and review workshops, starting with Functions and continuing with Projects to review risk based contingency items and cost uncertainty elements for an integrated assessment of overall contingency values. The RQE contingency development template, used in association with these challenge workshops, was updated with the assistance of Palisade to include the expanded and comprehensive 3 point estimate approximations required for RQE contingency calculations as defined in Section 3.0 of this document.

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The checklist attached to the RQE Contingency Development Plan defined the quality review criteria which were utilized to assess the contingency development process inputs, which were distributed in advance of the workshop. These checklists were not mandatory to complete the workshop process but were provided to the teams as guidelines and expectations for what lead in considerations should be made prior to the workshops. Projects and Functions were asked to come to the workshops with any opportunities identified the same way in the table (tagged as opportunity instead of risk which of course would be the bulk majority of line items for review). There were limited opportunities identified by the project or functional teams. Most identified that all cost and schedule optimizations/opportunities were already incorporated in the development of their base estimates and as such there were none reasonably foreseen that could be further applied to the RQE contingency development process.

The 3 point estimates for cost uncertainty was to be provided by the project team by Project # and PEPCCC (Project Management-Engineering-Procurement-Construction-Commissioning-Closeout) element and not bundle. Cost estimate PEPCCC was to be considered for cost to go only, and excluded LTD costs as they are already sunk and certain to ensure an appropriate representation of forward looking for contingency could be estimated. A comment and basis column was added at the end of each table to provide rationales and explanatory details regarding 3 point analysis. In most cases this was prepared in advance of the workshop and completed/adjusted after the workshop. In preparation for each workshop, Projects and Functions were asked to ensure the following was completed prior to the meeting:

Information provided in RQE contingency development template has been;

- Reviewed by their team and relevant stakeholders to ensure the gate 3 data is correct,
- Trued up to the latest project status,
- Completed with all additional RQE delta information and rationale comments

A quality check of the of each bundle and function's contingency information was conducted by using the following RQE Contingency Development Checklist. (REF EEE) The checklist was a guideline to try to extract the highest quality risk and uncertainty inputs prior to the workshops to avoid obvious errors or improper

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inclusions. A consistent agenda (or “script”) was development by the challenge panel and reviewed in the workshop to provide a standardized and consistent approach for executing the challenge meetings. The agenda was circulated to the project and functional managers in advance to give them a sense of the focus areas of the challenge meetings. See RQE Contingency Development Agenda (Ref HHH). RQE Contingency Development Template, for Cost Uncertainty (Ref FFF) and RQE Contingency Development Template for Discrete Risk (Ref GGG).

The team leads were asked to validate their submissions with their P&C Leads and Project/Functional directors prior to the workshop meeting. The reviews were conducted with a challenge panel which attended all meetings to coach and review the templates line by line with the project teams.

RQE Risk Contingency Development Workshops included involvement from;

- Risk consultant Shoshanna Fraizinger

The Risk Management Team members

- Ryan Smith, Manager
- Lisa Ren, Section Manger
- Donna Flewell – Process Specialist
- Mirela Courtney – Process Specialist
- James Wu – Process Specialist
- Atef Soliman Cost & Schedule Analyst
- Cost Estimates inputs provided by Mirela Courtney – Process Specialist

Challenge Panel comprised of;

- Dennis Curley, Outage Manager
- Steve Wiacek, Finance Controller

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- Andy Elliott, NR PMO Manager
- Jim Carter and/or Carrie Okizaki Modus
- Norton Thomas, Enterprise Risk Management
- Other SMEs were appropriate were included.

Official RQE Contingency Development Minutes of Meeting (REF III) were taken and later distributed to assist the teams with final updates followed up on to ensure closure and incorporation to the final template submissions.

### 3.3 Schedule Uncertainty and Risks to Critical Path

The overall program schedule was analyzed in three major segments (driven by critical path through the integrated schedule) as represented in the Rev A outage logic. These segments were based on the following:

1. Defueling activities – as described by technically driven estimate provided by the vendor (see ref. NK38-PLAN-35000-10005), i.e. “lead in”
2. RFR activities - as described by the vendor class 2 estimate (incorporating all the refinements provided by the rev 0, rev. 0’, rev 0 proxy and ultimately rev. 1 submissions) and;
3. Refurbishment lead in/out activities – utilising the logic of best and worst case scenarios of known integration and interface, Bruce lead out activity logic, OPEX incorporation based on comparisons of other facilities (ie; Wolsong, LePreau)

Detailed forward and back pass analysis was performed and range estimates applied to estimated durations with the support of SMEs and window owners. OPG owned and JV owned schedule based discrete risks were reviewed and some were identified to have a) impact to Program critical path and/ or b) interface or integration aspects; these risk items were pulled into a vertical slice review against the major schedule segments and associated schedule uncertainty values to ensure there was no “double count” or contingency considerations being applied. Individual consultation with SMEs and outage manager continued from July through August and a workshop outlining

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preliminary results and challenge was held on Tuesday August 25th with VP Execution, Director of Planning and Control, Outage Manager, Project Director for RFR, Scheduling Manager and Risk Manager. The preliminary list was adjusted to result in the final schedule risk and uncertainty analysis presented in the RQE.

Sep 23, NPET senior management review was conducted to review the overall 4 units schedule contingency. Also, it focused on items for key items for program contingency and management reserves. This 4-unit analysis was again challenged for the uncertainty and risk applications, ensuring the right range of uncertainties (with basis) and the right risks were applied (with basis) to the schedule. This underwent extremely detailed and rigorous reviews with escalating oversight, all the way up the MODUS direct involvement and NPET member direct involvement.

Burn rate details used in the risk analyses were programmatically defined and applied with the support of the finance and RQE organizations (for both the schedule uncertainty items and schedule impacting discrete risks), Burn Rate - Critical Path Contingency Calculation (REF JJJ), dated as Sep 16 email correspondence in Burn rates for NR PMT, NR construction, etc were obtained from the master consolidated file and optimistic, most likely, and pessimistic critical path burn rates were provided. The range of burn rates covered the “carrying cost” at “off peak” and “peak” period on NR critical path, which shall cover the various execution windows that the risks may occur.

### 3.4 Insurance Uncertainty

Insurance aspects of contingency have been contemplated in conjunction with discrete risk and cost values provided by Finance based on Program assumptions and planning basis defined by the BCS. These have been directly translated into the integrated template for overall modelling and RQE contingency calculations.

### 3.5 Various Review Meetings

The contingency development workshops took place as follows:

- July 13th – Project Contingency Work shop dry run with P&C leads.
- July 14th – Project Contingency Development Review Work shop – Turbine Generator

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- July 16th - Project Contingency Development Review Work shop – Islanding
- July 20th Project Contingency Development Review Work shop –RFR
- July 20th Project Contingency Development Review Work shop – Operations & Maintenance
- July 21st Project Contingency Development Review Work shop – Engineering
- July 22nd Project Contingency Development Review Work shop – Shutdown Layup,
- July 22nd Project Contingency Development Review Work shop – Functional Departments
- July 22nd Project Contingency Development Review Work shop – Fuel Handling /Defueling
- July 23rd Project Contingency Development Review Work shop – Steam Generator
- July 23rd Project Contingency Development Review Work shop – Balance of Plant
- July 27th Project Contingency Templates due end of day to Risk Management Team

Interface and Integration activities took place as follows:

- July 27th – TEMPLATE FREEZE – all project and functional templates for contingency will be extracted for integration i Total Cost Snapshot #1.
- Week of July 27 - Risk department performs template integration to master model and quality check (Lisa Ren), checks and balances performed on actions and queries stemming from workshops.

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- July 28th Risk Team completed Quality check of final templates, and uploading into Program Contingency template.
- July 29th Additional Cost Uncertainty for the Bundles and functions were uploaded
- July 29th NR Program level schedule Risk and uncertainty were identified
- Insurance elements were incorporated in the master template
- August 10-14 Palisade review template.
- Interface and integration reviews utilising the Master model and template inputs from activities described in sections 3.2 – 3.7 were conducted for the first views in preparation for “snapshot #1” refinement.
- Quality Review of data entered by Risk team August 17 to 21
- Snapshot 1 prepared and communicated on Wednesday August 19th.
- Snapshot 1 contingencies were presented the week of August 24th as part of bundle integration reviews. Adjustments to contingency input sheets were prepared by risk organization and presented in the NPET review sessions.
- August 31st to September 4th Management Review
- August 31st to September 4th Palisades Risk Consultant analysis of results.

Bundle Integrated Review Meeting held to review final submissions, materials reviewed included scope reports, basis and assumptions, cost estimate summaries, schedules and preliminary contingency analysis.

- August 24 Bundle Integration Review – Balance of Plant
- August 25 Bundle Integration Review – Islanding
- August 25 Bundle Integration Review – Turbine Generator



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- August 25 Bundle Integration Review – Steam Generator
- August 26 Bundle Integration Review – Fuel Handling/Defueling
- August 26 Bundle Integration Review – Specialized Projects
- August 27 Bundle Integration Review – Shutdown Layup
- August 27 Bundle Integration Review – RFR
- August 24 Bundle Integration Review – Balance of Plant (unique scope)
- August 24 Refurbishment Risk Oversight Committee (R-ROC) meeting
- September 1 – Risk Assessment of Critical Path with Director of Ops and Maintenance
- September 3rd to 9th NPEP Reviews of separate submissions by the bundles and functions
- Snapshot 2 provide September 4th
- September 4th Final Snapshot and Prep Contingency Review Workshop
- September 8th Overview of Key Risk Scores KPMG
- September 10th Integrated Contingency Estimate Review for NPET
- September 11th Input detail of Schedule Uncertainty RFR
- September 14th review of 3 point estimates with Outage Manager.
- September 15th New model walkthrough provided by Palisades.
- September 18th Final RQE alignment Meeting
- September 24th Review S Curve

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NPET has conducted three review sessions on Aug 25, Sep 11, and the Total Reserves final presentation and review on October 16th. The focus of the meeting was to present the various contingency snapshots prepared in support of RQE and the major contributors of cost and schedule contingencies to allow for details drill down on key elements and executive level decision making. Modus, ERM, and Asset Planning as oversight team to OPG board of directors has conducted various review meetings on the contingency products throughout the development process.

### 3.6 Quality Checks

Quality Checking was done by the risk management team members by completing quality and data integrity checks after the workshops:

- a) Project Teams and NR Estimating were tasked to review the impacts and uncertainty ranges.
- b) Risk management team followed up on actions from review meeting, confirm completion of actions, by reviewing the meeting minutes in detail by Risk log # to ensure the advice provided from the workshop panel was considered. The changes were implemented and reflected in the final submitted data for input into the Palisade @ Risk software.
- c) Risk management team conducted data integrity check to ensure data entry errors were captured upon imputing of the three point estimates into the @Risk software and reviewed with the project teams as required. Inherent to the model, a built in quality check identifies if there are any three point estimates where the optimistic impact exceeds the most likely, pessimistic is less than optimistic, etc.
- d) An additional check was to review the submitted spreadsheets vs. RMO registered Risk Log numbers, to ensure all items were captured in the risk register.
- e) OPG was conducting various model inputs integrity reviews during the model development and contingency calculation, in parallel Senior consultant from the Palisade's software did various overall quality check of the physical model and the formulas. At the time of writing this report is

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preparing user manuals and final reports to ensure the model can be easily re-run for check estimate.

- f) OPG Asset Planning and Investment group, ERM, Modus (oversight team from OPG board of directors), Mike White (oversight from MOE), and KPMG have all reviewed and endorsed this RQE NR contingency development process, content, and prudence.

## 4.0 MANAGEMENT RESERVE

Management Reserve (MR) is defined as an amount of project budget withheld for management control purposes. This is reserved for unforeseen work within the scope of the project (PMBOK).

Due to the “unknown, unknown” nature of management reserve, a list of management reserve drivers is developed to define necessary funding (judgment based assessment) to support NR program. This is a common practice when developing MR for capital projects. At NPET and CNO presentation of the Total Reserves for refurbishment, a total management reserves of 800M was determined to be appropriate. The presentation used and a list of management reserve drivers agreed upon with NPET is included in Appendix A.

## 5.0 CONCLUSION – TOTAL RESERVES ESTIMATE

The Refurbishment risk organization has performed activities in accordance with the principles of the RQE contingency development plan and outputs and process to obtain inputs are in alignment with the contingency breakdown structure diagram outlined in the contingency development plan.

Based on evaluation from Palisade, this contingency model configuration aligns with industrial best practices on mega projects. Also the level of details and integrations of schedule and cost uncertainty and risks are reflecting best practice on mega projects.

A RQE Contingency Calculation – Snapshot 3 Report, NK38-REP-09701-0566838 was captured September 30<sup>th</sup>. A MS Excel spreadsheet of the final contingency calculations is on file. This final contingency calculation was augmented with executive adjustments for a small number of emergent items as well as the Management

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Reserve analysis to develop a “Total Reserves” estimate. The Management Reserve was developed using executive judgment, analysis of OPEX, and an overall assessment of appropriateness based on the number of days of potential delay and % of overall estimate to complete for the NR program. This results in a Total Reserves Estimate as outlined the RQE MCF (Master Consolidated File) “Total Reserves Summary” tab.

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## 6.0 REFERENCE DOCUMENTS

Document Number	Title
NK38-NR-PLAN-09701-10006	RQE Contingency Development Plan
NK38-REF-09701-0566066 Includes all the document references mentioned within in this report as listed below:	RQE Contingency Development Report Reference Documents
REF AAA	OPG RQE Contingency Model Scope of Work to Palisade
REF BBB	OPG NR Contingency Calculation Initial Finding
REF CCC	Detailed Palisade Agenda
REF DDD	Palisade Recommendation Implementation
REF EEE	RQE Contingency Development Checklist
REF FFF	RQE Contingency Development Template, for Cost Uncertainty
REF GGG	RQE Contingency Development Template, for Discrete Risk
REF HHH	RQE Contingency Development Agenda
REF III	RQE Contingency Development Minutes of Meeting
REF JJJ	Burn Rate - Critical Path Contingency Calculation
NK38-REP-09701-0566838	RQE Contingency Calculation – Snapshot 3 Report
NK38-REP-09701-0567077	Palisade OPG RQE Model - Summary and Final Report



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### 7.0 APPENDIX A – Management Reserve Drivers

#### Examples of Management Reserve Drivers/Events

This list contains some of the “unknown unknowns” that Management Reserve funds might address. It is not intended to be complete or comprehensive, and other unknown unknowns that emerge may require MR funds.

##### **Vendor Default or Unavailability**

- The risk is that a major NR vendor becomes unwilling or unable (e.g bankruptcy, takeover, change of business philosophy or strategy) to execute the work they have been contracted to perform, resulting in a need to secure a new qualified vendor to perform the scope of work.

##### **Labour Environment**

- The risk is that future challenges in the labour relations environment results in work slowdowns, stoppages, or work to rule action during refurbishment increasing costs and extending schedule.
- The risk is that illnesses (such as pandemic flu) cause delays and cost overruns due to shortage of workers.

##### **Political Environment**

- The risk is that changes in the political landscape impact or delay the project, resulting in cost increases/impacts.

##### **Nuclear Safety and Security**

- This risk contemplates an event where an external entity or regulator, such as the MOL, shuts down all work and OPG cannot gain approval to proceed resulting in financial impacts and schedule delays due to stand downs.
- The risk is that, due to an international or localized event (such as terrorism) site security requirements (or the application rigor of the existing requirements) are increased resulting in added scope, cost increases, and schedule delays.
- The risk is that international or localized events or criminal acts (such as a military coups, piracy, or theft) impact the delivery or availability of required materials or resources for the project impacting cost and delaying schedule.
- Impact due to nuclear event. The risk is that a new nuclear event or accident, whether at an OPG site, another CANDU facility or in the international nuclear community, may delay the refurbishment due to negative public perceptions, new requirements, etc.

##### **Force Majeure**

- The risk is that a force majeure event such as an earthquake, tornado, flood, extreme/beyond normal weather conditions or other such happening results in a need to perform significant rework to get the project back up and running. This assumes that there remains a business case to complete the Refurbishment after the damage from the act of god is assessed.

##### **Financial Factors**

- The risk is that financial factors outside the control of the project (i.e. such as escalation or interest fluctuations beyond those assumed in the development of the RQE base estimate) have a significant impact on the cost of the project.

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## 8.0 APPENDIX B – Timeline of Challenge Meetings and Reviews of Risk and Uncertainty Submissions, Snapshot 2 Support

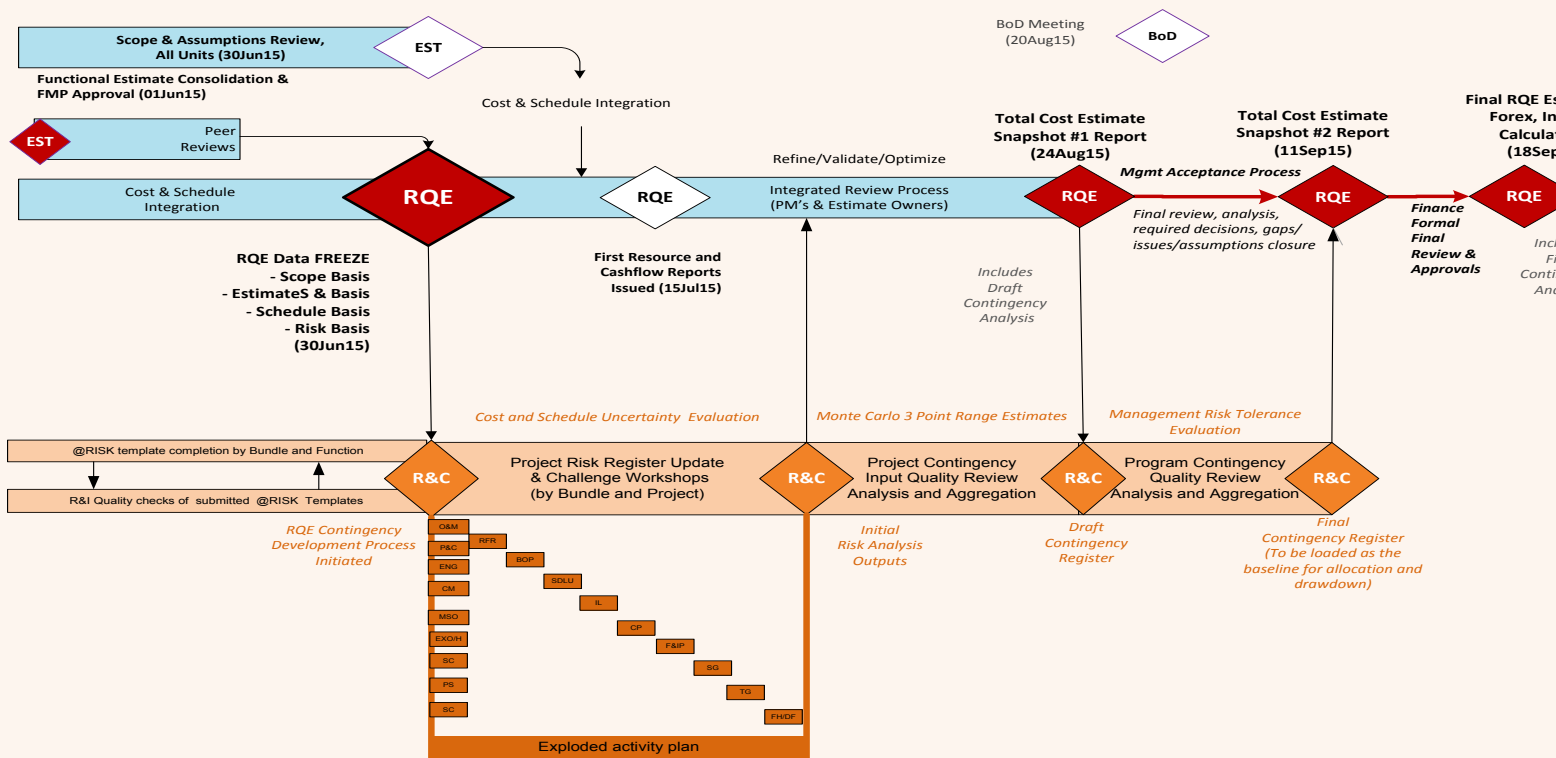
### RQE CONTINGENCY DEVELOPMENT PROCESS & ACTIVITIES

June 2015

July 2015

August 2015

September 2015



ID	Risk Title	Risk Description	Urgency	Risk Status	Owner	Delegate	Risk Date Last Reviewed	Risk Response Type	Post Mitigation TCD	Current				Post						
										Probability	Financial	Schedule	Score	Probability	Financial	Schedule	Score			
Project: Balance of Plant - 73335																				
14206	High Dose for HFD Program [Window 73]	ALARA review has been completed and assessed the Horizontal Flux Detector Replacement Program to result in 115 Rem dose to workers. The high dose is due to hotspots in the SDS2 bunker.		Active	John Stopar	George Naguib	11-Apr-16	Mitigate	30-Jun-16	5	2	2	10	4	1	1	4			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			6756	In Progress	Contingency Plan for HFD Replacement	This action is associated with Risk ID 14207. Contingency planning for stuck detectors during the HFD replacement window will need to be established prior to executing the work.	John Stopar	George Naguib	30-Jun-16											
13299	Radiation Protection Risks with Flux Detector Removals [Window 28, 73]	Due to the highly radioactive nature of the flux detectors, there is a possible schedule delay during execution of FD removals if a detector becomes lodged, stuck, or broken within the chopper tool. The Stern design of the chopper tool includes small contingency tooling to dislodge detectors in the case of minor issues during chopping. This tooling is designed to deal only with specific circumstances (ie. minor blockages). Darlington Reactor Maintenance has made use of a robotic assembly during removals on the outermost FD assemblies on the deck. The execution team cannot rely on this robotic tool due to the wholesale replacement strategy. The deck is far too crowded with safety related drive mechanisms to allow use of a travelling robotic assembly. The purpose of this risk is to document the possibly schedule and cost delays associated with unforeseen failure of the chopping tool. EDIT 20NOV2015: This risk is also associated with HFD schedule delays due to radiological interferences with RFR.	2	Active	John Stopar	George Naguib	11-Apr-16	Accept	15-Jul-16	3	2	3	9	3	2	3	9			
			There are no Not Started, In Progress Actions associated with the risk.																	
11337	Reactivity Deck Training Location [No Window Related]	The risk is that current facilities are insufficient for reactivity mechanism training. In the event that the EPC contractor cannot use the existing DNGS training facility, a new facility would be required. This would cause significant cost increase to the project.	3	Active	John Stopar	George Naguib	17-Feb-16	Mitigate	31-Mar-14	2	1	4	8	1	1	3	3			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			1723	In Progress	Details of Risk Response Strategy for Risk #11337	Training Plans are to be developed by the EPC vendor for Flux Detectors and AAs. A station integration meeting will be conducted to ensure alignment with the vendor training plan (as shared use of the RMD mock up will be required).	John Stopar		15-Dec-15	VFD and HFD Mock-ups exist in Turbine Hall. Arrangements for shared use required. J.Stopar 30 SEP 2015 : the Unit 2 Level 1 is still under development and the execution windows for Adjusters, VFDs are being shifted. The schedule must be set before meaningful discussions can take place with the Fuel Handling Dept which is the owner of the RMD rehearsal Facility.										
12027	Possible Electrical Cable Insulation Damage When Replacing Flux Detectors [Window 28, 73]	Possible deterioration of existing cable insulation (from the Flux Detector to the Amplifier) when replacing Flux Detectors becauseaged cable insulation may be very fragile and breakdown upon contact.	3	Active	John Stopar	George Naguib	11-Apr-16	Monitor	15-Jun-16	3	1	2	6	3	1	2	6			
			There are no Not Started, In Progress Actions associated with the risk.																	
14026	Horizontal Flux Detector Mock Up at MCDF [Window 73]	Due to the high number of interferences in the SDS2 Bunker and inability to perform real life training in situ, an HFD mock up is being planned and constructed at the MCDF in order to aid both Refurb and Station personnel in realistic training and contingency planning.		Active	John Stopar	George Naguib	11-Apr-16	Monitor	30-Jun-16	3	2	1	6	3	2	1	6			
			There are no Not Started, In Progress Actions associated with the risk.																	
144	RM Drive Mechanism Damage due to handling and AA Replacement work	This risk is associated with the possible damage to RM Drive Mechanisms during handling (ie. removal and reinstall of AA Drive Mechanisms) as well as surrounding work during AA rod replacement and VFD replacement work.		Active	John Stopar	George Naguib	26-Apr-16	Mitigate	31-Oct-16	3	1	2	6	2	1	1	2			
			There are no Not Started, In Progress Actions associated with the risk.																	





<a href="#">14226</a>	73592 - Containment project SID 7010 Procurement Risk for 18" AOVs [No Window Related]	The risk is that late delivery (& subsequent replacement) of the 18" 3-Way AOVs will impact vault atmosphere during refurbishment. For Containment Sope ID 7010, due to DNGS OPEX, the 18" valve originally specified was found unsuitable for this application. A different valve was recommended. The tech. Spec. is being prepared by contractor, review by HSL design and OPG. The procurement of the valve may be delayed due to the availability of the tech spec. Current quoted lead time is approximately 4 months. The work was originally scheduled to start after D1641 (July 2016) Impact: The installation schedule will be determined after the firm delivery date is available.		Active	Scott Guthrie	Gee Sham	06-Apr-16	Mitigate	18-May-16	4	2	4	16	2	2	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">14300</a>	Conventional Electrical (Project # 73762) Hydro One work protection requirements in switchyard [Window 4, 126, 127]	It has recently been determined that OPG owned equipment in the switchyard is in an area requiring Hydro One work portection. Typically these areas require the work to be performed by Hydro One and not by OPG or it's contractors. It is mostly certain at this point that the affected scope will have to be taken from AREVA who is currently the intended constructor (though no execution contract has been issued). Currently AREVA has a contract to assess and perform work planning for this and other electrical scope. Should it be confirmed that scope has to be taken from AREVA, it will have to either be given to Hydro One, or taken out of refurbishment for the station to oversee. In this case, Hydro One would again be performing the work, but the deliverables that are part of all refurbishment work (CWPs, ITPs, procedures) would likely not be required.		Active	Scott Guthrie	Greg Mills	11-Apr-16	Accept	30-Jun-16	4	2	4	16	4	2	4	16
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">14401</a>	AA Replacement Staff Experience [window #21]	This risk is associated with the introduction of new tooling and processes to staff with little experience in performing the work. AA Rod Replacement has never been performed at Darlington and is new to the contractor. The lack of experience is associated with the tooling/work process of replacing and discharging AA rods as well as assembly and installation of correct AA Rod Types.		Active	John Stopar	George Naguib	26-Apr-16	Mitigate	31-Oct-16	4	4	4	16	2	1	1	2
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">13898</a>	Risk of not having qualified procedure staff in time to complete procedure updates for BOP projects [No Window Related]	Resource availability in the procedure group currently pose as a risk. Qualified procedure staff required to complete procedure updates for BOP projects. The impact is that without the procedures updated and available in Passport, there is a chance that the work will not be accepted resulting in a delay to execution.		Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	31-May-16	3	2	5	15	3	2	5	15
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">13369</a>	73592 - Vault Work Interferences with JV Work [Window 8]	BoP project work will get delayed due to JV work being on critical path, this will lead to a contractor stand down resulting in additional costs and schedule delays. This will affect the vault work for the containment projects, e.g. Installation of the manifolds, roll-up doors at the airlocks and transfer chamber doors.		Active	Scott Guthrie	Gee Sham	11-Feb-16	Monitor	30-Jun-16	3	1	4	12	3	1	4	12
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">13633</a>	ASDCH - Late Materials as a result of late issuance of PO to Manufacturers [Window 130, 124]	There is a risk that due to the late issuance of manfuacturing POs and EC revisions, materials will need to be expedited in order to arrive on time for execution. This will require funding above and beyond the estimated cost of materials.	2	Active	Scott Guthrie	Doina Idita	20-Apr-16	Monitor	30-May-16	3	2	4	12	2	2	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">13633</a>	Vendor Material Tracking/Timely Delivery for Execution	The Procurement Tracking Tool (PTT) is now in place however and data populated however a large number of BoP POs have not been issued resulting in a risk that materials will not be available within 90 days prior to the applicable outage window. Weekly tracking of PO issuance and systematic material delivery risk audits are required to mitigate the overall risk.vendors have demonstrated a number of areas where they are not yet adequately managing procurement and hence the material procurement schedule remains at risk.	3	Active	Scott Guthrie	Katie Stewart	16-Dec-15	Mitigate	10-Dec-15	4	3	3	12	3	3	3	9
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6548	In Progress	BoP Material Risk Review	BoP staff to complete a systematic review of all materials that do not have a PO issued against them to 1) document they have reviewed all items and establish a baseline tracking file using PTT 2) identify a subset of materials that they believe may be at risk for delivery within the 90 day window 3) Review each material subset generated with Supply Chain to determine extent of risk.	Scott Guthrie		31-May-16	Project Engineer material risk excel files generated. BoP admin assembling all excel files into single binder to facilitate review with Supply Chain. Binder to be ready for Supply Chain review by April 22 and review completed by April 29. Action TCD extended to April 29 as a result. May 2/16 update: Binder with all materials assembled and forwarded to Supply Chain for review May 3/16. Comments/feedback requested from Supply Chain by May 10/16. Action extended to May 17 as a result. May 13/16 Update: Supply Chain feedback delayed to May 16. Meeting to be setup with Fox to review findings week of May 16. Action extended to May 30 as a result.							

Run by:

13944	vendors' information causing rework [Window 130, 124]	there is a risk or re-work on design E-C packages which implies cost increase for their revision.	Action# Status Action Title Action Description Owner Delegate Due Date Comments																	
			6606	In Progress	Action ESFOX to issue POs for ASDCH components/equipment to obtain vendor information	Engage installation vendor to issue the POs for the ASDCH components/equipment in the very next future (ASAP), get the required vendors'information, and finalize the Design Commissioning Specification, installation and commissioning work plans	Katie Stewart	Doina Idita	10-Jun-16	Date extended to May 20 to account for new Engineering baseline schedule received for Design revisions. Update 05.13.16: 2nd Extension to June 10 required, ES Fox confirmed that all vendor docs required to proceed with design revisions will be submitted by June 10.										
14206	High Dose for HFD Program [Window 73]	ALARA review has been completed and assessed the Horizontal Flux Detector Replacement Program to result in 115 Rem dose to workers. The high dose is due to hotspots in the SDS2 bunker.	Active John Stopar George Naguib 11-Apr-16 Mitigate 30-Jun-16 5 2 2 10 4 1 1 4																	
			Action# Status Action Title Action Description Owner Delegate Due Date Comments	6756	In Progress	Contingency Plan for HFD Replacement	This action is associated with Risk ID 14207. Contingency planning for stuck detectors during the HFD replacement window will need to be established prior to executing the work.	John Stopar	George Naguib	30-Jun-16										
14370	Project 73750 Valve Rehabilitation - Risk of system modifications due to increased weight of replacement valves (Window 122)	The Valve Rehabilitation Project covers 80 valves - a subset are subject to replacement with new. A number of replacement valves are not available like for like with the original, and are being addressed with NICRs. During preparation of the NICRs as part of the procurement process, it became known that some replacement valves have significantly higher weights than the original valves. There is a risk of system modifications due to increased weight impacting on system stress reports/seismic analysis/allowable stresses.	3 Active Scott Guthrie M Hodges 19-Apr-16 Monitor 28-Oct-16 2 2 5 10 2 2 5 10																	
			There are no Not Started, In Progress Actions associated with the risk.																	
13299	Radiation Protection Risks with Flux Detector Removals [Window 28, 73]	Due to the highly radioactive nature of the flux detectors, there is a possible schedule delay during execution of FD removals if a detector becomes lodged, stuck, or broken within the chopper tool. The Stern design of the chopper tool includes small contingency tooling to dislodge detectors in the case of minor issues during chopping. This tooling is designed to deal only with specific circumstances (ie. minor blockages). Darlington Reactor Maintenance has made use of a robotic assembly during removals on the outermost FD assemblies on the deck. The execution team cannot rely on this robotic tool due to the wholesale replacement strategy. The deck is far too crowded with safety related drive mechanisms to allow use of a travelling robotic assembly. The purpose of this risk is to document the possibly schedule and cost delays associated with unforeseen failure of the chopping tool. EDIT 20NOV2015: This risk is also associated with HFD schedule delays due to radiological interferences with RFR.	2 Active John Stopar George Naguib 11-Apr-16 Accept 15-Jul-16 3 2 3 9 3 2 3 9																	
			There are no Not Started, In Progress Actions associated with the risk.																	
13656	There is a risk that ownership of Construction Interfaces is not clear, and as a result, not captured the entirety of costs(all windows)	RTE project and breaker open Construction interface areas have been confirmed and estimated in Fox's latest Class 3 estimates. Implementation of the RTE Construction Interfaces and a transition plan to ensure all remaining Construction Interface areas are ready prior to breaker open is required to ensure gaps are not discovered during field execution (when opportunities to mitigate are more limited). In addition, proactive planning for trades on-boarding, skillset confirmation (VBO lessons learned) and supervisory effectiveness training are required to ensure success in the field. These areas remain a risk until planning is required to minimize risk to OPG (FME being an example based on BNGS & Lepreau OPEX with fuel failures post Refurb). Alignment of the various areas between OPG and the Vendor must be resolved before issuance of the Ph 2/3 Execution contracts to minimize any churn after the contracts are issued.	3 Active Scott Guthrie Kevin Tse 08-Apr-16 Monitor 05-Aug-16 3 3 3 9 2 3 3 6																	
			There are no Not Started, In Progress Actions associated with the risk.																	
136	The risk is that the new drill card process will create delays for the vendor (all	The risk is that the new drill card process will create delays for the vendor. This will represent slow-downs to the project and cost increases	1 Active Scott Guthrie Kevin Tse 08-Apr-16 Monitor 15-Aug-16 3 2 3 9 3 2 3 9																	
			There are no Not Started, In Progress Actions associated with the risk.																	

13671	The risk is that should onboarding qualifications be required by execution personnel, delays may be observed (all windows)	The risk is that should onboarding qualifications be required by execution personnel, delays may be observed unless an alternate qual method is introduced.	1	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Aug-16	3	2	3	9	3	2	3	9
There are no Not Started, In Progress Actions associated with the risk.																	
13903	Potential Delays of the ASDCH pump-motor assemblies delivery [Window 124]	There is a risk for the small valves (NC1) required for draining/filling of the ASDC pump-motor to be procured late considering the time KSB needs them for the equipment FAT testing) If this risk occurs, then:-ASDCH pump-motor assemblies delivery may be delayed-there is an additional cost associated with this strategy due to ES Fox overhead	4	Active	Katie Stewart	Doina Idita	20-Apr-16	Mitigate	29-Apr-16	3	1	3	9	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6604	In Progress	Finalize procurement strategy for ASDCH pump-motor assemblies delivery	Response startegy for this risk is to mitigate the impact:1. finalize the design specification for those specific small valves2. engage EPC vendor to investigate market for the available vendors, issue the RFP and award the PO to that vendor who can meet the bid evaluation criteria and the required lead time to avoid the delays in ASDCH pump-motor assemblies delivery	Katie Stewart	Doina Idita	30-May-16	1.Design specification complete and to be accepted by OPG 2.Velan has been engaged in conversations with ES Fox and the PO is imminent Due date extended until confirmation received on delivery date							
14072	73312 - Fire Penetrations Barriers Inspections Inadequate Resources [No Window Related]	The risk is that there are inadequate resources in NR Design & Field Engineering (FE) for the work under IIP-OI-006 and the required work will not be finished on time. The work was significantly increased due to newly realized scope as per NK38-CORR-09701-0554318 (Attached). In addition to the above scope, It was realized by Design that there were many penetrations missed in the first phase of inspections by FE so a new plan was developed to re-inspect the rooms with the help of Design as per NK38-CORR-09701-0574472 (Attached). There is a risk that many new penetrations will be discovered and FE will have to re-inspect all rooms instead of using a sampling criteria as outlined in the attached memo. If FE is required to re-inspect all rooms (even low risk) then this will significantly increase work for FE, Design & Projects and cause further schedule delays. This is a risk because IIP-OI-006 commitment is to be fulfilled by the end of 2016.	4	Active	Scott Guthrie	Amuk Sandhu	05-May-16	Monitor	30-Jun-16	3	1	3	9	2	1	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
14278	Conventional Electrical (Project # 73618) Contract Award Delays Leading to Material Delay Risk [Window 4, 126, 127]	Risk is that delays in awarding BOP Electrical scope to a Constructor will result in missed material order milestones and therefore material late on site for work. Ongoing delays as a result of constant scope change, discovery items and work protection concerns has resulted in several "restarts" on the process of awarding work. Work has been on the verge of being awarded several times and then cancelled due to discovery of new scope,or some other item of concern to the organization. In the last month discovery of work protection complications has resulted in additional delays to preparation of award package.		Active	Scott Guthrie	Greg Mills	11-Apr-16	Mitigate	18-May-16	3	1	3	9	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
11337	Reactivity Deck Training Location [No Window Related]	The risk is that current facilities are insufficient for reactivity mechanism training. In the event that the EPC contractor cannot use the existing DNGS training facility, a new facility would be required. This would cause significant cost increase to the project.	3	Active	John Stopar	George Naguib	17-Feb-16	Mitigate	31-Mar-14	2	1	4	8	1	1	3	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			1723	In Progress	Details of Risk Response Strategy for Risk #11337	Training Plans are to be developped by the EPC vendor for Flux Detectors and AAs. A station integration meeting will be conducted to ensure alignment with the vendor training plan (as shared use of the RMD mock up will be required).	John Stopar		15-Dec-15	VFD and HFD Mock-ups exist in Turbine Hall. Arrangements for shared use required. J.Stopar 30 SEP 2015 : the Unit 2 Level 1 is still under development and the execution windows for Adjusters, VFDs are being shifted. The schedule must be set before meaningful discussions can take place with the Fuel Handling Dept which is the owner of the RMD rehearsal Facility.							
	Project 73750 - Insufficient Temporary Facilities To	Event - Temporary facilities on site prove to be inadequate. Much of the valve work will need to be performed elsewhere (due to construction and facilities scheduled to be in place) As there is limited	3	Active	Scott Guthrie	M Hodges	11-Apr-16	Monitor	29-Apr-16	2	2	4	8	2	1	2	4



12295	Temporary facilities to Support Valve Rehab Scope resulting in delays and cost increase. [Windows 122, 124, 57, 29]	performed "on-site" (due to contamination and logistics or welded in valves) As there is limited space during refurb, this may result in increase costs and schedule to remove valves offsite (i.e.decontam / ship contaminated valves off site). This may affect the following windows: 29, 48, 54, 57, 103, 104, 122, 124, 131 Cause - Unforeseen needs associated with valve rehab facilities. Impact - Additional facilities required causing schedule and cost impact.	There are no Not Started, In Progress Actions associated with the risk.														
13757	[Window 532] Lube Oil Tanks Possible Repairs	The Risk is that upon inspection of the 3 Turbine Lube Oil Tanks, there will be extensive repairs required. The probability of this risk occurring is moderate to high, as OPEX from tanks in similar environments showed extensive degradation over a similar lifetime.	3	Active	Scott Guthrie	Oweis Chohan	15-Dec-16	Monitor	31-Jul-16	4	2	2	8	4	2	2	8
There are no Not Started, In Progress Actions associated with the risk.																	
12027	Possible Electrical Cable Insulation Damage When Replacing Flux Detectors [Window 28, 73]	Possible deterioration of existing cable insulation (from the Flux Detector to the Amplifier) when replacing Flux Detectors becauseaged cable insulation may be very fragile and breakdown upon contact.	3	Active	John Stopar	George Naguib	11-Apr-16	Monitor	15-Jun-16	3	1	2	6	3	1	2	6
There are no Not Started, In Progress Actions associated with the risk.																	
12418	Adjuster Rod Replacement Construction Costs [Window 21]	Due to the large delta between third party and EPC Vendor estimates for Construction costs, associated with Adjuster Rod removal, installation, and holding rack modification, there is a risk that the estimated construction costs at Gate 2H are increased in Phase 2 of the project.	3	Active	John Stopar	George Naguib	11-Apr-16	Monitor	15-Oct-16	3	2	1	6	3	2	1	6
There are no Not Started, In Progress Actions associated with the risk.																	
13321	LPSW Alternative Cooling (Project # 73514) Interfaces with the BDBE and the BA Project components not ready [Window 57A, 57B]	The risk is that LPSW Alternative Cooling will not be available when required (MEC 124457) as a result of interfacing components (BDBE and the BA Projects) potentially not installed in a timely manner. The impact of this will be an inability to provide cooling water to the loads under MEC 124457, which may impact other project schedules.	3	Active	Scott Guthrie	Greg Mills	11-Apr-16	Monitor	30-Sep-16	2	2	3	6	2	2	3	6
There are no Not Started, In Progress Actions associated with the risk.																	
13578	The Risk is that items to be procured by the Balance of Plant Project may have lead times greater than expected (all windows)	The Risk is that items to be procured by the Balance of Plant Project may have lead times greater than expected. This would impact the execution schedule. In general, a valid mitigation strategy will be to expedite shipments through the procurement vendors.	3	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Aug-16	2	2	3	6	2	2	3	6
There are no Not Started, In Progress Actions associated with the risk.																	
13579	Balance of Plant Work Group Interference Schedule Risk [window 104]	The Risk is that due to unforeseen interaction with other work groups and projects, the risk is that BOP projects in the vault will face interferences and schedule delays.	1	Active	Scott Guthrie	Greg Mills	22-Jun-15	Monitor	22-Jun-15	2	1	3	6	2	1	3	6
There are no Not Started, In Progress Actions associated with the risk.																	
13607	ASDCH - Execution/installation window schedule delays due to work interferenced with JV work [Window 130,124]	The risk is that the Auxiliary Shutdown Cooling project will face schedule delays during the planned work windows due to the interferences with R&FR/JV work. The ASDC project will get delayed due to the JV work being on critical path for a variety of reasons (i.e. 1. removal of the cable trays required for pulling the power supply cables to pump-motors will be performed immediately after installation of the bulkhead, and their re-installation is plan to be done just before the PHT refill or later on, 2. getting access for the ASDC equipment and materials to SDC rooms when R&FR work is at full speed, 3. work interferences in the same area of the vault) which will lead to a contractor stand down resulting in additional cost and schedule delays.	1	Active	Scott Guthrie	Doina Idita	20-Apr-16	Monitor	01-Jul-18	3	1	2	6	3	1	2	6
There are no Not Started, In Progress Actions associated with the risk.																	
13644	Fission Chamber Guide Tube Redesign Risk [Window 129]	The Risk is that due to clearance issues caused by RF&R components, there will be a requirement to redesign the fission chamber guide tubes.	1	Active	Scott Guthrie	George Naguib	11-Apr-16	Monitor	31-Aug-16	3	2	2	6	3	2	2	6
There are no Not Started, In Progress Actions associated with the risk.																	
13647	The risk is that equipment to be replaced/modified is obsolete and additional unforeseen effort will be required to replace (all windows)	The risk is that equipment to be replaced/modified is obsolete and additional unforeseen effort will be required to replace. this is a project-wide risk impacting multiple projects in the bundle .	1	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Aug-16	2	3	1	6	2	3	1	6
There are no Not Started, In Progress Actions associated with the risk.																	
1	Schedule delays due to interferences with other	Possible impact on BOP project schedules and budgets due to work windows moving and/or changing	1	Active	Scott Guthrie	Kevin Tse	15-Apr-16	Monitor	08-Apr-16	3	1	2	6	2	1	2	4

3732	interferences with other projects and/or windows changing (all windows)	urations and/or interferences from other workgroups. Cause: Schedules/execution windows may change as a result of vertical integration with other projects. To be resolved once schedule is at Rev 0.	There are no Not Started, In Progress Actions associated with the risk.														
13755	[Window 532] 73312 - Fire Barrier Inspections - Sealant Material [No Window Related]	The Risk is that during inspections of fire barrier penetrations, deficiencies will be found by the project causing delay. There is also the possibility that extensive documentation and governance changes will be required. IIP-OI-024. The deficiencies mainly relate to the fact that a non-approved fire barrier(sealant) has been used and is not fire rated.	2	Active	Scott Guthrie	Amuk Sandhu	05-May-16	Accept	31-Aug-16	3	1	2	6	3	1	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
13756	[Window 532] Testing of all private fire main control valves	The risk is that during operability testing of the private fire main control valves, significant issues are found with the valves. Should this occur, the impact is that the sample size of valves may be increased, increasing the scope and schedule of the inspection campaign. In addition, there is a risk that current sample size of valves (alternate compliance) may not be accepted by the regulator. If such, sample size may increase, increasing scope/schedule/cost. Also, there is a risk that the testing method to test these valves may require the installation of TMODES, increasing project schedule/cost and scope. In addition, repairs are not estimated as base cost for these inspections. These will be tracked accordingly.	3	Active	Scott Guthrie	Oweis Chohan	01-Dec-15	Monitor	24-Sep-15	3	1	2	6	3	1	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
13755	Project 73750 - There is a risk that flanges at the LPSW valves are degraded [Window 57]	Event - LPSW flanges found to need refacing or replacement. The current estimate requires flanges to be in good condition for DSR TS0630-6, replacement of LPSW valves. Cause - Corrosion on flange faces. Impact - This would result in delays to LPSW valve replacement. This would impact cost and schedule for both the valve rehab project and the possibly the stopple plug project 73613.	1	Active	Scott Guthrie	M Hodges	14-Dec-15	Accept	27-Jul-16	2	1	3	6	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
13852	Additional Funding required if max performance fee awarded	EVENT: Additional Funding required if max performance fee awarded. CAUSE: of project funding is held back as an incentive to perform well. The maximum multiplier is which totals to a fee. This means that of contract is an additional cost to the project. This score is given when Performance indicator criteria are met. IMPACT: Additional cost to the project		Active	Scott Guthrie	Kevin Tse	09-Sep-15	Monitor	31-Jan-16	3	2	1	6	3	2	1	6
			There are no Not Started, In Progress Actions associated with the risk.														
13853	There is a possibility that we would need to extend the warranty period for materials beyond the 2 year timeline. (All windows)	Event: There is a possibility that we would need to extend the warranty period for materials beyond the 2 year timeline. Cause: The expectation is that material needs to be procured at arrived at site t-6weeks from the execution window. However, there are instances where the execution work occurs later on within the execution window, especially for work currently assigned to segment windows (131, 132, 133) Impact: Warranty may have elapsed prior to installation resulting in additional cost to cover extra warranty requirement		Active	Scott Guthrie	Kevin Tse	16-Apr-16	Monitor	15-Sep-16	3	2	1	6	3	2	1	6
			There are no Not Started, In Progress Actions associated with the risk.														
13902	Seismic Requirements for Flask Use on RMD [Window 21]	There is a risk that further engineering and work planning effort will be required to address the seismic requirements for use of the RM flask over the RMD. Due to the seismic requirements on the RMD, an assessment to confirm no seismic risk is imposed on reactor mechanisms and associated equipment, as a result of AA rod removals from the reactor core.		Active	John Stopar	George Naguib	11-Apr-16	Monitor	31-May-16	3	2	2	6	3	2	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
13939	ASDCH - Multilin 239 relay installed on the 600V circuit breaker (supplying the ASDCH pump-motors) to fail the vibration test [Window 124]	There is a risk that the Multilin 239 relay installed on the 600V circuit breaker (supplying the ASDCH pump-motors) will fail the vibration test. This assembly is a "first of a kind" design for DNGS. If the risk occurs, than the associated Electrical design EC's for pump-motor protection shall be changed by placing the Multilin 239 relay in another location.	3	Active	Katie Stewart	Doina Idita	20-Apr-16	Monitor	01-Feb-17	2	1	3	6	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
13946	73592 - Risk of Modification being required for VVRS driers 18 inch 3-way AOV Replacement Project [Window 009]	The risk is that Engineering's assessment of the AOV replacement NICR will be invalidated by certified vendor information. If this risk is realized, a (minor) modification will need to be done in house.	4	Active	Scott Guthrie	Gee Sham	11-Feb-16	Mitigate	01-Aug-16	2	1	3	6	2	1	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
13	ASDCH Large volume of project documentation (TPARs/QMs/etc) may be	As the ASDCH modification is complex, a significant number of new and OPG existing documents must be updated/created (there were identified 210 documents). There is a risk of EPC contract cost increase if ES Fox underestimated the number of the OPG	2	Active	Katie Stewart	Doina Idita	19-Apr-16	Mitigate	30-Jun-16	2	1	3	6	2	1	2	4
			There are no Not Started, In Progress Actions associated with the risk.														

<a href="#">994</a>	required [Window 90]	procedures/documentation (non-change papers associated with EC project) which must be marked-up/created due to the implementation of the ASDCH modification.																
<a href="#">14004</a>	73592 - Containment project estimate of PMT cost [Window 8]	The risk is that the Containment project will require to pay additional Preventative maintenance costs to cover gaps between IPG work and work during the Refurb outage and removal of the T-Mod within the same scope.  T-Modification removal is in the ES Fox scope of work.	3	Active	Scott Guthrie	Gee Sham	11-Feb-16	Mitigate	30-Sep-16	3	2	1	6	2	1	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">14026</a>	Horizontal Flux Detector Mock Up at MCDF [Window 73]	Due to the high number of interferences in the SDS2 Bunker and inability to perform real life training in situ, an HFD mock up is being planned and constructed at the MCDF in order to aid both Refurb and Station personnel in realistic training and contingency planning.		Active	John Stopar	George Naguib	11-Apr-16	Monitor	30-Jun-16	3	2	1	6	3	2	1	6	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">14400</a>	Adjuster Rod Toolset [window #21]	The existing Adjuster Rod replacement toolset at Darlington is not complete.		Active	John Stopar	George Naguib	26-Apr-16	Mitigate	31-Jul-16	3	2	1	6	1	1	1	1	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">14402</a>	RM Drive Mechanism Damage due to handling and AA Replacement work [window #21 and #28]	This risk is associated with the possible damage to RM Drive Mechanisms during handling (ie. removal and reinstall of AA Drive Mechanisms) as well as surrounding work during AA rod replacement and VFD replacement work.		Active	John Stopar	George Naguib	26-Apr-16	Mitigate	31-Oct-16	3	1	2	6	2	1	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">11864</a>	Unique Components Rehabilitation (Project # 73782) Increased Scope of Cables/EPs Replacement [window 104]	Life cycle costs and scope for EQ Cable and EP replacement was based on partial U2 and completed U1 inspection findings. Future inspections on following units may result in scope increase or reduction. Scope increase will have schedule and cost impact. This risk updated and cited as part of Gate 3.	3	Active	Scott Guthrie	Greg Mills	11-Apr-16	Monitor	30-Jun-16	2	2	1	4	2	2	1	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6389</a>	Not Started	Review Cable and EP inspection results for U3	Facilitate/expedite Engineering Review of Cable and EP inspection results for U3. This involves reviewing the NIR and EP inspections from the U3 outage.	Scott Guthrie	Greg Mills	30-Jun-16	U3 inspection reviews were concluded before the end of 2015 and it is now May 2016. This review is behind and issue needs to be escalated with management. Date bumped out to June 30.								
<a href="#">12311</a>	Fission Chamber Guide Tube Installation Risk [Window 129]	The risk is that possible misalignment between the view port, thimble and calandria nozzle will hinder installation of the temporary fission chamber guide tube.	2	Active	John Stopar	George Naguib	11-Apr-16	Mitigate	15-Aug-17	2	2	2	4	1	1	1	1	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">13296</a>	73769 - Risk to CNSC concurrent of the modification in the Darlington Reactor shim mode operation [No Window Related]	CNSC concurrent of the modification in the Darlington Reactor shim mode operation will have an impact on the schedule of the project. If CNSC concurrent is not received in time, the installation of the software will be delayed.	3	Active	Scott Guthrie	Gee Sham	06-Apr-16	Monitor	29-Jul-16	2	1	2	4	2	1	2	4	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">13635</a>	Tooling and Design rework [Window 28, 73]	The risk is that due to complications with storing the In-Core Flux Detectors in the Irradiated Fuel Bay, rework on design may be required to revise the tooling. Should this occur, the impact will be to perform design that is above and beyond the current understood scope.	1	Active	John Stopar	George Naguib	11-Apr-16	Monitor	30-Apr-16	2	2	2	4	2	2	2	4	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">13662</a>	the risk is that the vendors will issue change orders for requirements not originally anticipated at the time of	Due to changing standards and expectations from OPG functional support, the risk is that the vendors will issue change orders for requirements not originally anticipated at the time of contracting.	1	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Aug-16	2	2	1	4	2	2	1	4	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">13669</a>	The risk is that lack of space in the layed-up unit will result in conflicts in the SATM/laydown area system (all windows)	The risk is that lack of space in the layed-up unit will result in conflicts in the SATM/laydown area system. This could result in delays and overall issues with performing the work.	1	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Jul-16	2	2	2	4	2	2	2	4	
			There are no Not Started, In Progress Actions associated with the risk.															
	ASDCH Strategic Spare parts not available and would result in modification	The risk is that the ASDC modification will not be accepted by stakeholders at AFS due to an unavailability of strategic spare parts (i.e. spare pump cartridges). These spares were not ordered in time for AFS, due to lack of the funding for operational spares.	2	Active	Katie Stewart	Doina Idita	20-Apr-16	Mitigate	30-Aug-16	2	2	2	4	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								

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<a href="#">13945</a>	not accepted at AFS [Not Window related]	Refurb capital funding cannot be used for operational spares. Due to the high cost of the strategic spares, a business case must be developed and approved. Please note: 2-5 year inspection spares were purchased for ASDC.																	
			<a href="#">6605</a>	In Progress	Resolution of operational spare parts for ASDCH	Identify a way for funding the modification operational spare parts. DRAS in progress to document that BOP will procure the installation, commissioning and the minor inspection spare parts. NR Engineering intends to initiate BCS and put together a plan for procuring the strategic spare parts when purchasing the ASDC pump-motor assemblies for the other units (U3, 1, and 4)	Katie Stewart	Doina Idita	30-May-16	Action extended to May 30/16 in order to review DRAS and get signatures.									
<a href="#">14001</a>	ASDCH pump-motor CSA certification at risk to be rejected [Window 124]	There is a risk that: - KSB request for CSA certification of the ASDCH pump-motor to be rejected CSA as KSB is a European vendor. If this risk occurs, then a major design re-work will be required. - of cost increase of the KSB pump-motor for ASDCH due to the CSA certification requirements. There is a need to engage a third party to prepare a report proving the equivalency between the european (used for manufacturing of the pump-motor assemblies) and north american standards.		Active	Katie Stewart	Doina Idita	19-Apr-16	Mitigate	30-Aug-17	2	1	2	4	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6603</a>	In Progress	KSB to engage TUV (Germany equivalent CSA) to prepare a report proving the bridge/equivalency between the european and north american codes/standards	KSB to engage TUV (Germany equivalent CSA) to prepare a report proving the bridge/equivalency between the european and north american codes/standards Update: KSB did not need to engage TUV they are currently working directly with UL who has identified applicable CSA stds that will achieve equivalency through ULL, many of these will be met through MITP. Risk is considered low but will be monitored through to UL listing. This action will not be completed until ULL is received TCD: August 2017	Katie Stewart	Doina Idita	30-Aug-17										
<a href="#">14025</a>	ICFD Lemo Connector Corrosion [Window 28]	OPEX from previous DNGS ICFD work indicates that there may be heavy corrosion on the U2 ICFD assembly heads, and more specifically on the lemo connectors. This risk is identified for contingency planning in case lemo connectors need be replaced. In more sever corrosion cases, single well may need to be abandoned if detectors cannot be installed.		Active	John Stopar	George Naguib	11-Apr-16	Monitor	30-May-16	4	1	1	4	4	1	1	4		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">14205</a>	HFD Installation Challenges due to sagged guide tube [Window 73]	There is OPEX which indicates that installation of longer Horizontal detectors, with a dry moderator, may be presented by major challenges due to sagging of horizontal ICFD guide tubes. A response to this challenge may include delaying longer detector installations until after moderator fill. OPEX indicates the possibility that guide tube sag is less apparent with a full moderator. This would have possible impacts to the overall outage schedule if detector installs are pushed out.		Active	John Stopar	George Naguib	11-Apr-16	Accept	30-Jun-16	2	1	2	4	2	1	1	2		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">14207</a>	Risk of Stuck Detector during HFD Program [Window 73]	There is a risk that, during horizontal in-core flux detector removals, a detector is lodged in the cutting chamber of the Stern ICFD Cutter Tool. Although the tool is built with contingency tooling for a number of "expected" stuck detector positions, contingency planning is required for a variety of other conditions. Due to the already high doses in the SDS2 bunker as well as significat dose rates coming off a stuck detector, contingency planning will need to involve minimizing the amount of time personnel are in the vicinity of the tool, as well as a well docunted process for safe stating the area in the case of stuck detector challenges.		Active	John Stopar	George Naguib	11-Apr-16	Mitigate	30-Jun-16	2	1	2	4	2	1	1	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6756</a>	In Progress	Contingency Plan for HFD Replacement	This action is associated with Risk ID 14207. Contingency planning for stuck detectors during the HFD replacement window will need to be established prior to executing the work.	John Stopar	George Naguib	30-Jun-16										
<a href="#">14393</a>	ALARA Risks Associated with AA Replacement Project [window 021]	Due to the nature of the AA Replacement work, there is a potential for contamination spread and a risk of unplanned exposure during the removal process.		Active	John Stopar	George Naguib	23-Apr-16	Mitigate	30-Jun-16	2	1	2	4	1	1	2	2		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">14406</a>	Risk that Detector does not meet Specification [window #129]	There is a risk associated with the performance of the selected fission detectors such that they will not provide the functionality required by the specification.		Active	John Stopar	George Naguib	26-Apr-16	Mitigate	30-Jun-17	2	1	2	4	1	1	1	1		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">12</a>	Horizontal Flux Detector Guide Tube Replacement [Window 73]	The risk is that the horizontal flux detector (HFD) guide tubes will need to be replaced. A calandria tube to HFD gap measurement is currently being completed by IMS to determine if there is a need to replace the HFD guide tubes. HFDs are prone to saq as calandria tubes are, which may result in	3	Active	John Stopar	George Naguib	17-Feb-16	Accept	30-Jun-14	1	3	3	3	1	3	3	3		
	Run by:		There are no Not Started, In Progress Actions associated with the risk.																
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19		contact between calandria tubes and HFDs during normal operation (sag until contact) or during refurbishment by removal or installation of calandria tubes.																
13753	Risk of Procurement of Miniature fission chambers [No Window Related]	May require procurement of new miniature fission chambers or they are not fit for use.	2	Active	John Stopar	George Naguib	11-Apr-16	Monitor	31-May-16	3	1	1	3	1	1	1	1	
			There are no Not Started, In Progress Actions associated with the risk.															
13758	[Window 532] 73312 - SG Secondary Containment Structure [Window 532]	The Risk is that upon inspection/assessment of the SG fuel tank secondary containment structures, extensive deficiencies will be found. If this occurs, reconstruction of the containment structure may be required. This would increase project scope and schedule.	2	Active	Scott Guthrie	Amuk Sandhu	05-May-16	Accept	30-Jun-16	1	1	3	3	1	1	3	3	
			There are no Not Started, In Progress Actions associated with the risk.															
13881	Unique Components Rehabilitation (Project # 73782) Potential delay to project due to materials not on site [Window 104]	The risk is that Material on site milestones may be missed due to material lead times, and delays in establishing a PO to the OEM. This risk is against the Unique Components Rehabilitation Project (# 73782) and is specific to the EP modules which are being ordered by E.S. Fox from Mirion Technologies. It was originally planned to issue the material PO for the modules in May/June 2015 (Phase 2) and therefore no order of long lead materials was required during Phase 1. However, the completion of Phase 1 was delayed, and the PO for Phase 2 was also delayed. As such, the original material order by date (late July 2015) was missed. Fox issued a PO to Mirion which took additional months to be approved with a promised delivery date of November 2017. A meeting at E.S. Fox's location in Niagara was held with Mirion representatives. A plan was worked out to move delivery to June 5. This should meet the installation related deadlines. As of yet, the PO has not formally been changed to this delivery date. There is a on-going risk that additional problems or delays will jeopardize this date.	4	Active	Scott Guthrie	Greg Mills	11-Apr-16	Mitigate	30-Apr-16	1	1	3	3	1	1	3	3	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6388	In Progress	Ask Mirion to formally change delivery date to June 5 to reflect current delivery plan (project 73782)	Current target date is not reflected in the Fox subcontractor (Mirion) PO. Ask Mirion to formally change delivery date to June 5 to reflect current delivery plan.	Scott Guthrie	Greg Mills	30-Jun-16	Following up with E.S. Fox project manager. Discussed Aril 27, Fox PM agreed to atte4mpt this with Mirion. Pushed date out to June 30.								
14000	ASDCH - KSB pump-motor Warranty Expires prior to MOD AFS [Not Window Related]	There is a risk that the ASDCH pump-motors manufactured by KSB Germany warranty renegotiation would be required because there is duration gap between delivery to site (2017) and AFS (2019) resulting in warranty being expired at the time of AFS. Renegotiation of warranty will result in cost increase.		Active	Katie Stewart	Doina Idita	19-Apr-16	Accept	30-Jun-16	3	1	1	3	3	1	1	3	
			There are no Not Started, In Progress Actions associated with the risk.															
14208	Adjuster Absorber Rod Drop During Replacement [Window 21]	This risk is associated with the risk of dropping an adjuster absorber rod in one or both of the following scenarios: 1. Upon removal of spent AA Rods with the RM Flask. 2. Upon Installation of new AA rods into the reactor core. The impact of a dropped rod may result in severe damage to the AA rod itself as well as possible guide tube and locator damage.		Active	John Stopar	George Naguib	11-Apr-16	Monitor	30-Sep-16	1	2	3	3	1	2	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
14209	Less than Adequate AA Guide Tube Gap Inspection Results [Window 21]	This risk is associated with the risk that the AA vertical guide tube gap inspection on AA13 guide tube at the back end of the AA replacement program results in less than adequate measurements. Although the OPEX indicates that the risk is low, there would need to be extra work planning and execution work required to fix the gap measurements and study the extent of condition.		Active	John Stopar	George Naguib	11-Apr-16	Accept	30-May-17	1	3	3	3	1	3	3	3	
			There are no Not Started, In Progress Actions associated with the risk.															
14403	RMD Mockup for AA Replacement [window #21]	Risk is that the RMD Mockup does not adequately reflect the field interferences from surrounding mechanisms.		Active	John Stopar	George Naguib	26-Apr-16	Mitigate	31-Oct-16	3	1	1	3	2	1	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
13632	ASDCH - DBOM revisions due to obsolete materials [Window 130,124]	Should materials be obsoleted during the time between creation of the DBOMs and field installation, there is a possibility of rework on design. The effect to this would be schedule delays to installation and cost increases to revise the design via a FIC or EC rev (whichever will be appropriate).	1	Active	Scott Guthrie	Doina Idita	20-Apr-16	Monitor	24-Jun-16	2	1	1	2	2	1	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
13642	Schedule Delays for Fission Chambers [Window 129]	Due to the nature of the Fission Chamber work, there is some probability that issues during startup, reinsertion, and repositioning may affect startup. The result of this work would be increased time for labour hours above and beyond the estimated value	1	Active	John Stopar	George Naguib	11-Apr-16	Monitor	07-Aug-17	1	1	2	2	1	1	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
	ASDCH MOD New Revision	ASDCH modification Design EC packages went through DCAVR process without having associated QWA finalized (Deviation MEMO approved by NDA in effort). Based on the memo, also, the QWA		Active	Katie Stewart	Doina Idita	19-Apr-16	Accept	30-Apr-16	2	1	1	2	1	1	1	1	

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14370	Project 73750 Valve Rehabilitation - Risk of system modifications due to increased weight of replacement valves (Window 122)	The Valve Rehabilitation Project covers 80 valves - a subset are subject to replacement with new. A number of replacement valves are not available like for like with the original, and are being addressed with NICRs. During preparation of the NICRs as part of the procurement process, it became known that some replacement valves have significantly higher weights than the original valves. There is a risk of system modifications due to increased weight impacting on system stress reports/seismic analysis/allowable stresses.	3	Active	Scott Guthrie	M Hodges	19-Apr-16	Monitor	28-Oct-16	2	2	5	10	2	2	5	10
			There are no Not Started, In Progress Actions associated with the risk.														
12295	Project 73750 - Insufficient Temporary Facilities To Support Valve Rehab Scope resulting in delays and cost increase. [Windows 122, 124, 57, 29]	Event - Temporary facilities on site prove to be inadequate. Much of the valve work will need to be performed "on-site" (due to contamination and logistics of welded in valves) As there is limited space during refurb, this may result in increase costs and schedule to remove valves offsite (i.e.decontam / ship contaminated valves off site). This may affect the following windows: 29, 48, 54, 57, 103, 104, 122, 124, 131 Cause - Unforeseen needs associated with valve rehab facilities. Impact - Additional facilities required causing schedule and cost impact.	3	Active	Scott Guthrie	M Hodges	11-Apr-16	Monitor	29-Apr-16	2	2	4	8	2	1	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
12297	Project 73750 - Risk of Added Cost to Valve Rehabilitation Due to Addition of IEE/NICR/MODs [Windows 122, 057, 124]	Event - IEE/NICR/MODs are required as a part of valve rehabilitation. Cause - Obsolete parts Impact - The realization of this risk would lead to increased cost and added delays to schedule.	3	Active	Scott Guthrie	M Hodges	11-Apr-16	Accept	15-Apr-16	2	2	4	8	1	1	3	3
			There are no Not Started, In Progress Actions associated with the risk.														
14413	Project 73750 Phase 2 cost escalation (Windows 122, 124, 029, 057)	The current estimate for the execution phase of the valve rehab project may be substantially lower than the actual costs.	3	Active	Gary Grahn	M Hodges	28-Apr-16	Mitigate	26-Oct-19	4	2	1	8	4	2	1	8
			There are no Not Started, In Progress Actions associated with the risk.														
12305	Project 73750 - Risk of Increased Cost Due to Valve / Actuator Discovery Work or as a Result of Obsolete Valves [Window 29, 122, 124, 131]	Event - Valves will be replaced / repaired / overhauled as per the current approved scope. During this work, there is the potential for 'discovery' issues to arise that will need to be addressed in order to return the valve to proper working order (either the valve or the actuator). This 'discovery' work will result in additional cost or schedule delay. May also result in NICRs being required. This may affect windows: 29, 48, 54, 57, 103, 104, 122, 124, 131 Cause - Inaccurate drawings leading to valve to actuator fit up problems. Actuators may not be adequate for new valves and may need to be replaced. Impact - Depending on the severity of the issue there could be cost or schedule impacts.	3	Active	Scott Guthrie	M Hodges	11-Apr-16	Mitigate	29-Apr-16	2	2	3	6	1	2	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
13778	Project 73750 - Additional Tenting for Contamination Control - Valve Rehabilitation [Window 29, 48, 54, 57]	Event - Implementation of tenting for contamination control may require a modification. Activities that may cause loose/airborne contamination include use of an arter grinder for valve overhaul. This may affect windows: 29, 48, 54, 57, 103, 104, 122, 124, 131 Cause - Procedures drive the requirement for a temporary modification. Impact - Cost impact due to additional resources needed for TMOD.	1	Active	Scott Guthrie	M Hodges	12-Apr-16	Mitigate	27-Jun-16	2	1	3	6	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
13785	Project 73750 - There is a risk that flanges at the LPSW valves are degraded [Window 57]	Event - LPSW flanges found to need refacing or replacement. The current estimate requires flanges to be in good condition for DSR TS0630-6, replacement of LPSW valves. Cause - Corrosion on flange faces. Impact - This would result in delays to LPSW valve replacement. This would impact cost and schedule for both the valve rehab project and the possibly the stopple plug project 73613.	1	Active	Scott Guthrie	M Hodges	14-Dec-15	Accept	27-Jul-16	2	1	3	6	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Balance of Plant - 73696																	
13644	Fission Chamber Guide Tube Redesign Risk [Window 129]	The Risk is that due to clearance issues caused by RF&R components, there will be a requirement to redesign the fission chamber guide tubes.	1	Active	Scott Guthrie	George Naguib	11-Apr-16	Monitor	31-Aug-16	3	2	2	6	3	2	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
12311	Fission Chamber Guide Tube Installation Risk [Window 129]	The risk is that possible misalignment between the view port, thimble and calandria nozzle will hinder installation of the temporary fission chamber guide tube.	2	Active	John Stopar	George Naguib	11-Apr-16	Mitigate	15-Aug-17	2	2	2	4	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
14406	Risk that Detector does not meet Specification [window #129]	There is a risk associated with the performance of the selected fission detectors such that they will not provide the functionality required by the specification.		Active	John Stopar	George Naguib	26-Apr-16	Mitigate	30-Jun-17	2	1	2	4	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														

13642	Schedule Delays for Fission Chambers [Window 129]	Due to the nature of the Fission Chamber work, there is some probability that issues during startup, reinsertion, and repositioning may affect startup. The result of this work would be increased time for labour hours above and beyond the estimated value	1	Active	John Stopar	George Naguib	11-Apr-16	Monitor	07-Aug-17	1	1	2	2	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Balance of Plant -																	
12348	Risk of increased scope to L15 replacement due to discovery issues at first welded connection [window 053]	There is a risk that additional scope is incurred in ESW L15 replacement due to potentially deteriorated or corroded condition of pipe at location where welds are expected to take place. If this risk materializes, there is potential for increased material costs (additional piping, connections, fittings), impact to ESW outage schedule, and potentially impact to other projects in refurbishment.	1	Active	Scott Guthrie	Jessica Perryman	22-Apr-16	Accept	03-Jul-17	3	1	4	12	3	1	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
14057	Valve Program Capability Risk - Project 73763	As a result of the recently obtained Class 3 valve cyclic maintenance estimate, alternative contracting and resource strategies are required to ensure successful completion of the D1621 valve program scope. This analysis needs to consider in-house & contracted BTU resource options. In addition, completion of the current cyclic valve program assessing must be limited to those activities that are readily transferable to another vendor/resource.	4	Active	Scott Guthrie	M Hodges	28-Mar-16	Monitor	10-Aug-16	4	3	3	12	2	3	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
14352	PHT & Aux: One-Time Marked up MMP for Pump Disassembly, Inspection and Repair may Require Revision [window 048]	During OPG review of the PHT Pump 3 comprehensive work package, and through conversations with the OEM, it was discussed that the MMP (NK38-MMP-33120-04) for this work may need to be revised due to incorporation of OEM information (technical bulletins & instructions), OPEX over the years, and there may be tooling updates required. The approved maintenance procedure NK38-MMP-33120-04 was last revised 9-Dec-2011. And the one time marked up procedure was written based on this MMP for Unit 2 refurbishment only (WO 3218143), which was approved for use 30-Mar-2014.	3	Active	Scott Guthrie	Jessica Perryman	20-Apr-16	Monitor	31-Aug-16	4	1	3	12	3	1	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
13641	PHT & Aux - Risk of Project Delays due to Conflicting Work in PHT Pump/Motor Room [Window 48]	The risk is that other work (such as the PHT Pump Motor Installations) will push the execution window for the PHT pump inspection/overhaul work. Any operation of the gantry crane and high rad work in the RMD will cause interruption of other work. Therefore, there is has a high chance of other work affecting the PHT Pump inspections, coupling removal/installation (other contractor), motor removal (other contractor), and pump contingency overhaul.	1	Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Monitor	17-Jun-17	2	1	5	10	2	1	5	10
			There are no Not Started, In Progress Actions associated with the risk.														
13314	EHS Vault Work Interferences with JV Work [Window 104, 68]	The risk is that the Emergency Heat Sink project will face schedule delays during planned work windows due to interferences with the R&FR/JV work. The EHS project will get delayed due to JV work being on critical path for a variety of reasons (eg: high radiation beams in vault, work interferences in similar areas of the vault, etc.) which will lead to a contractor stand down resulting in additional costs and schedule delays.	1	Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Monitor	28-Feb-17	3	1	3	9	3	1	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
14032	[Window 532] Lube Oil Tank Clean Out; Draining Risk: Fire Protection Inspections Project 73308	There is a risk that field conditions deviate from contract negotiated deliverables. Agreed upon tank level of 20% full (as per SOW and P.O) can potentially deviate if tank levels are higher when tanks are to be drained. As such, additional cost of tanker truck and schedule push may occur. (Current level of dirty tank at 70%, required OPG Plant commitment to drain out before contractor arrives on site)	3	Active	Scott Guthrie	Oweis Chohan	01-Dec-15	Mitigate	31-Aug-16	3	1	3	9	2	1	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
13260	PHT & Aux - Heat Exchangers Require Replacement [window 048]	The risk is that the D2O Collection Tank and Vent Condenser heat exchanger tubes will have degraded to a point which requires an entire heat exchanger replacement.	1	Active	Scott Guthrie	Jessica Perryman	22-Apr-16	Monitor	30-Jul-17	2	1	4	8	2	1	4	8
			There are no Not Started, In Progress Actions associated with the risk.														
13310	EHS - ACU Split Coil Design Is Not Implemented [Window 68]	The risk is that the ACU Split Coil design will not be implemented for future ACU Maintenance. This will cause the EHS class 1 piping in the vault to create a larger interference then currently exists for the like for like (13 foot coil) replacement, which will cause a futher reduction of approx 0.8 feet of clearance.	1	Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Monitor	30-Jun-16	2	2	4	8	2	2	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5010	In Progress	EHS Project to monitor Vault ACU Split Coil Design Implementation	The action is to monitor the installation of the ACU split coil design in D1531, as a monitoring mitigating action for Risk ID 13310.	Scott Guthrie	Jessica Perryman	28-Nov-16	11-Dec-2015: the installation was successful in D1511 (Unit 1). Continue to monitor the split coil performance in Unit 1 to determine if it will be implemented in the future. This requires interfacing with Station Engineering (Eric Kool).							
12318	Stopple Plug Cost Increase due to Extended Services [window 057]	If the sub-vendor Supplied equipment (TDW) is required for the entire 60 day LPSW outage, this will result in increased costs.The current assumption / plan is to use this for only small portion of the LPSW window (less than 7 days).	3	Active	Scott Guthrie	Jessica Perryman	22-Apr-16	Monitor	01-Aug-17	2	1	3	6	2	1	3	6
			There are no Not Started, In Progress Actions associated with the risk.														



13295	[Window 532] Risk of Fire Protection Emergent Repair Scope	DSRs IP1220-14, IP1300-1, and IP1220-3 are DSRs to perform assessments. Should deficiencies be found during these inspections/assessments, there is a generic contingency DSR for any work required in Engineering Scope. Currently, this DSR does not carry any funding to perform the work.	3	Active	Scott Guthrie	Oweis Chohan	28-Dec-15	Monitor	27-Jul-16	2	3	2	6	2	3	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5405	In Progress	Fire Protection Penetration/Construction Joint Field Inspections	Completion of the final fire penetrations and construction joints is required to assess the extent of repair scope. The first action is to complete the inspections TCD Aug 15. Upon completion of tyhat activity, the action ID will be updated to status when Engineering will complete the inspection analysis to confirm repair scope. That TCD will be established once the inspection reports are generated.  Update : OPG Field engineering providing the inspection service. Commencing Jan 2016. Expected finish, first quarter 2016. Insopection analysis ongoing,	Scott Guthrie	Gary Grahn	30-Jun-16	Extent of penetrations/construction joints confirmed, SoW being drafted to obtain selective sampling to confirm EOC for Sikaflex. Date extended to Jan 2016 to allow for SoW finalization, contract issuance and status of sampling findings.							
13347	PHT Pump Dismantling Tools Unavailable [Window 48]	The Risk is that the Primary Heat Transport (PHT) Pump disassembly/assembly tools required for PHT pump inspection and maintenance will not be readily available by the station. In the event of a forced outage, station maintenance will need to take back the PHT Pump tools for the use of seal replacement. This will lead to a contractor stand down until the PHT Pump tools can be obtained to continue PHT pump inspections.		Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Monitor	03-Apr-17	2	1	3	6	2	1	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
13364	PHT Pump Component Procurement Uncertainty [Window 48]	The risk is that there is an uncertainty in the cost of material procurement for the PHT Pump Long Lead components (15 month lead time). Funding was approved in Phase 1 to complete the purchase of the materials but the estimate from the OEM was a class 5 and did not include all the regulatory license approvals.	3	Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Monitor	31-May-16	2	1	3	6	2	1	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
13400	EHS Project - Inability to Perform Construction Walkdown [Windows 48, 104]	The risk is that there has not been a construction walkdown held for the Class 1 portion of this modification due to no planned Unit 2 outages available during the detailed design phase. The design and construction team have not been able to get into the reactor vault, therefore the design is based on available pictures and laserscans for piping layouts and supports. There is a large risk of interferences being present in the current piping runs which are not clearly visible from available pictures. 15-Nov-2015 update: Several walkdowns were performed during the VBO outage on Unit 2 to confirm the constructability of the design and note any interferences. 2 minor interferences were noted on portions of piping that could be measured, however much of the leak detection design could not be verified due to barriers and height of the desired install locations.	1	Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Monitor	31-Dec-18	3	2	2	6	2	1	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
13577	PHT Project - Switch Module Replacements [Window 48]	The risk is that during the replacement of the Primary Heat Transport (PHT) pressure switch cables, the alarm switch modules will also require replacement due to degradation over time.	1	Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Monitor	31-Jul-17	2	1	3	6	2	1	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
13658	EHS - DEC Revisions due to Unavailability of Vendor Information [Windows 48, 104]	The risk is that DEC revisions will be required due to the unavailability of vendor information. The design of the EHS piping and support structures depends on the dimension and weights of the material components (such as manual and check valves, and other items). These items will not be available until 4-6 weeks into procurement of the components, however PO's have not yet been issued for them (in progress).	2	Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Monitor	31-Aug-16	3	2	1	6	3	2	1	6
			There are no Not Started, In Progress Actions associated with the risk.														
13766	ESW L15, Risk of 72800-V223 passing during Refurbishment Outage on units 1&4 [Window 53]	Impact to ESW L15 Replacement - There is a risk that 72800-V223 will not provide sufficient isolation to the branches from the main header. V223 was replaced in all units during Vacuum Building Outage (Fall 2015), and will be used during refurbishment to provide isolation during replacement of ESW L15. V223 could only be inspected/replaced during VBO as all units have to be shutdown. This risk applies to future refurbishment outages units 1&4 as there is potential for V223 (butterfly valve) to degrade over time and not provide sufficient isolation.	1	Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Monitor	31-Jan-22	2	1	3	6	2	1	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
137	PHT & Aux - PHT Pumps Will Require Repairs [window 048]	During DNRU2 a single PHT Pump (2-33120-P3) will be inspected to determine the condition of the pump and if any contingency repairs are required. The risk is that the 2-33120-P3 is in poor condition and will require full repairs. This will lead to inspections of 2-33120-P1/P2/P4 and potential additional	1	Active	Scott Guthrie	Jessica Perryman	22-Apr-16	Monitor	30-Jul-17	1	2	5	5	1	2	5	5
			There are no Not Started, In Progress Actions associated with the risk.														

163		repairs. This would also impact the scope for the remaining refurbishment unit outages.																	
14017	EHS - Localized Pressure Test May Require New Tool [No window Related]	The EHS project will be installing class 1 piping through an existing penetration EP05066. The risk is that a new tool (vacuum box) may be required to complete a localized pressure test on the EP after installation of the piping. The impact would be increased procurement costs for the project (one time cost for U2, as the tool should be able to be re-used).	3	Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Accept	31-May-16	5	1	1	5	5	1	1	5		
			There are no Not Started, In Progress Actions associated with the risk.																
13631	The risk is that the project team will be taking on the effort for the commissioning Work Plans due to limited OPG resources (all windows)	The Current Assumption as of ES Fox's estimates is that OPG will be creating commissioning work plans as per the COIR. OPG will be sending a clarification to E.S. Fox and update the COIR, stating that ES Fox will be completing the Commissioning Work Plans, with OPG Verifying and accepting. Cost is for Engineer's time preparing CWP's.	3	Active	Scott Guthrie	Kevin Tse	15-Apr-16	Monitor	30-Sep-15	4	1	1	4	4	1	1	4		
			There are no Not Started, In Progress Actions associated with the risk.																
13664	Construction Interfaces	The Risk is that ownership and funding streams for various construction interfaces are unclear. As a result, the vendor was asked to remove CI costs from bids until clarity can be attained.	1	Active	Scott Guthrie		15-Jul-15	Monitor	15-Jul-15	2	2	1	4	2	2	1	4		
			There are no Not Started, In Progress Actions associated with the risk.																
13926	EHS - Hydraulic Analysis Reassessment [No Window Related]	The risk is that the Hydraulic Assessment will require a revision when the actual post-accident flow requirements are specified in the operating documentation for EHS supply.	1	Active	Scott Guthrie	Jessica Perryman	19-Apr-16	Monitor	31-Aug-16	2	1	2	4	2	1	2	4		
			There are no Not Started, In Progress Actions associated with the risk.																
14291	Stoppie Plug: Risk of burn through during welding of split tee (PMOD) [Window 57]	During the workplan review for the stoppie plug modification, it was identified that there is a risk of burn through of the 20" pipe during welding of split tee. This poses a potential for an unisolable leak from the Inter Unit Service Water Header (IUSWH). The maximum size of the leak would depend on the extent of any breach. Large leaks, while having a very low probability of occurrence, would have potentially severe consequences including flooding of U2 (north of Column Line 11 thus potential effects on U0 and U1) as well as the potential to impact on the operation of LPSW systems of Units 1, 3, and 4. Both of these events, should the break size be sufficiently large, would introduce a severe transient situation to the Plant and would likely require the use of a Group 2 Heat Sink in order to maintain Nuclear Safety. <del>The risk of these events has been mitigated by the following considerations:</del>	1	Active	Scott Guthrie	Jessica Perryman	22-Apr-16	Monitor	15-Apr-16	1	4	3	4	1	4	3	4		
			There are no Not Started, In Progress Actions associated with the risk.																
13352	[Window 515] Risk of detector accessibility	The Risk is that detectors in the field are not accessible for replacement. Should this be the case, relocation is the only option for the modification. This will be addressed via a FIC, and required more time and effort than anticipated, as the FHA/FSSA must always be adhered to. Any relocations must be reviewed, validated, and approved by the Design Services Provider as the design basis must be protected.	2	Active	Scott Guthrie	Oweis Chohan	15-Mar-16	Monitor	11-May-15	3	1	1	3	3	1	1	3		
			There are no Not Started, In Progress Actions associated with the risk.																
Project: Balance of Plant - 73550																			
14401	AA Replacement Staff Experience [window #21]	This risk is associated with the introduction of new tooling and processes to staff with little experience in performing the work. AA Rod Replacement has never been performed at Darlington and is new to the contractor. The lack of experience is associated with the tooling/work process of replacing and discharging AA rods as well as assembly and installation of correct AA Rod Types.		Active	John Stopar	George Naguib	26-Apr-16	Mitigate	31-Oct-16	4	4	4	16	2	1	1	2		
			There are no Not Started, In Progress Actions associated with the risk.																
12418	Adjuster Rod Replacement Construction Costs [Window 21]	Due to the large delta between third party and EPC Vendor estimates for Construction costs, associated with Adjuster Rod removal, installation, and holding rack modification, there is a risk that the estimated construction costs at Gate 2H are increased in Phase 2 of the project.	3	Active	John Stopar	George Naguib	11-Apr-16	Monitor	15-Oct-16	3	2	1	6	3	2	1	6		
			There are no Not Started, In Progress Actions associated with the risk.																
13578	The Risk is that items to be procured by the Balance of Plant Project may have lead times greater than expected	The Risk is that items to be procured by the Balance of Plant Project may have lead times greater than expected. This would impact the execution schedule. In general, a valid mitigation strategy will be to expedite shipments through the procurement vendors.	3	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Aug-16	2	2	3	6	2	2	3	6		
			There are no Not Started, In Progress Actions associated with the risk.																
13902	Seismic Requirements for Flask Use on RMD [Window 21]	There is a risk that further engineering and work planning effort will be required to address the seismic requirements for use of the RM flask over the RMD. Due to the seismic requirements on the RMD, an assessment to confirm no seismic risk is imposed on reactor mechanisms and associated equipment, as a result of AA rod removals from the reactor core.		Active	John Stopar	George Naguib	11-Apr-16	Monitor	31-May-16	3	2	2	6	3	2	2	6		
			There are no Not Started, In Progress Actions associated with the risk.																
1440	Adjuster Rod Toolset [window #21]	The existing Adjuster Rod replacement toolset at Darlington is not complete.		Active	John Stopar	George Naguib	26-Apr-16	Mitigate	31-Jul-16	3	2	1	6	1	1	1	1		
			There are no Not Started, In Progress Actions associated with the risk.																

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## Risk Report by Project with Associated Actions

13307	60, 133, 90]	maintenance work the scheduling of this work will need to work around and with many other projects. The estimates given were based on the information given in the Scope of Work which may not be accurate once the schedule is integrated. This may negatively affect the cost to do the work. Cause - Schedule integration. Impact - Schedule and cost impacts.	5403	In Progress	BoP Preventive/Corrective Work Scheduling in Outage Window & Effective Use of Staff	Once the vendors have been awarded for the Other and Electrical work scopes, a review will be required to confirm how the vendors will effectively manage work as it changes within an outage window. This could be caused by interferences or other issues requiring work control to move the WO within the same window. To alleviate this issue, the vendor needs to have a job jar strategy in place prior to the window to ensure that resources can be re-directed as required to other work thereby ensuring value for money for OPG.	Scott Guthrie	M Hodges	30-Jun-16	Discussed with ES Fox about job jar work. Once the schedule is integrated a review of the work will be completed to see which work can be performed independently of other work. There will be some work which will need to occur when the system is tagged out under permit. Other work can be performed either with a stand alone permit or during a long window for shutdown and layed up systems. This will be identified during the integration phase of scheduling. The schedule is in the process of being integrated. Due date changed to reflect completion of schedule integration. May 13/16 Update: First integration meeting review completed, second scheduled for June 2016. Level 3 schedules are now trades resourced and preliminary trades assessment has been completed. Challenge is determining extent of resources required for Portfolio, Outage overflow & AISC projects as Level 3 schedules down to trades level don't exist for that scope. Fox is attempting to estimate resources for that scope to confirm overall trades resources (action owner Scott Waters) to demonstrate that resources are planned. The job jar strategy will be finalized after the resource plan is finalized and the second Integration meetings are completed in June. Action extended to June 30/16.									
13355	Preventive Maintenance - "Other" Parts Risk	Event - Parts required which are no longer available. This may require design changes to be done. Also delays in obtaining parts may push the scheduled tasks requiring a lengthening of the work window or re-establishing the required plant conditions to perform the maintenance. Cause - Obsolete parts Impact - OPG is performing engineering function for this work, may require additional resources.	2	Active	Scott Guthrie	M Hodges	12-Apr-16	Monitor	16-Oct-16	4	1	1	4	4	1	1	4		
	There are no Not Started, In Progress Actions associated with the risk.																		
Project: Balance of Plant - 73762																			
14300	Conventional Electrical (Project # 73762) Hydro One work protection requirements in switchyard [Window 4, 126, 127]	It has recently been determined that OPG owned equipment in the switchyard is in an area requiring Hydro One work portection. Typically these areas require the work to be performed by Hydro One and not by OPG or it's contractors. It is mostly certain at this point that the affected scope will have to be taken from AREVA who is currently the intended constructor (though no execution contract has been issued). Currently AREVA has a contract to assess and perform work planning for this and other electrical scope. Should it be confirmed that scope has to be taken from AREVA, it will have to either be given to Hydro One, or taken out of refurbishment for the station to oversee. In this case, Hydro One would again be performing the work, but the deliverables that are part of all refurbishment work (CWPs, ITPs, procedures) would likely not be required.		Active	Scott Guthrie	Greg Mills	11-Apr-16	Accept	30-Jun-16	4	2	4	16	4	2	4	16		
	There are no Not Started, In Progress Actions associated with the risk.																		
13286	Project 73761 - Preventive Maintenance - "Other" Discovery Work [Window 29, 60, 133, 090]	The risk is that during the performance of preventive maintenance there will be deficiencies found that may require repair work. Balance of Plant has preventive maintenance work orders assigned to the "Other" category and some of them will require repairs outside of the preventive maintenance scope. This risk could apply to windows: 81, 122, 38, 132, 133, 78, 60, 22, 130, 131, 29, 90, 89, 48, 89, 46, 32, 28, 94, 55, 80, 100.	1	Active	Scott Guthrie	M Hodges	11-Apr-16	Accept	16-Oct-16	4	2	3	12	4	2	3	12		
	There are no Not Started, In Progress Actions associated with the risk.																		
13293	Project 73761, 73762 BOP Non-PM Discovery Work [Window 29, 60, 133, 090]	Event - During repair work there are deficiencies found that may increase the extent of necessary repairs above what was originally planned and assessed in the work order. Cause - Normal wear and tear associated with plant aging. Impact - Depending on the severity of the necessary repairs there may be cost and schedule impacts.	1	Active	Scott Guthrie	M Hodges	11-Apr-16	Accept	16-Oct-16	4	2	3	12	4	2	3	12		
	There are no Not Started, In Progress Actions associated with the risk.																		



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13303	Project 73762 - Preventive Maintenance - "Electrical" Discovery Work [Windows 126, 127, 004, 051]	Event - During the performance of preventative maintenance a deficiency is found that may require repair work. Cause - Normal wear and tear associated with aging equipment Impact - Depending on the discovery work found it may have schedule or cost impacts.	1	Active	Scott Guthrie	M Hodges	11-Apr-16	Accept	16-Oct-16	4	2	3	12	4	2	3	12
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Balance of Plant - 73769																	
13296	73769 - Risk to CNSC concurrent of the modification in the Darlington Reactor shim mode operation [No Window Related]	CNSC concurrent of the modification in the Darlington Reactor shim mode operation will have an impact on the schedule of the project. If CNSC concurrent is not received in time, the installation of the software will be delayed.	3	Active	Scott Guthrie	Gee Sham	06-Apr-16	Monitor	29-Jul-16	2	1	2	4	2	1	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Balance of Plant - 73514																	
14365	LPSW Alternative Cooling (Project # 73514) Material Risk for pre-req work [Window 513]	During readiness meetings conducted for oversight on WO 4785353 determined uncertainty regarding type of flanges to be used and whether or not valve repacking will be required. This may impact timing and costs associated with this pre-req for the installation of the LPSW TMODs.	4	Active	Scott Guthrie	Greg Mills	17-Apr-16	Mitigate	30-Apr-16	4	1	3	12	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
14427	LPSW Alternative Cooling (Project # 73514) Potential EC revision due to work window complications [Window 057]	Between March 4 and March 30, 2016 received email notifications from system engineer that complications relating to the LPSW outage window will partially invalidate a TMOD prepared for servicing critical cooling loads during the LPSW outage. There appears to be potential for having to perform an EC revision on the existing TMOD. See email attachments to this risk. As design has been complete for some time, an EC revision will cause considerable disruption and impact schedule and estimate. Impacts will likely involve revision to RQE, revision to approved installation work plans, revision to approved commissioning specifications, revision to installation strategy, etc. It is not clear what prompted this situation. With the issue of PIMS REV B2 (April 15, 2016) the PULSW outage window was changed, however the window coordinator says this is not the cause. This may have been due to original errors in defining the parameters of the TMOD. No SCR.	4	Active	Scott Guthrie	Greg Mills	04-May-16	Mitigate	30-Jun-16	4	3	1	12	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
13321	LPSW Alternative Cooling (Project # 73514) Interfaces with the BDBE and the BA Project components not	The risk is that LPSW Alternative Cooling will not be available when required (MEC 124457) as a result of interfacing components (BDBE and the BA Projects) potentially not installed in a timely manner. The impact of this will be an inability to provide cooling water to the loads under MEC 124457, which may impact other project schedules.	3	Active	Scott Guthrie	Greg Mills	11-Apr-16	Monitor	30-Sep-16	2	2	3	6	2	2	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Balance of Plant - 73592																	
14226	73592 - Containment project SID 7010 Procurement Risk for 18" AOVs [No Window Related]	The risk is that late delivery (& subsequent replacement) of the 18" 3-Way AOVs will impact vault atmosphere during refurbishment. For Containment Sope ID 7010, due to DNGS OPEX, the 18" valve originally specified was found unsuitable for this application. A different valve was recommended. The tech. Spec. is being prepared by contractor, review by HSL design and OPG. The procurement of the valve may be delayed due to the availability of the tech spec. Current quoted lead time is approximately 4 months. The work was originally scheduled to start after D1641 (July 2016) Impact: The installation schedule will be determined after the firm delivery date is available.		Active	Scott Guthrie	Gee Sham	06-Apr-16	Mitigate	18-May-16	4	2	4	16	2	2	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
13369	73592 - Vault Work Interferences with JV Work [Window 8]	BoP project work will get delayed due to JV work being on critical path, this will lead to a contractor stand down resulting in additional costs and schedule delays. This will affect the vault work for the containment projects, e.g. Installation of the manifolds, roll-up doors at the airlocks and transfer chamber doors.		Active	Scott Guthrie	Gee Sham	11-Feb-16	Monitor	30-Jun-16	3	1	4	12	3	1	4	12
			There are no Not Started, In Progress Actions associated with the risk.														
	Vendor Material Tracking/Timely Delivery for Execution	The Procurement Tracking Tool (PTT) is now in place however and data populated however a large number of BoP POs have not been issued resulting in a risk that materials will not be available within 90 days prior to the applicable outage window. Weekly tracking of PO issuance and systematic	3	Active	Scott Guthrie	Katie Stewart	16-Dec-15	Mitigate	10-Dec-15	4	3	3	12	3	3	3	9
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

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13653		material delivery risk audits are required to mitigate the overall risk.vendors have demonstrated a number of areas where they are not yet adequately managing procurement and hence the material procurement schedule remains at risk.															
	6548	In Progress	BoP Material Risk Review	BoP staff to complete a systematic review of all materials that do not have a PO issued against them to 1) document they have reviewed all items and establish a baseline tracking file using PTT 2) identify a subset of materials that they believe may be at risk for delivery within the 90 day window 3) Review each material subset generated with Supply Chain to determine extent of risk.	Scott Guthrie		31-May-16	Project Engineer material risk excel files generated. BoP admin assembling all excel files into single binder to facilitate review with Supply Chain. Binder to be ready for Supply Chain review by April 22 and review completed by April 29. Action TCD extended to April 29 as a result. May 2/16 update: Binder with all materials assembled and forwarded to Supply Chain for review May 3/16. Comments/feedback requested from Supply Chain by May 10/16. Action extended to May 17 as a result. May 13/16 Update: Supply Chain feedback delayed to May 16. Meeting to be setup with Fox to review findings week of May 16. Action extended to May 30 as a result.									
13946	73592 - Risk of Modification being required for VVRS driers 18 inch 3-way AOV Replacement Project [Window 009]	The risk is that Engineering's assessment of the AOV replacement NICR will be invalidated by certified vendor information. If this risk is realized, a (minor) modification will need to be done in house.	4	Active	Scott Guthrie	Gee Sham	11-Feb-16	Mitigate	01-Aug-16	2	1	3	6	2	1	3	6
	There are no Not Started, In Progress Actions associated with the risk.																
14004	73592 - Containment project estimate of PMT cost [Window 8]	The risk is that the Containment project will require to pay additional Preventative maintenance costs to cover gaps between IPG work and work during the Refurb outage and removal of the T-Mod within the same scope.  T-Modification removal is in the ES Fox scope of work.	3	Active	Scott Guthrie	Gee Sham	11-Feb-16	Mitigate	30-Sep-16	3	2	1	6	2	1	1	2
	There are no Not Started, In Progress Actions associated with the risk.																
Project: Balance of Plant - 73312																	
13663	The risk is that additional project oversight will be required during execution (all windows)	The risk is that additional project oversight will be required during execution. Should this occur, results could be delays to projects and decreases in efficiency	1	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Jul-16	4	3	4	16	4	3	4	16
	There are no Not Started, In Progress Actions associated with the risk.																
14324	Project 73312: BoP FOAK/FIAW projects - Strategic Risk Assessment/Mitigation Plan Required [all windows]	As a result of the recently completed FOAK risk review for the Alternate Shutdown Cooling Heat Sink projects, a systematic review of all BoP FOAK/FIAW projects and a systematic approach to resolve those issues is required. If a systematic approach is not taken there is a significant risk that opportunities to apply lessons learned effectively & efficiently across various BoP projects will be not be maximized.	3	Active	Scott Guthrie	Kevin Tse	28-Mar-16	Mitigate	12-Aug-16	4	4	3	16	2	3	2	6
	There are no Not Started, In Progress Actions associated with the risk.																
13898	Risk of not having qualified procedure staff in time to complete procedure updates for BOP projects [No Window Related]	Resource availability in the procedure group currently pose as a risk. Qualified procedure staff required to complete procedure updates for BOP projects. The impact is that without the procedures updated and available in Passport, there is a chance that the work will not be accepted resulting in a delay to execution.		Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	31-May-16	3	2	5	15	3	2	5	15
	There are no Not Started, In Progress Actions associated with the risk.																
	ES MSA Vendor Capability/Experience		3	Active	Scott Guthrie	Scott Guthrie	15-Feb-16	Mitigate	26-May-16	3	4	3	12	2	2	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

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13656	as a result, not captured the entirety of costs(all windows)	to ensure gaps are not discovered during field execution (when opportunities to mitigate are more limited). In addition, proactive planning for trades on-boarding, skillset confirmation (VBO lessons learned) and supervisory effectiveness training are required to ensure success in the field. These areas remain a risk until planning is implemented to minimize risk to OPG (FME being an example based on BNGS & Lepreau OPEX with fuel failures post Refurb). Alignment of the various areas between OPG and the Vendor must be resolved before issuance of the Ph 2/3 Execution contracts to minimize any churn after the contracts are issued.															
13668	The risk is that the new drill card process will create delays for the vendor (all windows)	The risk is that the new drill card process will create delays for the vendor. This will represent slow-downs to the project and cost increases	1	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Aug-16	3	2	3	9	3	2	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
13671	The risk is that should onboarding qualifications be required by execution personnel, delays may be observed (all windows)	The risk is that should onboarding qualifications be required by execution personnel, delays may be observed unless an alternate qual method is introduced.	1	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Aug-16	3	2	3	9	3	2	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
14072	73312 - Fire Penetrations Barriers Inspections Inadequate Resources [No Window Related]	The risk is that there are inadequate resources in NR Design & Field Engineering (FE) for the work under IIP-OI-006 and the required work will not be finished on time. The work was significantly increased due to newly realized scope as per NK38-CORR-09701-0554318 (Attached). In addition to the above scope, It was realized by Design that there were many penetrations missed in the first phase of inspections by FE so a new plan was developed to re-inspect the rooms with the help of Design as per NK38-CORR-09701-0574472 (Attached). There is a risk that many new penetrations will be discovered and FE will have to re-inspect all rooms instead of using a sampling criteria as outlined in the attached memo. If FE is required to re-inspect all rooms (even low risk) then this will significantly increase work for FE, Design & Projects and cause further schedule delays. This is a risk because IIP-OI-006 commitment is to be fulfilled by the end of 2016.	4	Active	Scott Guthrie	Amuk Sandhu	05-May-16	Monitor	30-Jun-16	3	1	3	9	2	1	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
	Project 73312: Potential for Additional Project Staff as a result of expanded Vendor	Challenges with EPC vendor capability have resulted in an increased level of project intrusiveness to validate EPC Vendor deliverable quality and confirm they are proactively managing their work. The resultant risk is that additional project staff may be required that exceed ROE FTE levels.	2	Active	Scott Guthrie	Kevin Tse	17-Mar-16	Monitor	15-Sep-16	3	3	3	9	2	2	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

137	[Window 532] 73312 - Fire Barrier Inspections - Sealant Material [No Window	The Risk is that during inspections of fire barrier penetrations, deficiencies will be found by the project causing delay. There is also the possibility that extensive documentation and governance changes will be required. ITP-OT-024	2	Active	Scott Guthrie	Amuk Sandhu	05-May-16	Accept	31-Aug-16	3	1	2	6	3	1	2	6
	There are no Not Started, In Progress Actions associated with the risk.																



55	Related]	The deficiencies mainly relate to the fact that a non-approved fire barrier(sealant) has been used and is not fire rated.																
13853	There is a possibility that we would need to extend the warranty period for materials beyond the 2 year timeline. (All windows)	Event: There is a possibility that we would need to extend the warranty period for materials beyond the 2 year timeline. Cause: The expectation is that material needs to be procured at arrived at site t-6weeks from the execution window. However, there are instances where the execution work occurs later on within the execution window, especially for work currently assigned to segment windows (131, 132, 133) Impact: Warranty may have elapsed prior to installation resulting in additional cost to cover extra warranty requirement		Active	Scott Guthrie	Kevin Tse	16-Apr-16	Monitor	15-Sep-16	3	2	1	6	3	2	1	6	
			There are no Not Started, In Progress Actions associated with the risk.															
13662	the risk is that the vendors will issue change orders for requirements not originally anticipated at the time of contracting (all windows)	Due to changing standards and expectations from OPG functional support, the risk is that the vendors will issue change orders for requirements not originally anticipated at the time of contracting.	1	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Aug-16	2	2	1	4	2	2	1	4	
			There are no Not Started, In Progress Actions associated with the risk.															
13669	The risk is that lack of space in the layed-up unit will result in conflicts in the SATM/laydown area system (all windows)	The risk is that lack of space in the layed-up unit will result in conflicts in the SATM/laydown area system. This could result in delays and overall issues with performing the work.	1	Active	Scott Guthrie	Kevin Tse	08-Apr-16	Monitor	15-Jul-16	2	2	2	4	2	2	2	4	
			There are no Not Started, In Progress Actions associated with the risk.															
13758	[Window 532] 73312 - SG Secondary Containment Structure [Window 532]	The Risk is that upon inspection/assessment of the SG fuel tank secondary containment structures, extensive deficiencies will be found. If this occurs, reconstruction of the containment structure may be required. This would increase project scope and schedule.	2	Active	Scott Guthrie	Amuk Sandhu	05-May-16	Accept	30-Jun-16	1	1	3	3	1	1	3	3	
			There are no Not Started, In Progress Actions associated with the risk.															
Project: Balance of Plant - 73773																		
13637	ASDCH - Final TSSA registration of Stress Analysis will cause rework to design [Window 90]	ASDC TSSA Registration carried through design completion is provisional, as the stress analysis performed made several assumptions to defer incorporation of Level D Waterhammer, LRV Loads, SDC HXs replacement, EHS modification. There is a risk of: 1. rework of the ASDC final stress analysis to include the above as required for the final registration of the modification. This final stress analysis shall include the stress signals of the other modifications (LRV, SDC HXs replacements, EHS, LDWH and NB3200 analysis). Impact is additional cost to design. 2. potential change in pipe schedule to Class 1, additional supports or reconfiguration of supports. Impact is additional cost to design as well as procurement	1	Active	Scott Guthrie	Doina Idita	20-Apr-16	Mitigate	30-Mar-17	4	2	4	16	2	2	3	6	
			There are no Not Started, In Progress Actions associated with the risk.															
13633	ASDCH - Late Materials as a result of late issuance of PO to Manufacturers [Window 130, 124]	There is a risk that due to the late issuance of manufacturing POs and EC revisions, materials will need to be expedited in order to arrive on time for execution. This will require funding above and beyond the estimated cost of materials.	2	Active	Scott Guthrie	Doina Idita	20-Apr-16	Monitor	30-May-16	3	2	4	12	2	2	3	6	
			There are no Not Started, In Progress Actions associated with the risk.															
13944	ASDCH - Lack of equipment vendors' information causing rework [Window 130, 124]	Due to the lack of manufacturers'/vendors' details/information on numerous components/equipment there is a risk of re-work on design EC packages which implies cost increase for their revision.	3	Active	Katie Stewart	Doina Idita	20-Apr-16	Mitigate	30-Jun-16	3	2	4	12	2	2	1	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6606	In Progress	Action ESFOX to issue POs for ASDCH components/equipment to obtain vendor information	Engage installation vendor to issue the POs for the ASDCH components/equipment in the very next futrure (ASAP), get the required vendors'information, and finalize the Design Commissioning Specification, installation and commissioning work plans	Katie Stewart	Doina Idita	10-Jun-16	Date extended to May 20 to account for new Engineering baseline schedule received for Design revisions. Update 05.13.16: 2nd Extension to June 10 required, ES Fox confirmed that all vendor docs required to proceed with design revisions will be submitted by June 10.								
	Potential delay of delivery ASDC pump-motor assembly(mounting hole	There is a risk that the ASDC pump-motor assembly will be delayed due to delays in FAT caused by the need to provide KSB an accurate layout of mounting anchors for the layout of holes in the forged pump casing base plate. Currently there are interferences which prevent a detailed rebar scan of the	4	Active	Katie Stewart	Doina Idita	18-Apr-16	Mitigate	27-May-16	3	2	4	12	2	1	3	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								

14368			6830	In Progress	ASDC project - Civil Design to identify rebar constraints for installation of ceiling anchors	In order to mitigate rebar interference with ASDC pump anchor installation design is requested to evaluate allowable number of rebar that could be cut during anchor installation.	Katie Stewart	Doina Idita	30-May-16	Date extended to May 30, Design is reviewing what is req'd to perform this assessment, an initial assessment will be req'd prior to drilling anchor holes in ceiling. Based on more detailed rebar scans and actual field conditions further assessment will be req'd during the actual field installation of the ceiling anchors.									
13903	Potential Delays of the ASDCH pump-motor assemblies delivery [Window 124]	There is a risk for the small valves (NC1) required for draining/filling of the ASDC pump-motor to be procured late considering the time KSB needs them for the equipment FAT testing) If this risk occurs, then:-ASDCH pump-motor assemblies delivery may be delayed-there is an additional cost associated with this strategy due to ES Fox overhead	4	Active	Katie Stewart	Doina Idita	20-Apr-16	Mitigate	29-Apr-16	3	1	3	9	2	1	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6604	In Progress	Finalize procurement strategy for ASDCH pump-motor assemblies delivery	Response strategy for this risk is to mitigate the impact:1. finalize the design specification for those specific small valves2. engage EPC vendor to investigate market for the available vendors, issue the RFP and award the PO to that vendor who can meet the bid evaluation criteria and the required lead time to avoid the delays in ASDCH pump-motor assemblies delivery	Katie Stewart	Doina Idita	30-May-16	1.Design specification complete and to be accepted by OPG 2.Velan has been engaged in conversations with ES Fox and the PO is imminent Due date extended until confirmation received on delivery date									
14322	ASDC pump-motor site testing [Window 90]	The risk is that the ASDC pump-motor assemblies will fail on site acceptance testing after the factory acceptance testing in Germany. .		Active	Katie Stewart	Doina Idita	21-Apr-16	Mitigate	29-Dec-17	2	2	4	8	1	2	3	3		
			There are no Not Started, In Progress Actions associated with the risk.																
13607	ASDCH - Execution/installation window schedule delays due to work interferenced with JV work [Window 130,124]	The risk is that the Auxiliary Shutdown Cooling project will face schedule delays during the planned work windows due to the interferences with R&FR/JV work. The ASDC project will get delayed due to the JV work being on critical path for a variety of reasons (i.e. 1. removal of the cable trays required for pulling the power supply cables to pump-motors will be performed immediately after installation of the bulkhead, and their re-installation is plan to be done just before the PHT refill or later on, 2. getting access for the ASDC equipment and materials to SDC rooms when R&FR work is at full speed, 3. work interferences in the same area of the vault) which will lead to a contractor stand down resulting in additional cost and schedule delays.	1	Active	Scott Guthrie	Doina Idita	20-Apr-16	Monitor	01-Jul-18	3	1	2	6	3	1	2	6		
			There are no Not Started, In Progress Actions associated with the risk.																
13939	ASDCH - Multilin 239 relay installed on the 600V circuit breaker (supplying the ASDCH pump-motors) to fail the vibration test [Window 124]	There is a risk that the Multilin 239 relay installed on the 600V circuit breaker (supplying the ASDCH pump-motors) will fail the vibration test. This assembly is a "first of a kind" design for DNGS. If the risk occurs, than the associated Electrical design EC's for pump-motor protection shall be changed by placing the Multilin 239 relay in another location.	3	Active	Katie Stewart	Doina Idita	20-Apr-16	Monitor	01-Feb-17	2	1	3	6	1	1	1	1		
			There are no Not Started, In Progress Actions associated with the risk.																
13944	ASDCH Large volume of project documentation (TPARs/OMs/etc) may be required [Window 90]	As the ASDCH modification is complex, a significant number of new and OPG existing documents must be updated/created (there were identified 210 documents). There is a risk of EPC contract cost increase if ES Fox underestimated the number of the OPG procedures/documentation (non-change papers associated with EC project) which must be marked-up/created due to the implementation of the ASDCH modification.	2	Active	Katie Stewart	Doina Idita	19-Apr-16	Mitigate	30-Jun-16	2	1	3	6	2	1	2	4		
			There are no Not Started, In Progress Actions associated with the risk.																
13945	ASDCH Strategic Spare parts not available and would result in modification not accepted at AFS [Not Window related]	The risk is that the ASDC modification will not be accepted by stakeholders at AFS due to an unavailability of strategic spare parts (i.e. spare pump cartridges). These spares were not ordered in time for AFS, due to lack of the funding for operational spares. Refurb capital funding cannot be used for operational spares. Due to the high cost of the strategic spares, a business case must be developed and approved. Please note: 2-5 year inspection spares were purchased for ASDC.	2	Active	Katie Stewart	Doina Idita	20-Apr-16	Mitigate	30-Aug-16	2	2	2	4	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6605	In Progress	Resolution of operational spare parts for ASDCH	Identify a way for funding the modification operational spare parts. DRAS in progress to document that BOP will procure the installation, commissioning and the minor inspection spare parts. NR Engineering intends to initiate BCS and put together a plan for procuring the strategic spare parts when purchasing the ASDC pump-motor assemblies for the other units (U3, 1, and 4)	Katie Stewart	Doina Idita	30-May-16	Action extended to May 30/16 in order to review DRAS and get signatures.									



<b>Project: Balance of Plant - 73308</b>
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ONTARIOPOWER  
GENERATION

Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

13756	[Window 532] Testing of all private fire main control valves	The risk is that during operability testing of the private fire main control valves, significant issues are found with the valves. Should this occur, the impact is that the sample size of valves may be increased, increasing the scope and schedule of the inspection campaign. In addition, there is a risk that current sample size of valves (alternate compliance) may not be accepted by the regulator. If such, sample size may increase, increasing scope/schedule/cost. Also, there is a risk that the testing method to test these valves may require the installation of TMODS, increasing project schedule/cost and scope. In addition, repairs are not estimated as base cost for these inspections. These will be tracked accordingly.	3	Active	Scott Guthrie	Oweis Chohan	01-Dec-15	Monitor	24-Sep-15	3	1	2	6	3	1	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
13852	Additional Funding required if max performance fee ( ) awarded	EVENT: Additional Funding required if max performance fee ( ) awarded. CAUSE: ( ) of project funding is held back as an incentive to perform well. The maximum multiplier is ( ) which totals to a ( ) fee. This means that ( ) of contract is an additional cost to the project. This score is given when Performance indicator criteria are met. IMPACT: Additional cost to the project		Active	Scott Guthrie	Kevin Tse	09-Sep-15	Monitor	31-Jan-16	3	2	1	6	3	2	1	6
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Balance of Plant - 73613																	
13785	Project 73750 - There is a risk that flanges at the LPSW valves are degraded [Window 57]	Event - LPSW flanges found to need refacing or replacement. The current estimate requires flanges to be in good condition for DSR TS0630-6, replacement of LPSW valves. Cause - Corrosion on flange faces. Impact - This would result in delays to LPSW valve replacement. This would impact cost and schedule for both the valve rehab project and the possibly the stopple plug project 73613.	1	Active	Scott Guthrie	M Hodges	14-Dec-15	Accept	27-Jul-16	2	1	3	6	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Balance of Plant - 73618																	
14278	Conventional Electrical (Project # 73618) Contract Award Delays Leading to Material Delay Risk [Window 4, 126, 127]	Risk is that delays in awarding BOP Electrical scope to a Constructor will result in missed material order milestones and therefore material late on site for work. Ongoing delays as a result of constant scope change, discovery items and work protection concerns has resulted in several "restarts" on the process of awarding work. Work has been on the verge of being awarded several times and then cancelled due to discovery of new scope,or some other item of concern to the organization. In the last month discovery of work protection complications has resulted in additional delays to preparation of award package.		Active	Scott Guthrie	Greg Mills	11-Apr-16	Mitigate	18-May-16	3	1	3	9	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Balance of Plant - 73028																	
14308	Refurbishment Maintenance - Milestone OP2170 S2,3,4 PC1 All PC1 Prepared At risk	A review of the work list found the following tasks flagged for permit: Segment 2 : 1625, Segment 3 : 421, Segment 4 : 472 for a total 2518 tasks for permitry. For segment 1, Refurb maintenance did not meet the milestone. There were 698 tasks in segment 1 which resulted in 265 PC1's. Given this ~ 3 to 1 ratio it is predicted maintenance will need to submit ~840 PC1's to meet the milestone.	3	Active	Val Bevacqua	Brad Schofield	12-May-16	Monitor	15-Apr-16	1	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Defuelling -																	
	PHT Pump Breakdown Stops Flow Defueling [Window 12]	EVENT: If one of the PHT pumps were to fail CAUSE: Flow Defueling will be used during the Defueling campaign which requires the continued use of the PHT pumps to circulate coolant IMPACT: The failure of one of the PHT pumps would make Flow Defueling impossible, requiring the use of Dummy Bundle push defueling for the entire reactor greatly extending the schedule and therefore cost of the project.	2	Active	Sorin Marinescu	Antonio Carito	03-May-16	Mitigate	15-Jul-16	4	3	4	16	2	4	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5669	In Progress	Procure enough DFB to entirely push defuel units.	Procure enough DFB to entirely push defuel units. Currently expected to procure enough DFBs to Defuel Unit 2 by September 1 2016.	Sorin Marinescu	Antonio Carito	15-Jul-16								

13872		<p>where the cost of the project.</p> <p>Update May03,2016:=====</p> <p>Original risk &amp; associated mitigation concentrated on a complete loss of ability to flow defuel. Based on recent station events and further evaluation, this update assumes some ability to continue flow defuel if a PHT pump or pump motor is lost. Impact of a single pump failure would result in an impairment to the project's ability to flow defuel per the current strategy.</p> <p>An elevated stator cooling event was recently experienced on U2 PHT Pump Motor 1. Initial evaluation of the impact indicated that 3 pump flow defuelling may be possible, but that the loop with the failed pump would have flows reduced to values below 25.4kg/s which would place those channels into the push defuel w/ dummy bundle regime. The result would be an increase to the push defuel phase of approximately 178 channels to the initial push scope of approximately 124 for a total of ~302 channels requiring push defuelling. This would impact critical path schedule by ~29 days (~15 for defuelling and ~14 for dummy bundle removal activities).</p> <p>An EDM for the pump motor was held on April 15, 2016 resulting in a backflushing strategy being implemented. Additional options examined included pump motor replacement (19-21 days outage time) and alternate cooling via ACUs ducted to the motor cavity.</p> <p>Execution of the backflush resulted in normal temperatures being established successfully. The event however, highlights the project's (and program's) vulnerability to loss of a PHT pump during defuel activities.</p> <p>Given that shut-down flow defuelling activities are known to cause elevated motor temperatures, coupled with the recently highlighted vulnerabilities to the PHT pump motors, efforts should be made to continue pursuing the alternate cooling methods for use during refurbishment defuelling. Strong consideration must be made to implement the alternative cooling strategies for defuelling even though nominal operational temperatures have been restored.</p>																																																																																											
11099	Single Ended Flow Defuelling Not Achievable at Lower Flows in Future Units (perf. impr. opp.) [Window 12]	<p>EVENT: The current limit for single-ended channel defueling is not lowered for future units. Note that this does not affect the U2 base case assumptions and strategy.CAUSE: currently the assumption about flow defueling is that we can successfully flow defuel at lower flows for future units. It is anticipated that flow requirement criteria currently used for single-ended defueling may be reduced, resulting in some schedule improvements for future campaigns. Data and experience gathered during U2 refurbishment is planned to be the basis for determining potential for this opportunity.</p> <p>IMPACT: This would result in the need to perform double-ended flow defueling or the use of Dummy Fuel Bundle push defueling either of which will result in future unit defueling campaigns being of similar duration to U2's.</p>	<table><tr><td>1</td><td>Active</td><td>Sorin Marinescu</td><td>Antonio Carito</td><td>11-Apr-16</td><td>Mitigate</td><td>30-Aug-16</td><td>2</td><td>1</td><td>5</td><td>10</td><td>2</td><td>1</td><td>4</td><td>8</td></tr><tr><td>Action#</td><td>Status</td><td>Action Title</td><td>Action Description</td><td>Owner</td><td>Delegate</td><td>Due Date</td><td colspan="8">Comments</td></tr><tr><td>5580</td><td>In Progress</td><td>Get required approval to lower defuelling criteria from 30 kg/s for 2 bundles to 24.9 kg/s</td><td>Get required approval to lower defuelling criteria from 30 kg/s for 2 bundles to 24.9 kg/s</td><td>Sorin Marinescu</td><td>Antonio Carito</td><td>15-Aug-17</td><td colspan="8"></td></tr><tr><td>5581</td><td>In Progress</td><td>Procure sufficient inventory of Dummy Fuel Bundles</td><td>Procure sufficient inventory of Dummy Fuel Bundles to facilitate push defuelling alternative for future Units (post Unit 2)</td><td>Sorin Marinescu</td><td>Antonio Carito</td><td>15-Dec-17</td><td colspan="8"></td></tr><tr><td>5582</td><td>In Progress</td><td>Create Unit 2 Monitoring and Performance Plan</td><td>Create Unit 2 Monitoring and Performance plan for execution during Unit 2 and implement OPEX on successive units to improve defuel duration target of 113 days. T.Carito, 30AUG2016</td><td>Sorin Marinescu</td><td>Antonio Carito</td><td>30-Aug-16</td><td colspan="8"></td></tr><tr><td colspan="15"></td></tr></table>	1	Active	Sorin Marinescu	Antonio Carito	11-Apr-16	Mitigate	30-Aug-16	2	1	5	10	2	1	4	8	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								5580	In Progress	Get required approval to lower defuelling criteria from 30 kg/s for 2 bundles to 24.9 kg/s	Get required approval to lower defuelling criteria from 30 kg/s for 2 bundles to 24.9 kg/s	Sorin Marinescu	Antonio Carito	15-Aug-17									5581	In Progress	Procure sufficient inventory of Dummy Fuel Bundles	Procure sufficient inventory of Dummy Fuel Bundles to facilitate push defuelling alternative for future Units (post Unit 2)	Sorin Marinescu	Antonio Carito	15-Dec-17									5582	In Progress	Create Unit 2 Monitoring and Performance Plan	Create Unit 2 Monitoring and Performance plan for execution during Unit 2 and implement OPEX on successive units to improve defuel duration target of 113 days. T.Carito, 30AUG2016	Sorin Marinescu	Antonio Carito	30-Aug-16																							
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11678	FH Operator Staffing For Defuel [Window 12]	<p>EVENT: Defueling campaign begins and station does not have the staff to both maintain running reactors and support Defueling activities</p> <p>CAUSE: The Defueling campaign will require station Fuel Handling staff to ensure successful completion of all work.</p> <p>IMPACT: Unit derating and impact to schedule and therefore cost of Defueling campaign due to the need to ration staff time between the station work and refurb activities</p>	<table><tr><td>2</td><td>Active</td><td>Sorin Marinescu</td><td>Antonio Carito</td><td>11-Apr-16</td><td>Monitor</td><td>03-Jan-22</td><td>3</td><td>1</td><td>3</td><td>9</td><td>1</td><td>1</td><td>3</td><td>3</td></tr><tr><td>Action#</td><td>Status</td><td>Action Title</td><td>Action Description</td><td>Owner</td><td>Delegate</td><td>Due Date</td><td colspan="8">Comments</td></tr><tr><td>5579</td><td>In Progress</td><td>Review Staffing Levels on a Quarterly Basis</td><td>Closely monitor staffing level by integrating with station to ensure necessary staff is hired and trained for U2 Refurbishment. As well as review staffing level on a quarterly basis for each unit going forward through the entirety of Refurbishment (per AR (2816024803), S.Sinnathamby, 01JAN2022</td><td>Sorin Marinescu</td><td>Antonio Carito</td><td>03-Jan-22</td><td colspan="8"></td></tr><tr><td colspan="15"></td></tr></table>	2	Active	Sorin Marinescu	Antonio Carito	11-Apr-16	Monitor	03-Jan-22	3	1	3	9	1	1	3	3	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								5579	In Progress	Review Staffing Levels on a Quarterly Basis	Closely monitor staffing level by integrating with station to ensure necessary staff is hired and trained for U2 Refurbishment. As well as review staffing level on a quarterly basis for each unit going forward through the entirety of Refurbishment (per AR (2816024803), S.Sinnathamby, 01JAN2022	Sorin Marinescu	Antonio Carito	03-Jan-22																																																					
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13395	Discovery scope for New Inverter Software [Window 12]	<p>EVENT: Once the new Inverter's are installed previously unknown scope relating the updates of Fuel Handling software are discovered that are necessary to incorporate the new inverters.</p> <p>CAUSE: The effects on the station software of the new inverter installation cannot be completely predicted or tested.</p> <p>IMPACT: The cost of the project would be impacted as the initial estimate was incorrect in light of the discovery scope</p>	<table><tr><td>3</td><td>Active</td><td>Sorin Marinescu</td><td>Antonio Carito</td><td>11-Apr-16</td><td>Mitigate</td><td>07-Sep-16</td><td>4</td><td>2</td><td>2</td><td>8</td><td>2</td><td>1</td><td>1</td><td>2</td></tr><tr><td>Action#</td><td>Status</td><td>Action Title</td><td>Action Description</td><td>Owner</td><td>Delegate</td><td>Due Date</td><td colspan="8">Comments</td></tr><tr><td>6345</td><td>Not Started</td><td>Revisit Software Installation Strategy for Unit 3,1,4</td><td>U2 Defuelling will use old inverters to limit the need for additional software updates, but the strategy will need revisiting following U2 installation as the other units will require encoder modifications. These new encoders may require additional software updates that have not been foreseen.</td><td>Sorin Marinescu</td><td>Antonio Carito</td><td>15-Dec-16</td><td colspan="8">Action cannot begin until U2 Installation occurs.</td></tr></table>	3	Active	Sorin Marinescu	Antonio Carito	11-Apr-16	Mitigate	07-Sep-16	4	2	2	8	2	1	1	2	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								6345	Not Started	Revisit Software Installation Strategy for Unit 3,1,4	U2 Defuelling will use old inverters to limit the need for additional software updates, but the strategy will need revisiting following U2 installation as the other units will require encoder modifications. These new encoders may require additional software updates that have not been foreseen.	Sorin Marinescu	Antonio Carito	15-Dec-16	Action cannot begin until U2 Installation occurs.																																																				
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Run by:

13909	Pipe Relocation in U4 RAB May Not Be Completed Before Next Flask Shipment	the 2018 flask shipment. Cause: Discovery issues and delays in design, procurement, fabrication, and installation. Impact: Station operation may be impacted if the flask transfer cannot be completed. The new piping that connects the new boilers to the existing steam distribution header in the powerhouse, which passes through the Unit 4 Reactor Auxiliary Bay (RAB), is located too low and will interfere with the loading of the spent resin flask transportation package. This new section of pipe will need to be relocated before the next flask transfer scheduled for early 2018, per e-mail from Operations.	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6461	In Progress	AHS Project 16-34000: Establish a Schedule with Adequate Margin for U4 RAB Line Reroute	Work with the Contractor to establish a schedule to complete the installation prior to the next flask shipment with adequate margin.	Mike Nairne	Raaj Kovinthan	30-Jun-16	OPG PO issued. Contractor is working to establish a design contract.									
14281	34000 - AHSF - Additional Security Camera Not Installed by AFS	Event: Additional security camera not installed by AFS. Cause: Technical/discovery issues. Impact: Delay to AFS.  During initial review it was discussed that without the bridge in place we could only make a estimated guess on camera coverage which was assessed at the time. As we move forward with placing the fence into service and doing commissioning we were required to complete a LUX level in the area of the bridge and a new camera assessment using the CNSC approved assessment tool. During the tests it was determined that the LUX levels at the ground are below required LUX level of 5 and that the assessment tool could not be made out from the cameras in some areas due to the pipes. Based on this information we have advised the need for additional lighting and camera assessment in the area to meet the CNSC requirements.	3	Active	Mike Nairne	Raaj Kovinthan	25-Apr-16	Transfer	31-May-16	2	1	5	10	1	1	5	5		
			There are no Not Started, In Progress Actions associated with the risk.																
12161	34000 - CBH Demo - Discovery Work	Event: The old Construction Boiler House (CBH) will be demolished after the new AHS Facility is placed into service. There is risk of discovering work that is not captured in the scope of the demolition contract. Cause: The scope of demolition work was not completely defined. Impact: Increase in the EPC contract cost.	2	Active	Mike Nairne	Raaj Kovinthan	25-Apr-16	Mitigate	05-Jan-16	1	1	4	4	1	1	4	4		
			There are no Not Started, In Progress Actions associated with the risk.																
12997	34000 - AHSF - Operating Manuals Are Not Ready by AFS	Event: There is a risk that Operating Manuals (OM) are not ready by AFS. Cause: The size and content of the new Boilerhouse Manual is significant. The work on the OMs was starte too late, and cannot be complete within the available time. The Operations Procedures group cannot support this project due to competing priorities. Impact: The Station will not accept the modification, and the AFS will be delayed.	3	Active	Mike Nairne	Raaj Kovinthan	25-Apr-16	Mitigate	30-Jun-15	1	1	4	4	1	1	4	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6155	In Progress	34000 - AHSF - O&M Procedure resource availability	Review the progress of the Operations Procedures group on a weekly basis.	Raaj Kovinthan		03-May-16	5 of 10 OMs complete and ready to issue. On track to complete OMs by AFS.									
14148	34000 - AHSF - Valve Packing Data Sheets Not Completed for AFS	Event: There is a risk that the Valve Packing database update will be not be completed prior to AFS. Cause: The effort/time required to complete the VPDS is greater than the available resources/schedule. Discovery issues delay the field work. Impact: The AFS may be delayed or the VPDS may be carried as an open item post-AFS. Cost may be greater than the available budget. Valve packing database update was not completed during installation.	4	Active	Mike Nairne	Raaj Kovinthan	20-Apr-16	Mitigate	22-Apr-16	1	1	4	4	1	1	4	4		
			There are no Not Started, In Progress Actions associated with the risk.																
14259	34000 - AHSF - CATIDs Not Set to Ready by AFS	Event: The CATIDs are not set to READY status by AFS. Cause: The Contractor does not have complete purchase documents to complete the CATID packages. The time required to obtain or disposition missing documentation is greater than the time available. The time remaining is not adequate to complete the preparation, review and acceptance of the CATID documentation packages (i.e. late start). Impact: The AFS is delayed or the CATIDs are carried as an open item post-AFS. There are 464 material Catalogue Identifications (CATID) that need to be set to "READY" status prior to AFS.	4	Active	Mike Nairne	Raaj Kovinthan	20-Apr-16	Mitigate	31-May-16	1	1	4	4	1	1	4	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6458	In Progress	AHS Project 16-34000: Expedite the Submission and Acceptance of CATID Purchase Docs	Ensure that the submission, review and acceptance of CATID purchase documements (HDOC) is completed and all CATID are set to "READY" status prior to AFS. Escalate if the process is behind schedule.	Mike Nairne	Raaj Kovinthan	29-Apr-16	The submission/acceptance process is being reviewed and on a weekly basis. Total: 464 Submitted: 348 Accepted: 100									
13287	34000 - AHSF - Vendors Fixed Price Cost to Complete Potentially Under Estimated	Event: There is a risk that the cost to complete the project may greater than the available budget. Cause: The Contractor fixed price proposal provided February 26, 2016 has underestimated the remaining work. There are significant discovery issues. Impact: The project may be forced to stop work until additional funding is obtained. Relocation of the steam line in the U4 Reactor Auxiliary Bay may be delayed.	1	Active	Mike Nairne	Raaj Kovinthan	25-Apr-16	Monitor	30-Nov-17	1	1	1	1	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6156	In Progress	34000 - Monitor Vendors Fixed Price Cost to Complete	Monitor the vendor's activities/costs and potential for vendor claims. Escalate issues and concerns immediately.	Mike Nairne	Raaj Kovinthan	30-Nov-17	The fixed price agreement has been singed by the Contractor and OPG. Fixed price PO as been issued by OPG and									
Project: DNGS Projects - 31306																			
	31306 - There is a risk the PARs do not meet the performance expectations. The pilot project is being	There is a risk if PARs do not meet the performance expectations. The pilot project is being		Active	Brian Graham	Marc Clemente	29-Apr-16	Accept	29-Apr-16	1	1	5	5	1	4	5	5		



12576	PAKS do not meet performance expectation during testing at AECL the project could be extended to accomodate additional testing	performed in parallel with full installation and the PAKS technology has not yet been tested at Darlington. PARs may not meet performance requirements. The last set of PARs plates from the pilot project have been sent to AECL and are being tested. The final AFS for this project is pending acceptable testing results.																	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			4501	In Progress	31306 - Complete Testing of U3 Vault PAR plates	All PARs are installed this risk will be closed after completion of confirmatory testing at AECL. There is a risk that the performance of the plates do not meet the expected requirements.	Marc Clemente		30-Jun-16	Last of the initial pilot program for PARs Plates will be removed in the fall 2015 during D1531. This action will be complete once AECL performs testing and NSATD group accepts the results. Plates have been removed AECL testing to be completed in 2016									
Project: DNGS Projects - 31412																			
12592	UPS replacement cost may be increased	Event:  First time replacing Class II Power UPS equipment may result in schedule delays and increase cost to plan the work properly Legacy design deficiencies may be discovered as a result of detailed design and class II power load review material cost may be higher due to change in exchange rate OPG oversight cost may be higher than estimated Cause: · Design is in progress. Impact: · Project cost will be increased		Active	Ricardo Fiorini	Shailesh Shah	28-Apr-16	Accept	15-Dec-17	4	2	4	16	3	1	3	9		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			4342	In Progress	31412	Stakeholder involvement in the planning phase when writing the work plans and scheduling the work. field walkdowns will minimize discoveries.	Shailesh Shah		15-Dec-17	.DLC UPS first installation is in progress and scheduled to complete 31Mar2016. Inside station first installatin is scheduled to start from D1641. All lessons learned will be incorporated in future installations.									
12583	Factory Acceptance Testing may impact Project schedule	Event: Technical issues may be discovered during the Factory Acceptance Testing (FAT). Cause: · New technology equipment · First time testing. Impact: Project schedule will require extension or realignment.		Active	Ricardo Fiorini	Shailesh Shah	28-Apr-16	Mitigate	30-Jun-16	5	2	3	15	1	1	1	1		
			There are no Not Started, In Progress Actions associated with the risk.																
12584	Legacy Design Issues	Event: Legacy design issues may be discovered during Detailed Design. Cause: Configuration management issue. Impact: Project schedule will be delayed and budget will be increased..		Active	Ricardo Fiorini	Shailesh Shah	28-Apr-16	Accept	31-Aug-16	3	2	5	15	1	2	3	3		
			There are no Not Started, In Progress Actions associated with the risk.																
14330	D1641 execution schedule has no float	Event: Technical issues may be discovered during D1641 execution Cause: · Lessons learned from DLC UPS Installation · First time installation inside unit Impact: Project schedule will require extension or realignment or may require outage window extension		Active	Ricardo Fiorini	Shailesh Shah	28-Apr-16	Monitor	13-May-16	3	3	4	12	2	2	3	6		
			There are no Not Started, In Progress Actions associated with the risk.																
12588	Project may require acceleration	Event: · Project may require acceleration. Cause: · Current UPS equipment may fail. Impact: · Project schedule will require realignment.		Active	Ricardo Fiorini	Shailesh Shah	28-Apr-16	Accept	15-Dec-17	2	2	5	10	2	1	3	6		
			There are no Not Started, In Progress Actions associated with the risk.																

12591	Class II Power Load Review	Event: · Operation to complete a detailed load review of class II power system. Cause: · Currently operation cannot complete load reviews due to other station priorities. Impact: · Project schedule will be delayed																
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4341	In Progress	31412	Secure resources from Operations to complete the Class II Power load review.	Shailesh Shah		06-Jan-17	Any TMOD requirement due to load review will be addressed by design.								
13692	Schedule maybe delayed to support UPS replacement	Event:  Refurb electrical odd and even bus outage schedule will not be provided in first year of each unit outage Planned outage starting 2017 will not be in spring as assumed Cause: Currently Work Control cannot confirm windows. Impact: Project schedule will be delayed.	1	Active	Ricardo Fiorini	Shailesh Shah	28-Apr-16	Monitor	15-Dec-16	3	3	3	9	2	3	4	8	
			There are no Not Started, In Progress Actions associated with the risk.															
Project: DNGS Projects - 31426																		
12606	Deferment in PTF timeline to support Execution - 31426	Changes to execution PTF timeline and for future release per Darlington Refurbishment or Fuel Handling Operation/Maintenance requirements. Opdata revision delay due to De-fuel Program impacting PTF execution timeline.	3	Active	Rajbir Singh		12-May-16	Mitigate	11-Nov-16	5	2	5	25	3	2	3	9	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4444	In Progress	31426	Maintain upfront review and coordination with Refurbishment organization and FH Technical Dept. to incorporate changes in schedule. Initiate early dialogue with SWCs and line management to determine installation windows.	Kevin Cheong		30-Sep-14	0								
12617	Lack of dedicated OPS & MTCE support for Installation planning - 31426	Obtain dedicated Ops & Mtce resource to support installation planning. Currently lacking staff to support. This may impact the installation schedule.	3	Active	Rajbir Singh		12-May-16	Mitigate	29-Jul-16	4	1	4	16	3	1	3	9	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4456	In Progress	31426	Escalated to FH management.	Kevin Cheong		30-Jul-14	0								
Project: DNGS Projects - 31432																		
12626	16-31432 - Configuration Issues	Late identification of configuration management issues or legacy issues with design documentation.	3	Active	Francis Davis	James Mcmillan	21-Apr-16	Mitigate	22-Dec-16	4	1	5	20	2	1	3	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4522	Not Started	Walkdowns	Complete walkdowns early in detailed design phase with the purpose of verifying field conditions to identify potential configuration issues.	Francis Davis	James Mcmillan	31-Jul-15									
			4524	Not Started	Project 31432 ITF	During detailed design ensure configuration issues are documented in ITF with actions assigned to correct the issue.	Francis Davis	James Mcmillan	30-Sep-15									
12632	16-31432 - Long Lead Material	Risk that long lead material will not be delivered on time to meet the installation schedule.	4	Active	Francis Davis	James Mcmillan	21-Apr-16	Avoid	28-Sep-16	3	3	5	15	3	2	3	9	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4511	In Progress	Project 31432 Equipment Vendor	Engage equipment vendor early on to allow them to prioritize their orders.	Francis Davis	James Mcmillan	30-Jun-16	Bids have been received from Canberra and BOT Engineering.								
			4533	In Progress	Project 31432 Lead Time and Schedule	Confirm lead time and schedule during the bid evaluations. Ensure these line up with the SOI.	Francis Davis	James Mcmillan	30-Jun-16	No longer EPC contract strategy.								
	16-31432 - Estimate Quality	Risk that cost exceeds project estimate. BCS was developed without a proposal from vendor.	3	Active	Francis Davis	James Mcmillan	21-Apr-16	Mitigate	29-Dec-16	3	4	1	12	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								

12623			4518	In Progress	Project 31432 Contingency	Contingency has been added to the project budget. No longer EPC. Need to re-evaluate at design completion stage.	Francis Davis	James Mcmillan	01-Aug-16	
Project: DNGS Projects - 31506										
12646	No OPEX available for New Boiler Blowdown Design performance.This may result in subsequent additional inspection and system design changes	Although the design features used in the modified Boiler Blow-off system (single pipe design with flow restriction at pipe exit) are standard but there is no OPEX of Boiler Blow-off System performance with flow restriction. The Boiler Blow-off systems at Pickering and Bruce do not use flow restriction and also have more than one pipe at the exit of the Blow-off system. Additional inspections costs will be expensed after the first installation to gather OPEX and if potential issues are identified design updates for other units may be required. Potential changes to the first unit design & need for removal/re-installation.		Active	Ricardo Fiorini	Ashish Deb	27-Apr-16	Mitigate	31-Aug-16	341122112
There are no Not Started, In Progress Actions associated with the risk.										
12641	Discovery Work during Outage can potentially result in system design chnages and can result in Outage delay	There is a risk that the as found conditions in the Boiler Blowdown Duct Chimney are not as per the design documents and modification design cannot be installed as planned. Design changes to approved design may be needed. In addition to the design changes the work may not be completed within the allocated outage window, hence delaying the outage completion.		Active	Ricardo Fiorini	Ashish Deb	02-May-16	Mitigate	30-Jun-16	41282112
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments
			4259	In Progress	Flexibility in design to cater for unknown field conditions	Vendor to have flexibility in design to cater for as found field conditions (like re-bars interference with the anchors), adjustment of pipe support frame.	Ricardo Fiorini	Umar Rizwan	31-Dec-15	The current approved design has provides a 100 mm X 100 mm area for locating the anchor. There is still a risk of hitting a re-bar as scanning under water is not possible. This risk will be accepted and addressed during installation.
			4260	In Progress	Contingency support design to be available to address unknown field conditions	Vendor to have contingency support designs available that can be installed if original design cannot be implemented.	Ricardo Fiorini	Umar Rizwan	31-Dec-15	The current design does not include any contingency support configurations. A mock-up test is planned to test the anchor installation prior to the Outage. Any design changes to the current support design will need to be carried out under the FIC process.
			4261	In Progress	Need for additional piping inspection to confirm field conditions	Video inspection already completed for pipe support inspections to be reviewed to identify any anomalies. If required, additional inspections can be planned prior to implementation of the modifications. Inspections were completed during VBO-2015. The results of inspections need to be reviewed.	Ricardo Fiorini		31-Dec-15	Video inspections have been completed in Units 2 & 3. Inspections may need to be carried out in the remaining units. As part of the VBO work, refurbishment organization conducted inspections of all the Boiler Blowdown Shafts/Chimneys. The inspection videos will be reviewed to identify any installation issues. Based on the review of these videos a decision will be made regarding completing inspections in Unit 4 and 1.
12643	Vibration Limit exceeded	Prior to the final AFS of the modification, it is planned to carry-out vibration testing of the modified piping to ensure acceptance criteria for vibration limits outlined in the Modification Design Requirements (NK38-MDR-36410-10003, Section 2.3.2) is met. There is a risk that the system vibrations are not within the acceptance limit.		Active	Ricardo Fiorini	Ashish Deb	27-Apr-16	Mitigate	30-Apr-15	31262112
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments
			4266	In Progress	Design/Installation of Contingency Support(s) required to address High Vibrations during system commissioning	The system design changes will be analyzed to ensure requirements of the MDR are met by the revised system configuration. If during testing system vibrations are found outside of specified acceptance criteria, then additional contingency support(s) could be installed to address the issue.	Ricardo Fiorini		31-Dec-15	The risk of finding issues with vibration results is low based on discussion with the Design Agency (RCMT/AMEC-NSS) and OPG vibration group. The velocity measurements will be taken during commissioning and in case issues are found then detailed vibration data will be analyzed and a path forward will be defined. Additional material for a single support is being ordered to ensure material is available if additional support is required to address the vibration issue.





Risk Report by Project with Associated Actions

12642	Diving work in BBD Chimney is considered "High Safety Risk" activity and has a potential of injury and can delay the work completion	Underwater work is considered high risk activity (potential of delay to installation work as minimum and potential of fatality as worst case) as diving work has not been attempted in the Boiler Blowdown Duct Chimney before. The flow conditions in the BBD chimney are not fully known.		Active	Ricardo Fiorini	Ashish Deb	02-May-16	Mitigate	30-Jun-16	3	1	1	3	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4265	In Progress	Prepare rescue plan to deal with accident scenario during diving work	Vendor to prepare a rescue plan to deal with any accident scenarios during performance of diving work.	Ricardo Fiorini	Umar Rizwan	29-Jan-16	A rescue plan will be provided prior to the start of the D1641 Outage.							
12645	Potentially degraded Concrete Condition in the BBD Chimney/Enclosure can impact anchor performance	A risk has been identified that the blow-off duct/shaft concrete may have been degraded by the periodic operation of Units 1, 3, & 4 at elevated temperatures following interim repairs/modifications to the blow-off lines, which resulted in termination underwater (95 m & 98 m elevations) within the vertical section of the ducts. The degraded concrete surface may impact anchor performance.		Active	Ricardo Fiorini		27-Apr-16	Mitigate	31-Mar-15	3	1	1	3	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4268	In Progress	Anchor design to cater for degraded BBD Chimney Concrete Condition	Vendor to take into account any concrete surface degradation in the design of anchors such that they penetrate deep within concrete.	Ricardo Fiorini		31-Dec-15	Design/Anchor selection accounts for concrete surface degradation. Project team to review results of video inspections of the Boiler							
Project: DNGS Projects - 31508																	
13862	31508 - Delay - NV537 Installation	The installation of the NV537 modification is at risk of delay. The delay is due to a pre-existing condition where the station OM has been claiming the valve as part of containment boundary during dousing water fill operation. In the absence of resolution to the CB issue, it has not been possible to process a revision to the OM, which would require a similar containment boundary be defined. EC was approved with the condition that pre-existing station condition regarding use of V542 and NV537 as a temporary containment boundary during dousing storage tank fills was resolved.This line and associated valves are not of the required class for designation as a CB, and a plan to request an exemption for this case has been unsuccessful. This action generated out of this issue ( AR 28172655-01 ) has not been resolved and next anticipated step is a CNSC submission by Plant Design on Jan 29, 2016. There is also a related risk that the results could result in rework, contributing to delay.	2	Active	Brian Graham	Dale Schnedler	26-Apr-16	Monitor	30-Apr-16	5	1	5	25	5	1	5	25
			There are no Not Started, In Progress Actions associated with the risk.														
14172	31508 - BDBE Procedure updates (EMeG's) Delay/Rework	Uvailability of adequate resources with correct skill sets for preparing/updating the Emergency Mitigating Response Guide procedures may cause delays and rework, impacting the fainal AFS and turnover for Fukushima modifications.	3	Active	Brian Graham		26-Apr-16	Monitor	31-Jan-17	3	1	5	15	3	1	5	15
			There are no Not Started, In Progress Actions associated with the risk.														
12649	31508 - Fukushima Phase I There is a risk of scope growth impacting cost and schedule of the project.	Project may experience significant cost and schedule impacts due to scope definition:  Initial scope for this project consists of numerous modifications initially provided as solutions in a "Fast track" context, rather than problems. Program is composed of numerous small modification, integration issues with the overall respose drive changes. Many aspects of BDBE response are new, outside normal practices or require "extent of response" decisions. Frequent scope change and clarification continues to occur in the design phase, contributing to cost and schedule delays. This project is part of a larger,evolving program for BDBE and SAM, making it more difficult to control scope at the individual project level. Alignment with PNGS ( for compatibility of equipment and consistency) often results in delay and sometimes scope as there are significant difference between the stations. The BDBE project structure is unique in having a support organisation outside of projects which has retained a significant role in ongoing scope definition. This is an ongoing risk.	2	Active	Brian Graham	Dale Schnedler	26-Apr-16	Accept	31-Dec-17	2	2	5	10	1	2	5	5
			There are no Not Started, In Progress Actions associated with the risk.														
12648	31508 - Fukushima Phase I There is a risk of cost growth due to currency fluctuation.	Depreciation of the Canadian dollar relative to the US dollar could impact ability to complete project within release or available business plan funds resulting delay and possibly rework.	3	Active	Brian Graham	Dale Schnedler	26-Apr-16	Monitor	31-Dec-16	2	1	1	2	2	1	1	2
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 31514																	
12661	Lack of project and design staff	There is limited knowledge of reactor physics theory in projects and design.		Active	Ricardo Fiorini	Amanda Krishnakumar	25-Apr-16	Mitigate	31-Aug-16	5	2	5	25	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
	Sample tap off and return points	Existing sample tap off and return points for the GFP Monitoring system may not be sufficient to produce flow through the new delay sample tubing.		Active	Ricardo Fiorini	Amanda Krishnakumar	25-Apr-16	Mitigate	29-Jul-16	3	4	5	15	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

<a href="#">12663</a>			<a href="#">4506</a>	In Progress	Perform Engineering Calculations	Engineering calculations will be performed in order to determine whether or not the existing sample tap off and return points are sufficient to produce flow through the new delay tubing. Delay Coil design will be optimized as much as possible to ensure minimum flow is obtained.	Ricardo Fiorini		24-May-16	Preliminary Calculations are completed. Final approved calculations will be performed following completion of design by CCI (Coil Supplier), and will be valid for all four units.								
<a href="#">12666</a>	GFP - Antimony	The sample delay may not reduce the amount of Antimony plating on the inside of the sample holders.		Active	Ricardo Fiorini	Amanda Krishnakumar	25-Apr-16	Mitigate	29-Jul-16	3	3	5	15	2	1	1	2	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">4507</a>	In Progress	Obtain Antimony Plating OPEX	Engage subject matter experts and continue to validate technical assumptions related to Antimony plating inside the sample holders. Review OPEX from COG and other CANDU stations.	Ricardo Fiorini		31-Dec-15	Have obtained reponse to COG OPEX inquiry from a couple Nuclear Stations to date.								
<a href="#">12664</a>	Project schedule change	The project schedule will change if the sample tap off and return points need to be modified.		Active	Ricardo Fiorini	Amanda Krishnakumar	25-Apr-16	Accept	31-Mar-17	2	4	5	10	2	2	2	4	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">13804</a>	GFP & PHT Long Lead Material	Vendor has identified Lead times for material for GFP and PHT modifications that are longer than planned for in the vendor project schedule. If lead times are extensive, the installation and AFS dates may be delayed.		Active	Ricardo Fiorini	Amanda Krishnakumar	25-Apr-16	Mitigate	29-Aug-16	3	3	3	9	2	2	2	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">5692</a>	In Progress	16-31514 - EPC Vendor to pursue reduced lead times from equipment suppliers	ES Fox is working with Swagelok to reduce the lead time for the needle valves and the ball valves for the PHT modifications.	James Philipps		31-Dec-15									
<a href="#">14328</a>	16-31514: Effects of additional shielding required for GFP Sample Delay Coil	Due to the increased amount of shielding required for the GFP Sample Delay Coil to ensure 2.5 MREM working limit in room R-253, the design has to include a structural package, with calculations, to ensure safety. This will affect cost for design, as well as extra material and labour, as this was not anticipated and was specifically noted in the assumptions of the Purchase Order with ESFox to be a PCA during detailed design.		Active	Ricardo Fiorini	Amanda Krishnakumar	25-Apr-16	Mitigate	28-Apr-17	3	1	3	9	2	1	2	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6678</a>	In Progress	Complete and Thorough Design Review	To ensure a smooth installation process, a complete and thorough design review is required with appropriate stakeholders to avoid complications in the field during execution phase.	Amanda Krishnakumar		29-Jul-16									
Project: DNGS Projects - 31520																		
<a href="#">14326</a>	16-31520: Lack of Station Resources for Rest of Installation of Obsolete Chemical Analyzers	Control Maintenance (CCMD) and Chemistry Lab (THM) are the two main station resource groups that are required for installation of the remaining analyzers. CCMD in particular is low on resources and THM does not have as many qualified people for calibrating the analyzers. This can impact schedule if there aren't resources available when required for work.		Active	Ricardo Fiorini	Amanda Krishnakumar	27-Apr-16	Mitigate	29-Dec-17	4	2	4	16	3	2	3	9	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6688</a>	In Progress	Lessons Learned from First Installation	Lessons learned from station and vendor on first installation of Sodium Analyzer in Water Treatment Plant, AT35, to improve future installations.	Ricardo Fiorini	Amanda Krishnakumar	08-Apr-16									
			<a href="#">6689</a>	In Progress	Work with FLMs to get their support	After the first installation, a meeting needs to be set up with the FLMs of the station crews required for this project to get their support.	Ricardo Fiorini	Amanda Krishnakumar	29-Apr-16									
			<a href="#">6936</a>	In Progress	Work with Work Control to get analyzer work scheduled.	Work with Work Control to schedule remaining work for analyzers when CCMD is available.	Ricardo Fiorini	Amanda Krishnakumar	30-Jun-16									
<a href="#">1</a>	Outage Conflicts	If the installation/commissioning work is delayed and drags into scheduled unit outage timelines, the likelihood is that OPG will not be able to move forward from the end of this project.		Active	Ricardo Fiorini	Amanda Krishnakumar	25-Apr-16	Mitigate	03-Jun-17	2	2	2	4	2	2	1	4	

12681		then the risk is that OPG resources will not be available to perform the work for this project.	There are no Not Started, In Progress Actions associated with the risk.														
12682	Material Cost	Potential that material cost will not be the same as was anticipated.		Active	Ricardo Fiorini	Amanda Krishnakumar	25-Apr-16	Transfer	30-Nov-17	2	1	2	4	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
12689	Schedule Insufficient	Potential that the schedule is not sufficient enough to complete the stages of this project phase. This is also tied to risk 14326.		Active	Ricardo Fiorini	Amanda Krishnakumar	25-Apr-16	Mitigate	15-Jul-16	1	1	3	3	1	1	3	3
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 31526																	
12707	Lack of coordination with refurbishment organization during Installation Planning may result in refurbishment process non-compliance	Projects and Refurb to coordinate installation planning during Refurbishment to ensure Project Success		Active	Ricardo Fiorini		27-Apr-16	Mitigate	30-Mar-15	3	3	3	9	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6146	In Progress	Prepare Schedule meeting DNRU2 requirements to ensure Project Success	To meet the expectations of the Unit 2 refurbishment organization and to ensure work is planned and coordinated with the Projects & Refurbishment organization the P6 schedule of the project will be updated for Unit 2.	Umar Rizwan		15-Jan-16	Recovery plan delivered to refurb prep team. currently on track meeting milestones.							
Project: DNGS Projects - 31532																	
13867	Project 16-31532: Reduced ACU Performance Due to Blocked Water Flow to ACUs	The water feeding into the ACUs is lake water. There is a risk of a reduced ACU performance following installation due to the water flow to the ACUs being significantly reduced by a build up of deposits within the feedwater piping, resulting in insufficient cooling to the supported areas.	1	Active	Brian Graham	Matthew Tannous	29-Apr-16	Monitor	15-Sep-16	3	5	3	15	1	5	3	5
			There are no Not Started, In Progress Actions associated with the risk.														
13914	Project 16-31532: Increase in Cost of Replacement ACUs when Solicitating ACU Vendors	There is a risk that the cost of the replacement ACUs will be significantly higher than what was initially budgetted when developing the currently approved BCS, due to the estimate being prepared based on technical specifications which were not available when obtaining the initial estimate.	4	Active	Brian Graham	Matthew Tannous	29-Apr-16	Monitor	30-Nov-15	5	2	3	15	3	2	1	6
			There are no Not Started, In Progress Actions associated with the risk.														
12710	Project 16-31532: Delay of Flowrate Measurements for the Unit 2 Online ACUs to Support Detailed Design	The Unit 2 Technical Specifications have been prepared and approved ahead of completing the Flow Rate measurements. There is a risk that the project will encounter a delay to the schedule and increased costs to revise the Technical Specification and purchase the correct replacement ACU equipment for any affected ACUs, If the results of the flow rate measurements for the ACUs are significantly different than what is specified in the Technical Specification.	4	Active	Brian Graham	Matthew Tannous	29-Apr-16	Monitor	31-Jul-15	2	2	3	6	2	2	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 31535																	
12717	WTP - Geotechnical results on Foundations	Poor geotechnical parameters (or contaminated soil) could increase the cost and schedule of installing a new WTP. OPEX exists of poor conditions requiring caissons. Poor geotechnical conditions coul impact cost/schedule.		Active	John Ieraci		28-Apr-16	Mitigate	07-Aug-15	5	3	5	25	2	3	5	10
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4486	In Progress	Geotechnical Investigation	Perform the geotechnical investigation as early as possible so that any adverse consequences of poor geotechnical conditions can be accommodated early in the design. There will be an Option RFP price for caissons.	John Ieraci		01-Dec-16	0							
12715	WTP - Raw water data	Lake Ontario water quality data at future WTP raw water source not available and subject to change. This could impact costr/schedule if sampling program is required.		Active	John Ieraci		28-Apr-16	Mitigate	31-Aug-16	4	4	5	20	2	4	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4484	In Progress	WTP - Raw Water Quality Data	Water Quality data will be gathered as part of the WTP preliminary engineering to ensure WTP equipment is designed to accommodate the fluctuations. Historical data available for raw water turbidity of current WTP. Add extra pretreatment capacity and room.	John Ieraci		01-Dec-16								
	WTP - CNO trailer site	Real Estate is limited at DNGS. The preferred location of the proposed WTP outside the protected area at current CNO trailer is conflicted with nearby underground services. A survey of the site to be		Active	John Ieraci		28-Apr-16	Mitigate	31-Aug-16	4	5	5	20	2	5	5	10

<a href="#">12716</a>		area at current CNO trailers is confined with many underground services. Adequacy of the site to be confirmed by Vendor. There is a risk that lots of remedial work will be required to make the site suitable for a WTP. This could impact cost/schedule.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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<a href="#">12745</a>		<div>Project estimate is based on a vendor submitted performance fee quote.</div> <div>Schedule extension due to unit condition.</div> <div>Impact: Project schedule will be delayed and budget will be increased.</div>																	
<a href="#">12754</a>	Schedule extension may require due to SST outage alignment.	<div>Event: System Service Transformer outage should be scheduled after the Unit planned Outage.</div> <div>Cause: Computer design EC requirement..</div> <div>Impact: Project schedule will be delayed and budget will be increased</div>		Active	Ricardo Fiorini	Shailesh Shah	28-Apr-16	Accept	31-Aug-17	3	2	2	6	3	2	2	6		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">13684</a>	Scope increase	<div>Event: Scope increase during field execution,</div> <div>Cause: Field discovery.</div> <div>Impact: Project schedule will be delayed and budget will be increased.</div>		Active	Ricardo Fiorini	Shailesh Shah	28-Apr-16	Accept	30-Nov-16	2	2	2	4	1	1	1	1		
			There are no Not Started, In Progress Actions associated with the risk.																
Project: DNGS Projects - 31552																			
<a href="#">13738</a>	failure or unavailability of gantry crane on all units	<div>Event: there is a risk of failure of gantry crane</div> <div>Cause: Based on the OPEX from the installation of CCW Travelling screens on Unit1, LPSW on Unit 3 and Unit 4,</div> <div>Impact: delay project schedule and increase costs</div>		Active	Brian Graham	Sam Salama	27-Apr-16	Accept	15-Jun-18	4	1	4	16	4	1	4	16		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">12771</a>	There is a risk of Delays during outage	<div>Event: there is a risk of Delays during outage</div> <div>Cause: Based on the OPEX from the installation of U3 LPSW Travelling screens - D 1531,</div> <div>Impact: delay project schedule and increase costs</div>		Active	Brian Graham	Sam Salama	27-Apr-16	Accept	30-Mar-15	4	1	3	12	4	1	3	12		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">12770</a>	There is a risk of scope addition due to discovery work during construction	<div>Event: There is a risk of scope addition due to discovery work during construction</div> <div>Cause: Based on the OPEX from the installation of U1/ U2 CCW and U3 LPSW Travelling screens ,</div> <div>Impact: increase costs due scope addition during construction</div>		Active	Brian Graham	Sam Salama	27-Apr-16	Accept	30-Mar-15	2	1	1	2	2	1	1	2		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">13739</a>	There is a risk of severe weather conditions	<div>Event: There is a risk of severe weather conditions</div> <div>Cause: Based on the OPEX from the installation of CCW Travelling screens on Unit1,</div> <div>Impact: Delay project schedule and increase costs</div>		Active	Brian Graham	Sam Salama	27-Apr-16	Accept	15-Jun-18	2	1	1	2	2	1	1	2		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">12766</a>	There is a risk of increasing the Performance fee	<div>Event: There is a risk of increasing the Performance fee based on the ES MSA performance fee structure</div> <div>Cause: there is a potential the contractor could earn an additional █████ above the labour portion of the contract if they,</div> <div>Impact: Increase costs of the project</div>		Active	Brian Graham	Sam Salama	27-Apr-16	Accept	30-Mar-15	1	1	1	1	1	1	1	1		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">12767</a>	There is a risk of higher estimate due changing labour rates, profits, discovery work	<div>Event: There is a risk of higher estimate due changing labour rates, profits, discovery work</div> <div>Cause: Changing labour rates, profits, discovery work ,</div> <div>Impact: Increase costs of the project</div>		Active	Brian Graham	Sam Salama	27-Apr-16	Accept	30-Mar-15	1	1	1	1	1	1	1	1		
			There are no Not Started, In Progress Actions associated with the risk.																
Project: DNGS Projects - 31701																			
<a href="#">12780</a>	TRF T1601 Outage Window May Move	<div>Planned TRF T1701 Outage installation window is moved TRF or delayed due to Station priority.</div> <div>Project could incur substantial schedule and cost impacts in order to complete scope in the next planned TRF Outage Window. I.e. - Contractor delay charges/OPG overhead costs.</div>		Active	Francis Davis	Ray Kurhan	29-Apr-16	Accept	08-Feb-17	3	3	3	9	3	3	3	9		
			There are no Not Started, In Progress Actions associated with the risk.																
	EPC Contractor potential to delay start of TRF T1701	Installation cannot be completed by EPC Contractor within the planned/scheduled TRF T1701 outage window. Installation will be delayed until completion of the TRF Outage as a result of re-destination of		Active	Francis Davis	Ray Kurhan	29-Apr-16	Mitigate	28-Apr-17	3	3	3	9	2	2	1	4		



Risk Report by Project with Associated Actions

Report ID: 07077  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

<a href="#">12781</a>	delay/extend TRF T1701 Outage	maintenance window impacting critical path of the TRF Outage as a result of underestimation of scope.																
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4288	Not Started	31701	Incorporate working overtime/add 2nd shift/extra manpower as required during the TRF T1601 Planned Outage Window as a recovery plan.	Ricardo Fiorini		30-Nov-16	0								
<a href="#">12784</a>	New turbine will not perform with the same capacity or reliability as the existing current turbine	New turbine will not perform with the same capacity or reliability as the existing current turbine under our specific operating environment due to potential unknown parameters or latent failure modes. This could include possible interference and compatibility issues with the current TRF Systems Structures and Components (SSCs) of the CRS.		Active	Francis Davis	Ray Kurhan	29-Apr-16	Mitigate	28-Apr-17	2	4	4	8	1	2	3	3	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4292	Not Started	31701	To minimize/eliminate these potential risks, obtain new turbine replacement from the TRF turbine original equipment manufacturer (OEM). OEM has proven experience/OPEX with upgrading oil bearing turbines to dynamic gas bearing turbines in hydrogen cryogen	Ricardo Fiorini		30-Nov-16	0								
<a href="#">12778</a>	Detailed Design (EPC) Completion Milestone Missed	Detailed Design milestone of July 08, 2016 not complete by EPC Contractor as a result of under estimation of hours to complete per project schedule causing potential schedule/milestone delays impacting T1701 Outage execution.		Active	Francis Davis	Ray Kurhan	29-Apr-16	Mitigate	08-Jul-16	2	2	3	6	2	2	1	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4284	In Progress	31701	For T1701 Outage Scope EPC Contractor to follow D-INS-39000-10003 (TRF Planned Outage Milestones) and if schedule/milestones are impacted, Contractor to provide a Recovery Plan to OPG.	Ricardo Fiorini		08-Jul-16	EPC Contractor is behind schedule in issuing the latest PO to the turbine OEM Linde and the Design Agency AMEC is maintaining their position that their work will be delays possibly impacting/pushing the Detailed Design milestone date of Jan.22, 2016. OEM needs to provide certain drawings/information in order for Design Agency to complete their Detailed Design scope although several independedant tasks could be completed in parallel. Contractor has been asked to review intregated scheduled and see where effeciencies can be made to recover schedule.  ES Fox notified OPG that the Detailed Design Milestone of Jan.22, 2015 will not be achievable as the Turbine OEM documentation/deliverables are critical path and are required for AMEC to complete Detailed Design, refer to SCR#N-2015-16888. Project has prepared a directed change PCRAF-004 to realign vendor project schedule and yearly cash flows as the TRF T1601 Outage window has been moved/pushed to TRF T1701 Outage (start Feb.08, 2017). As a result this should recover the Detailed Design Milestone based on the new T1701 Outage Start Date. New Detailed Design Milestone TCD is July 08, 2016.  In Q1-2016 the Project has received new Production Schedule from ES Fox now targeting the Detailed Design complete date as 26-May-2016, which is in advance of the OPG Milestone 08-July-2016.								
	Configuration Issues Related to TRF Plant Equioment and Design	Identification of configuration management issues or legacy issues to ensure design documentation represents actual field equipment conditions, if any conditions are discovered additional effort/scope will be required to complete Detailed Design. potential schedule and cost impacts.		Active	Francis Davis	Ray Kurhan	29-Apr-16	Mitigate	01-Jun-16	1	1	4	4	1	1	3	3	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								



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ONTARIOPOWER  
GENERATION

Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

12796	31710 - Resources Unavailable if Work Moves	If the project has to move the SDC HX replacement work late into refurbishment due to failure to obtain isolation, or due to schedule delays preventing execution prior to Refurbishment, there is a risk that Refurbishment resources (Operations, Maintenance, Design, Field Engineering, Contract Management Office, Radiation Protection, etc.) are unavailable to provide support during 2 month long 24/7 execution periods that are back to back (1 .5 month gap in between ).		Active	James Philipps		29-Apr-16	Mitigate	31-Mar-15	4	2	5	20	2	1	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4300	In Progress	Oversight of Vendor Compliance to MA-022	Project to provide oversight of the vendor (accountable for detailed design, work plans and assessing) and will notify management early of any potential schedule delays and risks to MA-022 compliance.	Ricardo Fiorini		30-Jun-18	2015-09-16, 2051-10-09: In communication with Work Control to identify risks to and missed MA-22 milestones and to identify recovery dates to ensure SDC HX work stays on the plan.							
			4301	In Progress	Vendor Prepare recovery plans	Vendor will be accountable to prepare recovery plans & present status updates daily at Project Control Center (PCC) meeting.	Ricardo Fiorini		24-Mar-16	Dec 08, 2015: U2HX1 work has been kicked off the plan due to assessment incomplete. Work rejected from 2016WW12 and moved to 2016WW52.							
			4316	In Progress	31710 - Communicate with Work Groups to Secure Resources in Advance	Communicate and engage affected OPG work groups well in advance to ensure support will be available duringthe required time.	Ricardo Fiorini		15-Oct-15	0							
			4317	In Progress	31710 - Plan Installations Outside of High Resource Loaded Time Frames	Schedule tasks where possible when resources will be available. (I.e. outside of planned outages).	Ricardo Fiorini		31-Dec-16	0							
12792	Degraded PULSW Isolation Valves are not replaced prior to SDC HX's replacement.	There is a risk that degraded Powerhouse Upper Level Service Water (PULSW) system isolation valves are not replaced prior to SDC HX replacements. The PULSW system isolation valves for HX1 (PV11, PV57) and HX2 (PV12, PV60) are in a degraded condition and require overhaul / replacement prior to the SDC HX Replacement. If the valves are not replaced during a PULSW outage prior to SDC HX replacement, then the project will likely not be able to isolate the HX's, and therefore the Project execution will have to be deferred until the Isolation valves can be replaced. The use of ice plugs as an alternate means of isolation may also not be possible due to several limitations (will require the procurement of pipe freezing jackets for 16" diameter piping, a continuous supply of LN2 for the installation duration (30 days), a new feeder freezing penetration on the south side of the reactor (to enable ice plugging on PV11 pipe work inside containment) and minimal fluid flow in the pipe work (difficult with passing isolation).		Active	James Philipps		29-Apr-16	Mitigate	31-Dec-16	4	1	4	16	2	1	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4308	In Progress	31710 - PULSW Outages in D1321/D1411/D1531/D1641 to replace Valves	Identify the issue to station management and requested PULSW outages are added to every Unit Outage prior to SDC HX Replacement, to allow for PULSW isolation valve replacement.	Ricardo Fiorini		30-Apr-16	Unit 2: Valves could not be replaced in D1321. Unit 1: Valves replaced in D1411. Unit 3: Valves scheduled for replacement in D1531. Unit 4: Valves scheduled for replacement in							
			4309	In Progress	31710 - Vendor design alternate means of isolation	Requested EPC Vendor to evaluate alternate contingency means of isolation on the service water side and to provide an Isolation Strategy Report. The Project will then obtain approval from the station to have the EPC vendor design, fabricate, and install an alternate means of PULSW isolation.	Ricardo Fiorini		30-Jun-16	U2 TMOD to be complete by April 8, 2016. U1/U3/U4 TMOD to be complete by June 30, 2016.							
			5678	In Progress	31710 Execute Test PULSW Isolations	Perform test isolations in advance of the HX replacements to determine acceptability of pulsw isolation. If unacceptable, communicate to required stakeholders and take appropriate follow-up actions (move HX replacement into Refurb or post-refurb, re-attempt isolation, fix valves etc.)	James Philipps		31-Dec-16	U2HX1 test isolation planned for 2016WW04 per WO 4783166 and 4890198. Initial results are that isolation is acceptable on p/s and s/s. U2HX2 test isolation planned for 2016WW07 per WO 4783171 and 4875513.							
12786	16-31710: Incorrect Radioactive Waste Characterization of the SDC HX's Delays Waste Disposal	Event: The assumed radioactive waste characterization of the SDC HX's (used to determine design requirements for shipping container) is incorrect. Cause: Assumptions made in determing waste characterization prove incorrect, and radiological waste characterization is higher than planned due to higher than expected contamination of the HX. Impact: If a shipping container is designed and fabricated based on the incorrect characterization, then a new container will need to be designed and fabricated, which will significantly delay the removal of the old HX's from the Darlington site.		Active	Ricardo Fiorini	James Philipps	29-Apr-16	Mitigate	31-Mar-15	3	1	5	15	2	1	5	10
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6313	Not Started	16-31710 - Stage Old HX so it doesn't impact installations	If old HX cannot be shipped off-site immediately (due to need to obtain a new transport container), and the old HX is interfering with new HX installation, then obtain approval to store in a different location (new SATM approved).	James Philipps		30-Jun-16								
	Late Delivery of Long Lead Material (SDC HX's)	There is a risk that late delivery of long lead material will delay the start of installation. This risk is highest for the first HX, as the start of installation is very close to the completion of fabrication. For the remaining three HX's installed under this release. there is low risk of late deliverv.		Active	James Philipps		29-Apr-16	Mitigate	31-Mar-15	3	1	5	15	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

12787		In addition the the HX's, long lead material for temporary supports that was identified late (due to late design issuance) will delay temport support fabrication and installation which is a pre-requisite to HX replacement activities.																	4294	In Progress	31710 - Oversight of the EPC vendor to ensure committed delivery dates are for HX and other LLM..	EPC Vendor oversight of the HX Manufacturer to make sure the committed delivery dates are met.	James Philipps		31-May-16	Current delivery is March 24 2016 for U2HX1. Vendor is taking measures to try and improve date to March 03, 2016, in order to have on site well in advance of SOI date. 2016-03-30: Temporary supports are now critical path, so EPC vendor is expediting procurement and fabrication of these supports.
12788	31710 - Damage to Equipment & Materials	There is a risk that the HX and/or other equipment / material is damaged due to improper storage by vendor, poor handling during shipment/installation, or exposure to harsh environmental conditions.		Active	Ricardo Fiorini		29-Apr-16	Transfer	30-Jun-15	3	1	5	15	2	1	3	6									
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments																
			4296	In Progress	31710 - Vendor Preparation of procurement plan and material management plan.	The EPC vendor will prepare a procurement plan and material management plan that will identify the storage and warehousing of the SDC HX's. OPG will review and accept the plans, in order to ensure OPG's expectations for storage and shipment are met.	Ricardo Fiorini		31-Dec-17																	
			4299	In Progress	31710 - Approved Lift and Material Handling Plans to Mitigate Damage	OPG to provide oversight during fabrication and installation activities. OPG will review the installation work plans for lifting and rigging details and HX movements within the station, to ensure appropriate measure are being taken to mitigate damage to the HX's. HX Movements and Lifts will be performed per OPG approved Critical Lift Plans and Material Handling Plans.	Ricardo Fiorini		31-Dec-18	Preparation of U2HX1 work plans and lift/material handling plans is in progress. Plans for subsequent installations to follow.																
12790	31710 - Conflicts with other work being done inside the station	There is a risk that the installation timeline conflicts with other work being done inside the station. Work of higher priority may be in execution inside the station that will interfere with the project, be it conflict in resource allocation, use of space, or use of equipment. A key concern is with Refurbishment related activities, which may be scheduled to take place in parallel with this project.		Active	Ricardo Fiorini		29-Apr-16	Mitigate	31-Dec-18	3	1	5	15	2	1	2	4									
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments																
			4303	In Progress	Work with Refurbishment Organization to Address Conflicts	The project team will continually collaborate with the refurbishment organization to evaluate any potential conflicts during the planned installation windows.	Ricardo Fiorini		31-Oct-16	Initial discussions had with Refurbishment and Work Control at the beginning of November 2015. The project and Refurbishment will work to																
14146	31710 - Additional Design to Address Increased HX Seismic Loads Delays Start of Installation	There is a risk that additional design to address increased HX seismic loads delays start of installation. Additional design is required to due errors in the original Combustion Engineering HX model and seismic analysis. Therefore the loads on the floor anchors are greater than initially design for, and heat exchanger flexibility could result in unacceptpable loads and fatigure failures in the piping system. Additional engineering may result in modifications to the HX, new piping supports in the field or extensive fatigure analysis, all of which could significantly delay the start of field installation. If significant, this could push the work into refurbishment.		Active	James Philipps		29-Apr-16	Mitigate	29-Feb-16	2	1	5	10	2	1	4	8									
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments																
			6451	In Progress	Perform Seismic analysis	Perform Seismic Analysis and Level D analysis with HX natural frequency	James Philipps		15-Apr-16																	
12793	PULSW Piping Condition is unacceptable for welding to the new SDC HX Nozzles.	There is a risk that PULSW piping condition is unacceptable for welding to the new SDC HX nozzles. The PULSW piping at the HX tie-in points (shell side supply and discharge nozzles) is in a degraded condition due to microbiologically induced corrosion (MIC), and is approaching the minimum allowable wall thickness at certain pit locations. There is a risk that the piping is in such a degraded state, that it is unsuitable for welding to the nozzles on the new SDC HX's.		Active	Ricardo Fiorini		29-Apr-16	Accept	31-Mar-15	2	1	3	6	2	1	3	6									
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments																
			4312	In Progress	31710 - Replace PULSW Piping prior to HX Replacement	SDC HX / MIC Component Engineer was requested to have PULSW piping replaced by the Station prior to SDC HX Replacement. Work was not approved into scope. Therefore, if piping deemed unacceptable at time of replacement, then piping will need to be replaced on the spot. Vendor to ensure contingency material is available.	Ricardo Fiorini	James Philipps	31-Dec-18																	
	Environmental Releases during Installation	There is a risk of Environmental Releases during execution activities (HX draining and drying activities) to the lake and air.		Active	James Philipps		29-Apr-16	Mitigate	30-Jun-16	2	1	3	6	1	1	2	2									
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments																

<a href="#">12803</a>			<a href="#">4327</a>	In Progress	Work Plan Review by Environmental Compliance and ALARA	EPC vendor to ensure all requirements outlined in the Environmental Impact Worksheet are captured in the installation work plans. Darlington Environmental Compliance work group will review all work plans before they are routed for approval. Coordinate closely with ALARA regarding the drying and transport of the HX's within the station (inside andoutside). ALARA work group will review all work plans before they are routed for approval.	Ricardo Fiorini		08-Apr-16	Work plan review is in progress with sign-off expected by end of Feb 2016.								
<a href="#">12805</a>	Heat Exchanger Unavailability	There is a risk that the Project cannot obtain permission from Reactor Safety and Operations to exceed the 'maximum amount of acceptable unavailability for SDC HX's per year' (72 days per year per unit or 288 days per year per station [R-6]). The estimated time of each SDC HX's unavailability during replacement is 40 days, and therefore in a given year only 1 HX per unit could be replaced. This may prevent the SDC HX's from being replaced in order of age, with Unit 2 first, followed by Unit 1, Unit 3 and finally Unit 4.		Active	James Philipps			29-Apr-16	Accept	24-Mar-16	2	1	3	6	2	1	3	6
There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">12791</a>	Accessibility Issues	There is a risk that issues getting inside containment (access from MCR) or working inside containment (Breathing Air and Suit Communications system, Cooling System issues) cause delays to the execution work in the field and prolong the overall replacement duration.		Active	Ricardo Fiorini			29-Apr-16	Accept	31-Mar-15	2	1	2	4	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6390</a>	In Progress	16-31710 - Ensure Containment Systems Avaible for Work in SDC rooms	Work Plan has pre-requisite steps to ensure Breathing Air and Suit Communication systems, and SDC Air Condition Systems are available for use prior to starting the work in the field.	James Philipps		20-May-16	Work Plan preparation is in progress.								
<a href="#">12798</a>	16-31710 Design Quality	There is a risk that the EPC Vendor's Design Engineering Change (EC) Packages lack the necessary detail due to insufficient field walkdowns, or incorrect assumptions, thus leading to delays because of rework, or additional scope to address missed items.		Active	Ricardo Fiorini			29-Apr-16	Mitigate	31-Mar-15	3	1	1	3	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">4322</a>	In Progress	31710 - 3rd Party Review of Design	A third party review of design documentation is required as part of the Contract.	Ricardo Fiorini		30-Dec-16	Third party review required for revised Design due to rework								
<a href="#">12802</a>	Inability to completely dry the SDC HX's in a timely manner.	SDC HX's need to be dry prior to removal from containment and for shipping off-site. The time to dry the HX's needs to be minimized, as it is on critical path (new HX's cannot be installed until the old HX's are dry and removed from containment). The use of Munters, Heaters, HEPA units, and vacuum pumps may not be able to dry the HX's in the time allotted (based on the allowed unavailability duration for each HX Installation), which could extend installation schedule and impact nuclear safety (increased time with no redundant HX). There is a also a risk that this equipment cannot completely dry the HX's, which could cause a tritium emission during recycling from remaining D2O(see Pickering Moderator HX Recycling SCR N-2013-16015).		Active	James Philipps			29-Apr-16	Accept	30-Jun-16	3	1	1	3	3	1	1	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">4326</a>	In Progress	Incorporate Past HX Drying OPEX	The ES MSA Contractor is to review OPEX from Pickering HX Drying Activities during Detailed Design and Installation Planning, and review all options for HX drying, to ensure the preferred option can effectively remove all residual water from the HX's prior to shipment for disposal/recycling, and, enable HX replacement activities within the allowed SDC HX unavailability time.	Ricardo Fiorini		11-Dec-15	OPG has provided the EPC Vendor with OPEX on Moderator HX drying and Dry Fuel Storage Container Vacuum Pump system. OPG Projects and ALARA have had several discussions with the EPC vendor regarding drying requirements.								
Project: DNGS Projects - 31716																		
<a href="#">13727</a>	Risk of the production equipment failing testing and or commissioning due to the complexity in designing the amplifier boards - 31716	Based on Pickering OPEX and the complexity of designing the amplifier board, there is a risk that the delivered product might fail testing or commissioning. This can have an impact on the total cost of the project and lead to installation and or commissioning delays.	2	Active	Rajbir Singh	Bassam Alawi		12-May-16	Accept	31-May-17	4	2	4	16	2	2	4	8
There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">13776</a>	Risk of OPG Design not having the Technical Expertise to support the project - 31716	OPG Engineers providing design oversight might not recognize the limits of their technical expertise. This can cause significant rework and can impact the project scheudle if milestones are delays and or missed.	2	Active	Rajbir Singh	Bassam Alawi		12-May-16	Accept	10-Oct-16	4	1	4	16	1	1	3	3
There are no Not Started, In Progress Actions associated with the risk.																		
	Risk of the production equipment failing testing and or commissioning due to the complexity in designing the amplifier boards - 31716	Since the amplifiers will be custom designed, their quality will not have been proven. There is a risk that excessive failures occur. The consequences of excessive failures could be excessive rework and or commissioning delays.	1	Active	Rajbir Singh	Bassam Alawi		12-May-16	Avoid	01-Jul-19	3	2	4	12	2	2	2	4

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12809	amplifier boards failing prematurely since they will be custom designed and their quality will not have been proven - 31716	that premature failures occur. The consequences of premature failure could be spurious reactor trip or failure to trip during adverse conditions.	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments												
			6152	In Progress	Premature Failure - 31716	Since the amplifiers will be custom designed, their quality will not have been proven. There is a risk that premature failures occur. The consequences of premature failure could be spurious reactor trip or failure to trip during adverse conditions. Technical subject matter experts along with OPG designer will be involved in the oversight.	Bassam Alawi	Bassam Alawi	01-Jan-18													
			6153	In Progress	Introduce rigorous testing to mitigate equipment failure - 31716	To mitigate the risk of the production amplifier units from failing during commissioning, rigorous testing will be done at both the vendor facility and at the darlington station to identify equipment failures before installing on channel.	Bassam Alawi	Bassam Alawi	29-Dec-17													
13777	Risk of potential Schedule Impact due to changing future planned outage dates 31716	There is a risk that long range planning can risk meeting the changing future planned outage dates. This can change the execution strategy of the project and ultimately impact the project completion date.	2	Active	Rajbir Singh	Bassam Alawi	12-May-16	Accept	31-May-17	3	1	4	12	2	1	3	6					
			There are no Not Started, In Progress Actions associated with the risk.																			
13794	Risk of equipment vendors estimating or overestimating the development and production cost of the amplifier units - 31716	There is risk that some vendors may have under estimated the development and production cost of the equipment. This is indicated by the large discrepancies between the vendor quotes. The total vendor cost might exceed the vendor allocated budget in the BCS.	3	Active	Rajbir Singh	Bassam Alawi	12-May-16	Accept	29-Jul-16	3	3	3	9	1	2	2	2					
			There are no Not Started, In Progress Actions associated with the risk.																			
13779	Limited OPG Resources can cause delays to the projects due to lack of support - 31716	The OPG design resource is limited at the present time. There is a risk that any emergent issues on other projects could divert resources away from this project which can lead to schedule slippage.	3	Active	Rajbir Singh	Bassam Alawi	12-May-16	Accept	31-May-17	3	1	2	6	3	1	2	6					
			There are no Not Started, In Progress Actions associated with the risk.																			
Project: DNGS Projects - 32202																						
14173	32202 - BDBE Procedure updates (EMEG's) Delay/Rework	Uvailability of adequate resources with correct skill sets for preparing/updating the Emergency Mitigating Response Guide procedures may cause delays and rework, impacting the fainal AFS and turnover for Fukushima modifications.	3	Active	Brian Graham		26-Apr-16	Monitor	31-Jan-17	5	1	5	25	2	1	5	10					
			There are no Not Started, In Progress Actions associated with the risk.																			
12811	32202 - Fukushima Phase II - Risk of cost and schedule growth due to Functionality Review findings.	Beyond Design Basis Functionalaity Review could expand in scope due to discovery or find deficiencies requiring remedial actions by the project. This would result in extended project schedule and cost.	3	Active	Brian Graham	Dale Schnedler	26-Apr-16	Monitor	31-Mar-15	2	2	5	10	2	2	5	10					
			There are no Not Started, In Progress Actions associated with the risk.																			
12815	32202- Fukushima Phase II Risk of delay or cost increases due to scope definition/control	Project has significant risk of scope evolution stemming from:  Ongoing evolution of OPG/Industry/CNSC approach to BDBE. Initial scope for this project consists of numerous modifications initially provided as solutions in a "Fast track" context, rather than problems. Use of 'Category 4' Modification process, with weaker definition of deliverables. Program is composed of numerous small modifications, integration issues with the overall respose drive changes. Many aspects of BDBE response are new, outside normal practices or require "extent of response decisions. Frequent scope change and clarification continues to occur in the design phase, contributing to cost and schedule delays. Project is part of a larger program for BDBE and SAM response, making it more difficult to control scope at a project level. Alignment with PNGS ( for compatibility of equipment and consistency) often results in delay and sometimes scope as there are significant difference between the stations. The BDBE project structure is unique in having a support organisation outside of projects which has retained a significant role in ongoing scope definition. This may cause delay or cost impacts. <del>This is an ongoing risk.</del>	2	Active	Brian Graham	Dale Schnedler	26-Apr-16	Monitor	30-Dec-16	1	2	5	5	1	2	5	5					
			There are no Not Started, In Progress Actions associated with the risk.																			
	32202 Fukushima Phase II - Exchange rates may impact ability to complete project within release/schedule/available businees	Exchange rates may impact ability to complete project within release/schedule/available businees	3	Active	Brian Graham	Dale Schnedler	26-Apr-16	Monitor	31-Mar-15	1	1	1	1	1	1	1	1	1				



12812	There is a risk currency fluctuation for US EPC Vendors/Material will impact the ability to complete the project on schedule or withing the available release and business plan funds.	plan. Signiricant materials and EPC resources are sourced from the US.	There are no Not Started, In Progress Actions associated with the risk.															
Project: DNGS Projects - 33258																		
12823	Equipment reliability during Execution - 33258	All equipment on the alternate division must be functional. This applies also to equipment inside steam rooms. This can lead to increased prerequisites and schedule delays if equipment is deficient.		Active	Rajbir Singh	Mario Campigotto	12-May-16	Mitigate	31-Aug-17	4	2	5	20	2	3	3	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4459	In Progress	33258	Have dedicated Operations support to review permitry, equipment health, and upcoming work in order to identify risks in advance.	Rajbir Singh		30-Sep-16	0								
12826	Co-ordination with Station Work to Resume Installation 33258	Whichever bus is being worked on, the opposite division must be available without any work scheduled for the duration of the replacement. If it is not, work cannot proceed. If the work cannot be coordinate, the installation schedule will be deferred.		Active	Rajbir Singh		12-May-16	Mitigate	29-Sep-16	4	3	5	20	2	3	5	10	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4462	In Progress	33258	Have dedicated Operations support to review permitry, equipment health, and upcoming work in order to identify risks in advance.	William Donnelly		01-Sep-14	0								
12824	Lack of Operations resources during Execution 33258	The support of an operator is required to provide permitry support, review equipment health and scheduled work, etc. If resources are not available, this could result in schedule delays and cost increases.		Active	Rajbir Singh	Mario Campigotto	12-May-16	Mitigate	30-Sep-16	4	2	4	16	2	3	3	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			4460	In Progress	33258	Request support well in advance.	Rajbir Singh		30-Sep-16	0								
14149	Ground Interference with Station equipment post Installation - 33258	U3 ODD Final AFS is at risk due to the delay of the Voltage Regulation Testing and the Ground Fault board replacement. Grounding interference with Station equipment needed to be resolved which caused schedule delay. This will impact the Start of Installation for U3 EVEN in WWK 32 2016.		Active	Rajbir Singh		12-May-16	Mitigate	08-Aug-16	4	2	3	12	4	1	2	8	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6264	In Progress	33258	Voltage Regulation Testing has been scheduled for WWK10.	Mario Campigotto		18-Mar-16									
			6265	In Progress	33258	Replacement of custom Ground Fault board has been scheduled for WWK10.	Mario Campigotto		18-Mar-16									
Project: DNGS Projects - 33631																		
12830	33631 - There is a risk that the Vibration reduction path forward will increase the scope of the project and delay the project completion	The original plan was to replace all 8 RAB chillers with new or upgraded chillers over 2 winter season, starting in fall 2016. This is the only time available when the chillers can be removed from service. Based on a decision made at an EDM, the VSD chiller option has been placed on hold. This would allow time for a specialist in vibration / pulsation to analyze our sitaion and determine the root cause and the the best way to address the issue. Testing is currently in progress.		Active	Brian Graham	Marc Clemente	29-Apr-16	Accept	30-Jun-16	1	1	1	1	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			5167	Not Started	33631 - Evaluate impact to project based on path froward from EDM	Based on a decision from an EDM, the project path froward will be reevaluated and risks associated with the plan will be evaluated. The EDM will not be held until April 2016..	Marc Clemente		29-Jul-16	Testing with EDI is currently in progress. EDM will be held follow the completion of this testing based on a recommendation from EDI.								
Project: DNGS Projects - 33973																		
14317	Possible delay of 4th SG Installation - 33973	Per current SG outage plan, there is a little gap between AFS of the 3rd SG and start of install of the 4th SG. In case of any field discovery/emergent work and consequent delays to the AFS of the 3rd SG, the start of install for the 4th SG will be immediately impacted.		Active	Rajbir Singh		12-May-16	Accept	14-Nov-16	4	1	4	16	4	1	3	12	
			There are no Not Started, In Progress Actions associated with the risk.															
	Technical issues from 1st SG replacement impacting remaining replacements -	A new vibration monitoring system was installed on the 1st SG, but compatably issues were discovered during commissioning. An interim solution was implements; however, a long term risk has been identified. and it is being investigated by the equipment manufacturers (sub-vendor). This		Active	Rajbir Singh		12-May-16	Mitigate	28-Feb-17	3	1	5	15	3	1	5	15	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								

14251	33973	may increase cost. Other technical issues remain open from first SG commissioning and these could increase scope//complexity for the remaining replacements (cost and schedule). Possible Discovery work for each SG remains a risk.	6442	In Progress	Resolution of vibration monitoring system	To minimize risk and reowir to the remaining SGs, the vibration monitoring issue will be resolved prior to proceeding to installation of next SG.	Rajbir Singh		31-May-16										
			6443	In Progress	Float in installation schedule	The start of installation of the 2nd SG has been postpone by approximately 4 months to allow time for the resolution.	Rajbir Singh		31-Aug-16										
14249	Loss of Resources during Execution - 33973	If there are major delays to the SG outage schedule the project could loose continuity in expertise and knowledge within OPG resources (primarily DTL/MTL/FTL roles). Plus, there is risk of losing continuity in control equipment vendor's resources/expertise, which are critical for commissioning. Per experience from the first SG commissioning, Station resources are limited, and there is the risk of delay to commissioning if there are emergent issues. Due to the delay of 2nd SG Commissioning, the schedule is slipping into the approaching D1641 outage, which is resulting in potential loss of dedicated resources.		Active	Rajbir Singh		12-May-16	Mitigate	28-Apr-17	3	1	4	12	2	1	4	8		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6437	In Progress	Ensure project staff	Project staff will be retained for at least the second SG, but will be reassigned temporarily if there are major delays in the project schedule.	Rajbir Singh		31-Mar-17										
			6438	In Progress	Station Communication	The project will work with the Station to plan up front and secure resources to support commissioning.	Rajbir Singh		31-May-17										
			6439	In Progress	Resource Review	The resource load will be reviewed with the Station at Senior Management level. Resource commitments will be arranged early in the planning process.	Rajbir Singh		31-Mar-17										
14252	Possible machine overhaul for SG4 during Commissioning - 33973	Current SG4 machine status/condition - hydraulic start drive, internal gearing and bearing assemblies especially with the deteriorated condition of the front bearing/housing - deteriorated owing to the repeat start/stops cycle required as part of (controls system) commissioning. Thus the SG4 control system commissioning cannot be completed unless machine overhaul is done, impacting schedule.		Active	Rajbir Singh		12-May-16	Mitigate	31-May-16	3	1	4	12	2	1	3	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6444	In Progress	Station Co-ordination	Work with Station on potential mitigation/recovery plan, if possible include the potential of a gas generator replacement.	Rajbir Singh		31-May-16										
14248	Vulnerable SG Outage Schedule during Installation - 33973	SG outage schedule is vulnerable to emergent SG breakdown maintenance/repair. Such emergent issues could result in project delays in the order of months. There is also risk that major emergent issues could shuffle the order of execution of the remaining SG controls replacements. During the current SG4 Commissioning, issues for the speed probe have risen.		Active	Rajbir Singh		12-May-16	Mitigate	31-Mar-17	2	1	5	10	2	1	5	10		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6436	In Progress	33973	For delays greater than 6 months, the project will be placed in deferral status. Detailed designs have been completed for all of the remaining SGs. All design packages will be revised to incorporate the lessons learned from the first SG, allowing the flexibility to change the order of SG controls installations. The planning of the next SG will be integrated with the Station plan. This project schedule will minimize impact to VBO.	Rajbir Singh		31-Mar-17										
14250	Lack of Performance from EPC Vendor and possible multiple SG Outages during Execution - 33973	There will be a learning curve for the EPC Contractor in providing engineering support for execution since they do not have OPEX from first SG. Darlington OP&P does not allow for more than one SG to be removed from service at any time. Forced outage of any SG during the installation or commissioning of this project will result in more than one SG outage, which may affect station operation.		Active	Rajbir Singh		12-May-16	Mitigate	31-Mar-17	2	1	5	10	2	1	5	10		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6440	In Progress	Additional OPG Oversight	OPG's Project and Design team will provide additional oversight during the execution of the next SG.	Rajbir Singh		01-Mar-17										
			6441	In Progress	Salvaged Spares from previous SG replacements	Controls system components salvaged from the retrofitted SGs will be available as spares for the remaining SGs, thereby providing an interim bridging strategy until all SGs retrofits are completed in 2017. This may help in reducing the SG outage time.	Rajbir Singh		31-Mar-17										
12837	Emergent SG maintenance/repair issues arise.	There is risk of emergent SG maintenance/repair issues, casued by deteriorating SG equipent. The result would be delay of the SG controls execution and project schedule, since one SG only can be removed from service at any time. There would also be cost impact through interest charges.		Active	Rajbir Singh	Raaj Kovinthan	12-May-16	Accept	31-Jan-17	3	3	3	9	3	3	3	9		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			4425	In Progress	33973	This risk cannot be mitgited or avoided. Ensure installation schedule is aligned with the SG outage cycle plan.	Rajbir Singh	Raaj Kovinthan	31-Jan-17	Controls installation is aligned with 10 year SG outage plan. Will continue to monitor.									

14120	Gas Generator Vibration Readings Higher Than Expected	Event: There is a risk that the gas generator (GG) vibration readings will be greater than the readings recorded prior to the modification (i.e. GG vibration operating margin to alarm/trip could be reduced). Cause: The new monitoring equipment being more sensitive than the old equipment. Impact: This could result in the new equipment being not accepted for service by stakeholders and or delay to SG4 (2nd SG) return to service.		Active	Rajbir Singh	Raaj Kovinthan	12-May-16	Mitigate	20-Jun-16	4	2	2	8	2	2	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6266	Not Started	Evaluate Alternate Vibration Probe for Gas Generator	Evaluate an alternate vibration probe (manufacturer CEC) for the SG gas generator during commissioning of SG4.	Rajbir Singh	Raaj Kovinthan	11-Mar-16	Probe procured and ready to be tested durin commissioning.							
12841	Vendor expertise is not available during commissioning.	Turbomachinery commissioning expertise (within controls vendor) is a scarce resource. There is a risk that vendor resources may not be available to support commissioning, casued by changes in the execution schedule. The result would be delay to commissioning and SG return to service.		Active	Rajbir Singh	Raaj Kovinthan	12-May-16	Mitigate	30-Nov-17	3	1	2	6	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4429	In Progress	33973	OPG provide a 5-month advanced notice of the commissioning start date to the vendor.	Rajbir Singh	Raaj Kovinthan	30-Sep-16	First SG is complete. Vendor has been notified for 2ND SG (SG4):							
14147	Inability to Lubricate SG Trunnions to Support Commissioning Tests	Event: A recent SG trip event has required the SG trunnions (gas generator support structure) to be lubricated prior to each test run. There is risk of not being able to lubricate the trunnions in time for each commissioning test as scheduled. Cause: Mechanical Maintenance (MM) resources are not available when required to lubricate the trunnion. In ability to align the commissioning tests with MM resource availability. Impact: Delay of individual commissiong tests, overall commissioning schedule and SG return to service (AFS).		Active	Rajbir Singh	Raaj Kovinthan	12-May-16	Mitigate	20-Jun-16	3	1	2	6	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6280	In Progress	33973	Start of SG running tests and MM resource shortage.	Raaj Kovinthan		04-Feb-16								
14245	Cost Increase during Execution - 33973	There is a risk that project cost will increase during the Execution phase through: interest charges, inadequate vendor arrangements, and EPC Contractor under estimation. This financial increase may result from OPG initiated delays.		Active	Rajbir Singh		12-May-16	Mitigate	31-Mar-17	1	1	3	3	1	1	3	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6432	In Progress	33973	The project will be placed in deferral status if major delays (greater than 6 months) are encountered. The Contractor's estimate has been adjusted with actual costs from the first unit.	Rajbir Singh		31-Mar-17								
14247	Change of Market Rules post Detailed Design - 33973	Market rules have changed since the Standby Generators were last registered, and IESO has requested changes to protection setting outside the scope of this project. There is a risk of cost increase and schedule delay.		Active	Rajbir Singh		12-May-16	Transfer	31-Mar-17	1	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 38419																	
12868	Stress Analysis Discovery Issues	EPC Contractor preliminary and detailed stress analysis exceed budgeted amount per performance fee quote and BCS due to discovery issues.		Active	James Philipps		29-Apr-16	Mitigate	31-May-16	4	4	3	16	3	3	2	9
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5693	In Progress	16-38419 - Align Detailed Design Activities with LRV Replacement Project Stress Analysis	Vendor detailed design to consider LRV Replacemetrn project stress analysis and loading details as required as an input into the design. Design cannot be completed until LRV design activities are near completion.	James Philipps		31-Oct-16	Cost and Schedule estimated obtained from AMEC to perform design activities in support of D2O capping project. B&M/RCMT have provided an updated cost and schedule estimate that aligns with the AMEC design activities and schedule durations.							
12870	OPG Qualified Stress Analysts Resources Limited	Lack of qualified OPG resources to support acceptance of Stress Analysis Reports from EPC Contractor in a timely manner due to emergent work, and/or qualified resource limitations.		Active	James Philipps		29-Apr-16	Mitigate	31-May-16	4	2	3	12	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4350	In Progress	38419	OPG to ensure that adequate qualified resources are available to support scheduled work load for review, acceptance, and oversight of EPC Contractor Stress Analysis work.	Ricardo Fiorini		28-Mar-14	0							
12872	Design Discovery Issues	Additional Scope to Preliminary Design, Detailed Design, and/or Stress Analysis with EPC Contractor is required due to discovery issues.		Active	Ricardo Fiorini		29-Apr-16	Mitigate	31-May-16	3	4	3	12	2	3	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
	16-38419 Schedule Delays due to Dependence on LRV Design for this system, and could threaten the installation timeline for Definitive work	There is a risk that delays in the Detail Design of the LRV Project will delay the completion of Detail Design for this system, and could threaten the installation timeline for Definitive work		Active	James Philipps		29-Apr-16	Accept	31-Dec-15	3	3	3	9	3	3	3	9

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<a href="#">13774</a>			<a href="#">5518</a>	In Progress	38466 CSA Sewage Lift Station Project - Availability of Sanitary Trucks (Risk ID 00013774)	Confirm the availability of the sanitary truck for the installation well in advance to avoid unavailability of the resources.	Samantha Thurston	Samantha Thurston	12-Sep-16	March 9- vendor is confirming the project schedule so that resources can be allocated as required.							
<a href="#">13775</a>	38466 CSA Sewage Line Project - Weather delays	There is a risk that the winter weather could cause delays to the schedule if it is too cold to pump sewage and/or excavate. The impact of the severe weather is delay to schedule which would cause increased costs to maintain resources.	1	Active	Samantha Thurston	Samantha Thurston	09-Mar-16	Avoid	19-Jul-16	4	2	3	12	2	1	2	4
<a href="#">13799</a>	38466 CSA Sewage Line Project - Approval of the proposed route	In order to use the proposed new route: calculation, clearing interferences, and adding supplementary steel for the needed supports in addition to a number of approvals from the station are required i.e. use of the existing interior wall penetrations on the new proposed route, scanning for new penetration location(s). If permission is not granted then the line route may have to change which will have a cascading affect resulting in cost increase due to increased design effort.	2	Active	Samantha Thurston	Samantha Thurston	09-Mar-16	Mitigate	08-Aug-16	4	3	3	12	3	2	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5516</a>	In Progress	38466 CSA Sewage Lift Station Project - Approval of the proposed route (Risk ID 00013799)	To manage this risk, stakeholder involvement and approvals will be obtained as detailed design progresses.	Samantha Thurston	Samantha Thurston	08-Aug-16	Dec 10: Detailed design is ongoing. Stakeholders are being engaged during the design phase.							
<a href="#">13956</a>	38466 CSA Sewage Line Project - Excavation risks	Excavation is required for the tie in of the new sewage line to the outside existing asbestos line. The risk that could be encountered during excavation are as follows: 1. discovery of documented and undocumented buried services 2. discovery of undocumented items 3. requirement for dewatering 4. poor soil conditions 5. lack of availability of excavation equipment 6. lack of station space to store excavated soil 7. potentially contaminated soil causing difficulty with disposal The result of these risks being realized are an increase in schedule duration and an increase in cost.	2	Active	Samantha Thurston		09-Mar-16	Monitor	30-Dec-16	3	4	3	12	3	3	2	9
<a href="#">13767</a>	38466 CSA Sewage Line Project - Design - Existing Electric Pumps (P21/P22) insufficient to pump sewage	There is a risk that the existing electrical pumps (P21/P22) will not be capable of pumping out the sewage through the new line due to its extended length. It may also require changing the configuration, power supply, and the control system including modification of the electrical panel. The impact is increased cost and schedule.	3	Active	Samantha Thurston	Samantha Thurston	09-Mar-16	Monitor	29-Jul-16	3	3	3	9	2	2	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5520</a>	Not Started	38466 CSA Sewage Lift Station Project - Design - Existing Electric Pumps, P21/P22 (Risk ID 00013767)	Vendor's Engineering team to provide supporting calculation that: a) the existing pumps will support pumping out the sewage through the new line or b) bigger pumps are required in order to support the functionality of the new line.	Samantha Thurston	Samantha Thurston	29-Jul-16								
<a href="#">13802</a>	38466 CSA Sewage Line Project - Source of Clean Water	There is a risk that clean water cannot be provided to clean the temporary tank, temporary piping, and the main sewage sump (i.e. type of water, source of water). The impact is delays in the work leading to cost increase.		Active	Rajbir Singh	Samantha Thurston	09-Mar-16	Mitigate	10-Jun-16	2	1	2	4	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5523</a>	In Progress	38466 CSA Sewage Lift Station Project - Source of Clean Water (Risk ID 00013802)	Arrangement for the source of the water to be made prior to entering the construction stage.	Samantha Thurston	Samantha Thurston	10-May-16	Review of installation area and resources are in progress.							
<a href="#">13797</a>	38466 CSA Sewage Line Project - Condition of the Asbestos sewer line (0-79120-L68-W6ACC)	Inspection of the asbestos sewer line (0-79120-L68-W6ACC) from 2006 found only minor spot repairs were required. Since asbestos sewer line is expected to last 70 years, there isn't a large concern that major repairs would be required. An inspection in the future would be beneficial in identifying if any other spot repairs are required on the line. The risk for not inspecting the line is that the condition of the line will be unknown and even though there is a new sewage line (0-79120-L67-W6A) inside the powerhouse, the asbestos line, 0-79120-L68-W6ACC, may also need major repair and would lead to leakage or clogging the line.		Active	Samantha Thurston	Samantha Thurston	09-Mar-16	Accept	23-Jun-17	1	1	1	1	1	1	1	1
Project: DNGS Projects - 38933																	
<a href="#">12887</a>	Regulatory Risk - CNSC and/or TSSA Approval Delays	CNSC and/or TSSA approvals for the modification may take longer than expected resulting in a cost/schedule impact.		Active	Paul Razvi		27-Apr-16	Monitor	31-Dec-15	4	1	3	12	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">4239</a>	In Progress	TSSA/CNSC submission times	The Project will ensure CNSC and/or TSSA acceptance requests are submitted with sufficient time for approval.	Ricardo Fiorini	Paul Razvi	29-Apr-16								

12898	Test Valve Fails Seismic Shaker Table	Test valve fails seismic shaker table test when attempting to qualify the Valve to the owner-generated FRS. This could impact cost and schedule if vale required re-design.		Active	Paul Razvi		27-Apr-16	Mitigate	29-Feb-16	3	2	4	12	2	1	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
12885	3rd Party Design Review Delays	Mitigation of any issues or concerns identified by Independent (3rd Party) Design Review takes longer than originally anticipated resulting in cost/schedule impact		Active	Paul Razvi		27-Apr-16	Mitigate	31-Dec-15	3	1	3	9	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4234	In Progress	3rd Party Contract	LRV Design to issue contract for 3rd party design review.	Ricardo Fiorini	Paul Razvi	29-Apr-16								
12895	Regulatory Risk - OPR Report	CNSC does not accept the OPR revision by challenging the bounding cases identified by OPG and Design Agency. This could severely impact cost and schedule.		Active	Paul Razvi		27-Apr-16	Mitigate	30-Jun-16	3	3	3	9	1	2	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
12884	Design ECs are Late	Design EC's not issued per design schedule which could impact the installation schedule.		Active	Paul Razvi		27-Apr-16	Monitor	04-Jan-16	2	1	2	4	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 38948																	
12915	There is a risk the cost will increase during Execution - 38948	A risk of the EPC Vendor under estimating the modifications, level of effort required to install, commission, AFS and closeout the modifications. The additional cost might increase beyond the approved total project cost.		Active	Rajbir Singh	Bassam Alawi	12-May-16	Mitigate	31-May-16	4	4	3	16	2	3	1	6
			There are no Not Started, In Progress Actions associated with the risk.														
13924	Final AFS Date at Risk from schedule defferment - 38948	Original AFS date of July 25, 2016 was brought forward to May 2, 2016 due to Station demand. The new Final AFS date of May 02, 2016 is at risk due to the following items: - Additional Scope (administrative and field related) - Delay in Work Plans review by OPG stakeholders (MA-0022 Compliance) This will affectively delay the schedule of Execution.		Active	Rajbir Singh	Bassam Alawi	12-May-16	Mitigate	22-May-16	3	2	5	15	2	2	5	10
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5942	In Progress	38948	Obtain approval from performance engineering to help control/reduce additional scope and utilize the pre-screening process to expedite the WP reviews.	Rajbir Singh	Bassam Alawi	01-Apr-16								
12921	There is a risk of limited number of suppliers to stage long lead materials - 38948	Long Lead items may not be delivered in a timely manner due to the limited number of suppliers. This can lead to installation and commissioning delays.		Active	Rajbir Singh	Bassam Alawi	12-May-16	Mitigate	31-May-16	4	2	3	12	2	2	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4372	In Progress	38948	Maintain consistent communication with Vendors via weekly project meetings. Oversight has been increased. OPG is providing direct oversight over sub-vendor via weekly teleconferences and face-to-face meetings at vendor site.	Bassam Alawi	Bassam Alawi	01-Apr-16								
13916	There is a risk of not converting the TMOD to a PMOD before the 2016 chlorination season - 38948	There is an issue of the MCC tripping due to overheating of the thermal breakers. This was solved by changing the Full Load Amperage (FLA) from 9amps to 10 amps. The change in MCC set point resulted in operating the rental aerators outside of their design spec.  It was decided that the MCC issue would be addressed as part of the PMOD. Due to the limited OPG design resources, the conversion to a PMOD might not happen before the 2016 chlorination season. This would indicate that the aerators would continue to operate outside of their design spec for another season.	3	Active	Rajbir Singh	Bassam Alawi	12-May-16	Mitigate	31-May-16	3	2	4	12	2	2	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5943	In Progress	38948	1) Implement the recommendations provided by the OPG & HSL wrt. commissioning the Inactive Drainage System and submit a PCA to ES-Fox, if required, to support the work. 2) Re-utilize the current rental aeration units for the 2016 chlorination season.	Rajbir Singh	Bassam Alawi	29-Feb-16								
12918	Chlorine Spills may contaminate the environment during Installation - 38948	Chlorine release above the guidelines prescribed by the ministry of environment due to 4-unit continuous chlorination. This can ultimately impact the environment (lake water).		Active	Rajbir Singh	Bassam Alawi	12-May-16	Mitigate	31-May-16	3	1	2	6	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4363	In Progress	38948	1) Ensure Spill kits are readily available	Rajbir Singh	Bassam Alawi	02-May-16	0							
			4364	In Progress	38948	Ensure Spills are identified, contained and communicated to OPG Stakeholders as soon as possible.	Rajbir Singh	Bassam Alawi	02-May-16	0							

			<a href="#">4365</a>	In Progress	38948	Ensure fully approved commissioning strategy and sampling plan is adhered to during commissioning.	Rajbir Singh	Bassam Alawi	02-May-16	Commissioning work plan, strategy and sampling plan is currently being finalized with all stakeholders. TCD completion is March 7th.								
<a href="#">12914</a>	There is a risk of Regulatory Changes during Project life - 38948	Change in environmental regulations with respect to allowable levels of chlorine in discharge water (via lagoons). This will have an impact on project completion date.		Active	Rajbir Singh	Bassam Alawi	12-May-16	Accept	31-May-16	1	3	5	5	1	3	5	5	
There are no Not Started, In Progress Actions associated with the risk.																		
Project: DNGS Projects - 80016																		
<a href="#">12932</a>	80016 -New PT envelope parameters not defined, may impact design completion for PRV196	There is a risk to the completion of the design for PRV 196 as the new PT envelope has not been defined yet which is providing some uncertainty on what the specific design requirements will be. The design will be progressed but not approved until the PT envelope is approved through a challenge meeting. Station will determine the new PT envelope based on the latest fracture toughness curve at 120 ppm. Project manager will be a part of the working level meeting to provide input on the constraints and issues and monitor the impacts to the project related work. This risk will be monitored and any project impacts /additional modifications will either create a new project or require a superseding BCS for the additional scope.		Active	Brian Graham	Marc Clemente	29-Apr-16	Monitor	31-Mar-16	3	3	4	12	2	2	3	6	
There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">14419</a>	80016 There is a risk of implementing U1 and U3 modification for ECI set points due to equipment alignment conflicts and resources	The U1 and U3 installation for the ECI set point change modification are planned to be performed online. This requires no conflicting electrical work to be performed during the same week and requires Special Safety system qualified staff to perform the work. These resources are not available due to the large # of hours required for this project. U1 work was initially scheduled in WW30, 32 and 34 and has been rejected and currently sits in WW41, 44 and 46. But resources will still be an issue in this week and the expectation is this work will be rejected.		Active	Marc Clemente	Marc Clemente	29-Apr-16	Mitigate	15-Jun-16	3	1	3	9	1	1	2	2	
There are no Not Started, In Progress Actions associated with the risk.																		
Project: DNGS Projects - 80022																		
<a href="#">12935</a>	Lack of Station Support to support Scoping - 80022	OPG System Engineers (SREs) and Operations are required to provide input to the project scoping/installation planning phase. Unavailability of SREs/Ops when required could result in schedule delays.		Active	Rajbir Singh	Neha Bagria	31-Mar-16	Mitigate	30-Dec-16	3	1	4	12	2	1	3	6	
Action# Status Action Title Action Description Owner Delegate Due Date Comments																		
			<a href="#">4737</a>	In Progress	80022	Obtain resource commitments from Performance Engineering Section Managers and Operations.	Rania Mclarty	Rania Mclarty	30-Dec-16	Resource requirements will be discussed with the Station when the installation strategy is developed in the later half of 2015. A discussion with Performance Engineering (PE) was held on June 12, 2015. PE indicated								
<a href="#">12941</a>	Incomplete detailed scope prior to Installation - 80022	There is a risk that the cost of installation/commissioning will increase due to the fact that detailed scoping is not complete. It has yet to be determined which boards can be relaced online and which require an outage. Also, budgetary cost estimates are not available at this time.		Active	Rajbir Singh	Neha Bagria	31-Mar-16	Mitigate	31-Dec-16	4	3	3	12	3	3	3	9	
Action# Status Action Title Action Description Owner Delegate Due Date Comments																		
			<a href="#">4739</a>	Not Started	80022	Determine impact of taking each OH180 out of service and develop a detailed installation schedule.	Rania Mclarty	Rania Mclarty	30-Sep-16	This tasks is a significant effort, that will require contracted resources. This tasks will be done under contract after the nexte BCS.								
<a href="#">12940</a>	Incomplete design documentation from neighbouring project post Detailed Design - 80022	NICRs or ECs may be required to install the new re-engineered input and output boards. Currently it is assumed that the input and output boards will be an item equivalency and will follow the IEE process, but this had to be confirmed by project 34011 once all design documentation has been completed.		Active	Rajbir Singh	Neha Bagria	31-Mar-16	Mitigate	29-Feb-16	2	4	5	10	1	3	5	5	
Action# Status Action Title Action Description Owner Delegate Due Date Comments																		
			<a href="#">6100</a>	In Progress	Ensure IEE process is completed	Follow up with Computers and Control Design Section to ensure the IEE process is completed by Procurement Engineering prior to procurement of the input and output boards. This will validate that no design was required for the I/O boards.	Rajbir Singh	Rania Mclarty	29-Feb-16									
<a href="#">1</a>	Unexpected system response from Hardware Failure during	There is a risk that the replacement hardware will fail in the field due to complex design and insufficient testing and result in an unexpected system response.		Active	Rajbir Singh	Neha Bagria	31-Mar-16	Mitigate	31-Dec-16	2	4	5	10	2	3	4	8	
Action# Status Action Title Action Description Owner Delegate Due Date Comments																		

<a href="#">12943</a>	Commissioning - 80022		<a href="#">4740</a>	Not Started	80022	Ensure installation strategy incorporates contingency plans to mitigate unexpected system response.	Rania Mclarty	Rania Mclarty	31-Mar-16	The installation strategy will be developed in early 2016.							
<a href="#">12942</a>	OH180 Failure Rate may increase before SOI - 80022	There is a risk that the OH180 failure rate increases dramatically before the project is ready to begin installations. This may expedite the schedule of installation.		Active	Rajbir Singh	Neha Bagria	31-Mar-16	Accept	01-Jan-18	1	3	3	3	1	3	3	3
There are no Not Started, In Progress Actions associated with the risk.																	
<a href="#">12936</a>	Discovery Project Scoping/Installation Planning during Execution - 80022	If the project scoping/installation planning activity proves to be more extensive than anticipated this could negatively impact the schedule.		Active	Rajbir Singh	Neha Bagria	31-Mar-16	Mitigate	31-Mar-16	2	1	1	2	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5946</a>	In Progress	80022	Project will issue contract to vendor in phases to ensure work progresses while scope is finalized.	Rajbir Singh	Rania Mclarty	31-Mar-16								
Project: DNGS Projects - 31548																	
<a href="#">13374</a>	31548 FW Chem Cntl - Risk that Newly Installed Equipment will not Perform as Expected	There is a risk that the newly installed filtration skid will not perform as expected since this is a first-of-a-kind modification. Integration issues discovered during installation will cause schedule delays and cost increases.		Active	Francis Davis	Shelley Jones	29-Apr-16	Mitigate	01-Sep-17	3	1	2	6	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5097</a>	In Progress	31548 FW Chem Cntl - EPC Vendor Review OPEX for Detailed Design and Installation Planning	EPC vendor to review industry OPEX and incorporate lessons learned into the design and installation planning where applicable.	Francis Davis	Shelley Jones	30-Jun-16								
			<a href="#">5254</a>	Not Started	31548 FW Chem Cntl - EPC Vendor to Incorporate Lessons Learned from 1st Unit Installation into Subsequent Units	EPC Vendor to incorporate lessons learned from 1st unit installation into design EC and work planning packages for subsequent units.	Francis Davis	Shelley Jones	01-Sep-17								
Project: DNGS Projects - 31530																	
<a href="#">13537</a>	Project 16-31530: Scope Creep due to Undetected Underground Services	There is a risk that the project will experience scope creep during the construction phase of this project due to discovery of undetected underground services, resulting in a delay to the project's schedule and increased costs to relocate the discovered services.	1	Active	Brian Graham	Matthew Tannous	29-Apr-16	Avoid	01-Jun-16	2	3	2	6	1	2	1	2
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">13539</a>	Project 16-31530: Increased Design Errors and Rework During Execution Phase	This execution portion of this project is required to be AFS'd in time to accept the new transformers coming to site in Q2 2016 (project constraint). To accomplish this, the project is fast tracking the design deliverables in order to allow the start of construction in April 2016. There is a risk of an increased potential for design errors and rework (FICs) during the construction phase due to this project being fast-tracked, resulting in a delay which will impact the AFS date of the storage facility.	2	Active	Brian Graham	Matthew Tannous	29-Apr-16	Mitigate	18-Mar-16	2	3	2	6	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">13958</a>	Project 16-31530: Insufficient Station Resources to Support Execution	This project is planning to begin execution work at the beginning of April 2016 in order to have the facility ready for the transformers in August 2016. This is the same time the Unit 4 outage starts. There is a risk of insufficient station resources to support Execution since the outage will take priority over this project, resulting in schedule delays that will impact the project's critical path.	2	Active	Brian Graham	Matthew Tannous	29-Apr-16	Monitor	07-May-16	2	1	2	4	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 33819																	
<a href="#">13683</a>	DNG - VMS - Design Complete Milestone may not achievable	The completion of Detailed design completion milestone (PO12) for D1831 Outage may not be achievable as preliminary design is in progress which could impact subsequent actions.	3	Active	Ricardo Fiorini	Ashish Deb	27-Apr-16	Mitigate	28-Mar-16	2	2	2	4	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5653</a>	In Progress	Develop Design EC release strategy	OPG Design to review the Preliminary design documents to include the additional scope for 12 major pump sets, and to establish the impact of the software changes identified by the design supplier on the already completed EC's for the first six pump sets.	Ricardo Fiorini	Francis Davis	31-Dec-15								



ONTARIOPOWERGENERATION

Risk Report by Project with Associated Actions

13682	DNG - VMS - New system interface	The new system may be unable to utilize the existing cables from the field to the common room, S-103 due to the present condition of existing cable (unknown without proper testing)	4	Active	Ricardo Fiorini	Ashish Deb	27-Apr-16	Accept	31-Jan-16	1	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 80144																	
13927	Engineering/Reverse Engineering at EMC	There is a risk that EMC cannot perform engineering/reverse engineering work due to present QA qualification in place, resulting in a delay that will impact project schedule and cost. Vendor is also required to obtain OPG approval on welding and coating procedures before executing this work. Vendor cannot also perform PB work and will have to subcontract cooler replacement to a qualified company. This will require OPG Plant Design support to review and accept documentation before work can progress.	4	Active	Simion Deju	Mike Nairne	03-May-16	Monitor	23-Dec-16	3	4	3	12	3	4	3	12
			There are no Not Started, In Progress Actions associated with the risk.														
13702	Overhaul Cost	There is a risk that the cost of refurbishment will exceed estimated cost due to delays and cost increase (additional work), resulting in exceeding allocated funding and making refurbishment more expensive then byuing new motors.	2	Active	Simion Deju	Mike Nairne	03-May-16	Monitor	23-Dec-16	3	3	3	9	3	3	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
13703	Overhaul Schedule	There is a risk that the overhauled motors will not be ready in time due to delays in refurbishment of each motor, resulting in a delay of shipping refurbished motors that will impact plant refurbishment schedule for U2 and project cost.	2	Active	Simion Deju	Mike Nairne	03-May-16	Monitor	23-Dec-16	3	3	3	9	3	3	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
13704	Overhaul Resources	There is a risk that the overhaul supplier shop floor may not be able to support an increased volume of motor overhauls to ensure motor availability for the scope due to shortage of qualified personnel, resulting in a delay of delivery of refurbished motors that will impact project schedule and cost.	2	Active	Simion Deju	Mike Nairne	03-May-16	Monitor	23-Dec-16	3	3	3	9	3	3	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
13949	Handling of Residual Waste	There is a risk that handling of residual waste as a result of refurbishment of PHT pump motors at vendor could delay delivery of refurbished motors resulting in a delay that will impact project schedule and cost. Residual waste is required to be shipped back to OPG in the IP-1 container bringing refurbished motor back to OPG.	2	Active	Simion Deju	Mike Nairne	03-May-16	Monitor	23-Dec-16	3	1	3	9	3	1	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
13969	Transportation of Motors between OPG and Refurbishment Facility	There is a risk that ransportation of motors between Darlington and EMC, by trailer, could be delayed resulting in a delay that would impact project schedule and cost. Estimated duration of one trip built in our schedule was 10 days. Transportation could take longer due to delays caused load height requiring utilities lift wiring, travel limitation on weekends, road construction in various places or weather.	3	Active	Simion Deju	Mike Nairne	03-May-16	Monitor	23-Dec-16	3	2	3	9	3	2	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
14267	Asbestos Used In Old Motors	There is a risk that, as per OEM advice, asbestos was used to overhang corona shield in the old motors. Removal and replacement of winding stator in the old motors could have an impact on our project schedule and work. Contingency money to be included to support additional work.	2	Active	Simion Deju	Mike Nairne	03-May-16	Monitor	23-Dec-16	3	3	3	9	3	3	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
14268	Stator Wedge and Magnetic Putty	There is a risk details on stator wedge and magnetic putty used by OEM in the old motor could not be available due to intellectual property issues. Overhaul of the old motors is performed by a different company and not the OEM. This could impact project schedule and cost and could result in reduction of motor efficiency and increase of winding temperatures.	2	Active	Simion Deju	Mike Nairne	03-May-16	Monitor	23-Dec-16	3	3	3	9	3	3	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 33228																	
13713	33228 TCV20 - Constructability of Design Packages (Gate 3b Risk)	The risk is that the design packages can not be installed as designed, resulting in unanticipated installation or commissioning challenges and design, installation or commissioning planning rework.	4	Active	Francis Davis	James Mcmillan	09-May-16	Mitigate	30-Jun-16	2	1	2	4	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6420	In Progress	Detailed Work Plans	Prepare detailed installtion work plans and CWP to ensure price submission addresses all field related issues.	Francis Davis	James Mcmillan	31-May-16	Draft installation Work Plan for U1 submitted 19Apr16. Target completion of Installation Work Plan is 30May16.							
	33228 TCV20 - Execution Cost Estimate Quality (Gate 3b & 3c)	The risk is that the ESMSA Price Submission is underestimated due to the level of project definition at time of preparation of this risk register. The result is that Vendor execution costs may be higher than estimated (ie installation is more complex than anticipated).	4	Active	Francis Davis	James Mcmillan	09-May-16	Mitigate	30-Jun-16	2	1	2	4	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

<a href="#">13716</a>		NOTE: Performance Fee contract, not fixed price.	<a href="#">6420</a>	In Progress	Detailed Work Plans	Prepare detailed installtion work plans and CWP to ensure price submission addresses all field related issues.	Francis Davis	James Mcmillan	31-May-16	Draft installation Work Plan for U1 submitted 19Apr16. Target completion of Installation Work Plan is 30May16.																										
Project: DNGS Projects - 80151																																				
<a href="#">13894</a>	Detector Location may be inaccessible during Installation - 80151	Event: There is risk designated detector locations are not accessible during installation. Cause: The location of detectors is uncertain at this stage. This will be identified at the Detail Design of the Project. Impact: Uncertainty of the location of detectors may cause underestimation of budget of installation.	2	Active	Rajbir Singh	Neha Bagria	29-Apr-16	Monitor	30-Jan-19	3	3	3	9	2	1	1	2																			
There are no Not Started, In Progress Actions associated with the risk.																																				
<a href="#">13912</a>	Possibility of Increase in Project Cost as Budgetary quotes are unavailble-80151	Event: There is a risk that costs will exceed the estimate. Cause: Estimated cost is based on stakeholders' inputs. Budgetary quotes are not available at this early stage of project. Impact: Increase the estimated cost of the project.	2	Active	Rajbir Singh	Neha Bagria	29-Apr-16	Monitor	30-Nov-17	3	3	3	9	2	2	1	4																			
There are no Not Started, In Progress Actions associated with the risk.																																				
<a href="#">13897</a>	Inadequate Detector Capability for the hazard/location - 80151	Event: There is a risk that selected detection technology is inadequate for the hazard / location being detected. Cause: The selected detectors required to be compatible with the existing system of the plant which will be assessed during the detail design phase. Impact: Rework/reassessment for the compatible technology of detectors can lead to increase cost of Project.	2	Active	Rajbir Singh	Neha Bagria	29-Apr-16	Mitigate	24-Dec-17	2	2	3	6	1	1	2	2																			
<table><tr><th>Action#</th><th>Status</th><th>Action Title</th><th>Action Description</th><th>Owner</th><th>Delegate</th><th>Due Date</th><th>Comments</th></tr><tr><td><a href="#">5712</a></td><td>Not Started</td><td>80151 - DN FHA and FSSA Modifications - Detector Capability (Risk Log ID # 13897)</td><td>Qualified vendor to perform detailed design, provide supporting document, and obtain approval of the stakeholders.</td><td>Rajbir Singh</td><td></td><td>24-Nov-17</td><td></td></tr></table>																					Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments	<a href="#">5712</a>	Not Started	80151 - DN FHA and FSSA Modifications - Detector Capability (Risk Log ID # 13897)	Qualified vendor to perform detailed design, provide supporting document, and obtain approval of the stakeholders.	Rajbir Singh		24-Nov-17	
Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments																													
<a href="#">5712</a>	Not Started	80151 - DN FHA and FSSA Modifications - Detector Capability (Risk Log ID # 13897)	Qualified vendor to perform detailed design, provide supporting document, and obtain approval of the stakeholders.	Rajbir Singh		24-Nov-17																														
<a href="#">13896</a>	There is resource availability risk for the overall Project - 80151	Event: There is risk of resource availability during the overall project. Cause: Due to multiple areas included in the Scope of Work, multiple disciples will be required to commence the work. Complexity of Project has potential risk for the availability of resources. Impact: Unavailability of resources may delay the project.	2	Active	Rajbir Singh	Neha Bagria	29-Apr-16	Mitigate	28-Feb-19	2	2	2	4	2	1	1	2																			
<table><tr><th>Action#</th><th>Status</th><th>Action Title</th><th>Action Description</th><th>Owner</th><th>Delegate</th><th>Due Date</th><th>Comments</th></tr><tr><td><a href="#">5711</a></td><td>Not Started</td><td>80151 - DN FHA and FSSA Modifications - Availability of Resources (Risk Log ID 13896)</td><td>Arrangements for availability of the resources to be made ahead of time.</td><td>Rajbir Singh</td><td></td><td>26-Jan-18</td><td></td></tr></table>																					Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments	<a href="#">5711</a>	Not Started	80151 - DN FHA and FSSA Modifications - Availability of Resources (Risk Log ID 13896)	Arrangements for availability of the resources to be made ahead of time.	Rajbir Singh		26-Jan-18	
Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments																													
<a href="#">5711</a>	Not Started	80151 - DN FHA and FSSA Modifications - Availability of Resources (Risk Log ID 13896)	Arrangements for availability of the resources to be made ahead of time.	Rajbir Singh		26-Jan-18																														
Project: DNGS Projects - 80067																																				
<a href="#">13918</a>	schedule delay due to inability to install long stacking frames	Inability to install the Long Stacking Frames in stock due to dimensional discrepancies (out of tolerance) and misalignment causing schedule delay and affecting station online execution schedule stability.	3	Active	Ricardo Fiorini	Ashish Deb	27-Apr-16	Monitor	30-Jun-16	5	1	5	25	5	1	5	25																			
There are no Not Started, In Progress Actions associated with the risk.																																				
Project: DNGS Projects - 80063																																				
<a href="#">13937</a>	Potential Legacy Issues of the System affecting Detailed Design - 80063	There is a risk that scope may increase as a result of discovering legacy issues in the existing system, components or structures. Discovery issues may impact cost and/or schedule.		Active	Rajbir Singh	Hamid Tabrizi	30-Mar-16	Mitigate	31-Jul-17	2	3	1	6	1	3	1	3																			
<table><tr><th>Action#</th><th>Status</th><th>Action Title</th><th>Action Description</th><th>Owner</th><th>Delegate</th><th>Due Date</th><th>Comments</th></tr><tr><td><a href="#">5785</a></td><td>Not Started</td><td>16-80063 - DN Standby Generators Protective Relay Replacement -- Potential Legacy Issues of the System (Risk ID # 13937)</td><td>Extensive field walk downs and drawing verifications will be conducted early in the preliminary design and detailed design phases. Lessons learned and experiences from Pickering will be reviewed in detail to identify potential issues.</td><td>Rajbir Singh</td><td></td><td>01-Sep-21</td><td></td></tr></table>																					Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments	<a href="#">5785</a>	Not Started	16-80063 - DN Standby Generators Protective Relay Replacement -- Potential Legacy Issues of the System (Risk ID # 13937)	Extensive field walk downs and drawing verifications will be conducted early in the preliminary design and detailed design phases. Lessons learned and experiences from Pickering will be reviewed in detail to identify potential issues.	Rajbir Singh		01-Sep-21	
Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments																													
<a href="#">5785</a>	Not Started	16-80063 - DN Standby Generators Protective Relay Replacement -- Potential Legacy Issues of the System (Risk ID # 13937)	Extensive field walk downs and drawing verifications will be conducted early in the preliminary design and detailed design phases. Lessons learned and experiences from Pickering will be reviewed in detail to identify potential issues.	Rajbir Singh		01-Sep-21																														
<a href="#">13936</a>	Cost Estimate for Software Qualification and EMC Qualification for Project Budget - 80063	There is a risk that the estimate for software qualification and the effort for qualifying the equipment to electromagnetic compatibility requirements may be greater than estimated. Software Qualification estimate for this application is based on Pickering experience. There is a risk that software qualification may be more complex for the Darlington application and result in higher cost.		Active	Rajbir Singh	Hamid Tabrizi	30-Mar-16	Monitor	28-Feb-18	2	1	2	4	2	1	2	4																			
There are no Not Started, In Progress Actions associated with the risk.																																				
<a href="#">13938</a>	Modifications due to Under Frequency Relay Setting during Initiation - 80063	There is a risk that a significant amount of additional modifications may be required to accommodate any change to the SG under frequency protection settings, if it is determined to be necessary by the assessment in preliminary engineering.		Active	Rajbir Singh	Hamid Tabrizi	30-Mar-16	Mitigate	01-Feb-17	2	2	1	4	1	1	1	1																			
There are no Not Started, In Progress Actions associated with the risk.																																				
<a href="#">13938</a>	Change in SG Outage Schedule to support	There is a risk that emergent Station issues will change the SG outage schedule and affect the execution of this project and the project completion date.		Active	Rajbir Singh	Hamid Tabrizi	30-Mar-16	Monitor	24-Aug-20	2	1	2	4	2	1	2	4																			

13940	Schedule to support Execution - 80063	execution or this project and the project completion date.	There are no Not Started, In Progress Actions associated with the risk.														
13941	Software and EMC Qualification underestimation prior to Installation - 80063	There is a risk that the time required to complete software qualification and electromagnetic compatibility qualification may be greater than estimated. Delay in either could impact installation of the first SG and overall project completion.		Active	Rajbir Singh	Hamid Tabrizi	30-Mar-16	Monitor	16-Feb-18	2	2	2	4	2	2	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
13942	Technical issues during commissioning - 80063	There is a risk that technical issues may be discovered during commissioning of the first SG and require significant rework or additional work. Complex issues could increase cost and delay the schedule.		Active	Rajbir Singh	Hamid Tabrizi	30-Mar-16	Monitor	27-Oct-21	2	2	1	4	2	1	1	2
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 80062																	
13988	80062 - There is a risk that the vendor will change their battery manufacturing process	If battery manufacturer changes the manufacturing process, they may not support the batteries specially designed for OPG. Vendor is preparing to switch their manufacturing process for cell plates from vertical pour to side pour, they have found this process to be more efficient with better quality. If vendor does support the OPG specific batteries there will be additional costs for them to produce additional cell plate molds. The vendor recommends OPG switch to the standard batteries used in all other nuclear applications. The difference is between a single point plate suspension deign (standard) or a 2 point plate suspension design (OPG).	2	Active	Marc Clemente	Marc Clemente	29-Apr-16	Monitor	28-Apr-16	2	3	1	6	2	3	1	6
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 80150																	
13995	There is a risk that scope evolution will impact project schedule	There is a risk that once detailed design, materials and execution are further defined, the scope of work will change and the cost will increase.	2	Active	Francis Davis	Getuta Butoi	09-May-16	Accept	28-Mar-18	4	4	5	20	3	3	4	12
			There are no Not Started, In Progress Actions associated with the risk.														
13996	There is a risk that discovery issues could impact the scope of the project	There is a risk that, as a result of Configuration Management, discovery issues could impact the scope of the project, resulting in cost increase	1	Active	Francis Davis	Getuta Butoi	09-May-16	Mitigate	27-Mar-18	3	2	5	15	2	1	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6129	In Progress	80150 DN FRF Pmp Improv – Field walkdowns	Perform multiple field walkdowns to verify the actual field conditions against drawings. Look for any differences between units.	Francis Davis	Getuta Butoi	31-Jul-17								
13997	There is a risk that missing outage planning milestones could jeopardize installation schedule	There is a risk that missing outage planning milestones could jeopardize the ability to perform the work in the desired outages. Missing an outage would delay the entire project.	1	Active	Francis Davis	Getuta Butoi	09-May-16	Mitigate	27-Mar-18	3	2	5	15	2	1	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6128	Not Started	80150 DN FRF Pmp Improv – Outage deadlines	Plan for schedule milestones to be completed well ahead of outage deadlines.	Francis Davis	Getuta Butoi	31-Jul-17								
13998	There is a risk that station priorities will impact internal design and execution resources	There is a risk that internal design and execution resources to support this project (e.g. FE, CM, RP, Project Design etc) may be affected by station priorities resulting in schedule delays.	1	Active	Francis Davis	Getuta Butoi	09-May-16	Mitigate	25-Jun-24	4	2	3	12	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6102	In Progress	80150 DN FRF Pmp Improv – Resources issues	Design and Projects Section Managers to discuss resources issues at weekly review meeting.Obtain resources commitment from required station stakeholders. Provide regular updates regarding schedule changes to ensure availability of the resources.	Francis Davis	Getuta Butoi	31-Dec-16								
13999	There is a risk that manufacturing issues could delays start of installation	There is a risk that components manufacturing issues could result in schedule delays and/or increased costs.	1	Active	Francis Davis	Getuta Butoi	29-Apr-16	Mitigate	02-Mar-17	4	2	3	12	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6101	Not Started	80150 DN FRF Pump Improv - Vendor selection	Design and Projects to select a vendor with significant experience. Provide increased oversight throughout design and manufacturing process.	Francis Davis	Getuta Butoi	31-Oct-16								
Project: DNGS Projects - 31522																	
	16-31522 DMS Electrolyzer: There is a risk that sub Run by:	There is a risk that the sub-contracted design agency will not provide the required project support in subject to close out the project. This would be caused by the sub contracted company.	4	Active	Francis Davis	Ayman Abdalla	29-Apr-16	Monitor	30-Jun-16	2	1	3	6	1	1	2	2
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<a href="#">14041</a>	There is a risk that sub-contractor design agency resources will not provide project support for closeout activities	In order to close out the project. This would be caused by the sub-contracted company mismanagement of their resources, or due to personnel turnover at the sub-contracted company. This could cause an extended project schedule and additional project costs.	<a href="#">6071</a>	In Progress	Process all CTPs and PCAs expeditiously if acceptable	There is a risk that the sub-contracted design agency will not have sufficient funds to support the project. This action will ensure that money is not held back where it is deserved. The action is to process all CTPs and PCAs expeditiously to ensure the sub-contractor will continue work. This will be a continuous action through AFS and into design closeout phase.	Francis Davis	Ayman Abdalla	30-Jun-16	24FEB2016: There are 3 open CTPs and 2 open PCAs for the project. Meetings have been or will be arranged to review all remaining project costs to ensure all money is paid out where it is deserved.									
<a href="#">14456</a>	16-31522 DMS Electrolyzer: There is a risk that there will be insufficient funds to close out the project due to commissioning issues	The project encountered numerous issues during commissioning which extended the duration of the project and increased project costs substantially. Due to this, the project is submitting a PCRAF to access contingency to fund the remainder of the project.	4	Active	Ayman Abdalla	Francis Davis	13-May-16	Mitigate	30-Jun-16	3	2	2	6	2	1	1	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">7645</a>	In Progress	Submit PCRAF to Access Contingency	Submit a PCRAF for the DMS Electrolyzer project to access all [REDACTED] to support the project financially until close out.	Ayman Abdalla	Francis Davis	20-May-16										
<a href="#">14040</a>	16-31522 DMS Electrolyzer: There is a risk that the OEM will be unavailable to support commissioning	In the event that the T1501 outage or the Project schedules are delayed, OEM representative support may not be available during the new dates. This could be caused by the T1501 outage schedule being changed, lack of support from the main and sub-contractors, or by lack of resources due to vacation being taken in the holiday season. Potential impacts include increased project costs and a late restart of the TRF.	4	Active	Francis Davis	Ayman Abdalla	29-Apr-16	Monitor	31-May-16	1	1	2	2	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6217</a>	In Progress	16-31522 - Ensure OEM availability to support commissioning	As the execution schedule and phase 1 commissioning schedule changes, continue to ensure that the OEM representative is available to support.	Francis Davis	Ayman Abdalla	29-Feb-16	The OEM is scheduled to be available any time after March 2, 2016. Commissioning Phase I is scheduled for complete February 28 or 29. Commissioning Phase II to start when Phase I is complete and OEM will be required March 3 or 4.									
Project: DNGS Projects - 31512																			
<a href="#">14048</a>	Project 16-31512: Damage to Trailer Equipment During Storage	There is a risk of damage to the equipment within the trailers while they are being stored, due to a lack of available 208V power to maintain the batteries being charged, and to operate the heater to keep the electronics from being damaged by cold temperatures.	2	Active	Brian Graham	Matthew Tannous	29-Apr-16	Avoid	29-Jan-16	2	2	2	4	1	1	1	1		
			There are no Not Started, In Progress Actions associated with the risk.																
Project: DNGS Projects - 80124																			
<a href="#">14089</a>	Risk of Installation Delay as of inadequate information for number of controllers in Online/Outgae Work	Event: There is a risk that installation of controllers in outages and online could take longer than expected to complete. Cause: There is inadequate installation planning/discovery/legacy issues on the controllers to be replaced in each unit under Online or Outage. Detail Installation strategy required to be developed. Impact: Delay the Project Schedule.	2	Active	Rajbir Singh	Ajoy Mukhopadhyay	06-May-16	Mitigate	31-Dec-26	3	3	3	9	2	2	1	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6174</a>	Not Started	80124	Hold regular status meetings with Design to closely track progress. Ensure issues are promptly identified and raised to an appropriate level for quick resolution.	Rajbir Singh		31-Dec-26	This action will trigger in the Installation Phase									
<a href="#">14093</a>	Resource Unavailability When Required During Throughout the Project's Life	Event: There is a risk that System Engineers/Operations/Maintenance and other stakeholders will not be available at different stages of the project when required to provide input and or support to the project during design/installation planning/installation/commissioning.Cause: Resources could be diverted from this project to support higher priority projects/station issues. The volume of effort required for this project may be greater than the available resources. Impact: Schedule delay; cost increase.	2	Active	Rajbir Singh	Ajoy Mukhopadhyay	06-May-16	Accept	30-Nov-18	3	3	3	9	2	3	3	6		
			There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">14094</a>	Risk of Quality/Performance of the Installed Equipment (Controllers)-80124	Event: There is a risk that installed equipment does not meet performance expectation including software qualification and software categorization. Cause: Design and specification of new equipment may not match the criteria of existing system. Impact: Rework of detailed design; change of equipment, configuraion, and or programing; schedule delay; and cost increase.	2	Active	Rajbir Singh	Ajoy Mukhopadhyay	06-May-16	Accept	30-Jun-19	3	3	3	9	2	2	1	4		
			There are no Not Started, In Progress Actions associated with the risk.																
Project: DNGS Projects - 33621																			

14122	16-33621: There is a risk that not all installation support material will arrive as planned and the schedule will be delayed	There are still two open Purchase Orders for installation material required to support WO 2541181 (U2 ACU1 removal and replacement), however, the station has the same materials in store at the time. In the case that the material does not arrive in sufficient time to support the current project schedule, the project will need to obtain the materials which the station has on hand or the project will be delayed.	4	Active	Francis Davis	Cole Arthurs	29-Apr-16	Avoid	30-Jun-16	3	1	4	12	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6404	In Progress	16-33621: Ensure readiness for U2 ACU1 RE/RE	There is a risk that the scope addition requests for U2 ACU1 RE/RE work will not be accepted due to readiness of the project. This action is to ensure all ECs are approved, all work plans are authorized, all WO tasks are set to ready, all holds are removed, and all materials are on site and available.	Ayman Abdalla	Francis Davis	30-Jun-16								
6508	In Progress	16-33621: Shift priority of available station material required for installation support to ACU project			There are currently 2 open POs for for materials required to support U2 ACU1 installation and TOE. These materials are on order, but have yet to arrive. Identical materials are available on site, however they are not allocated for the SCA ACU project. In the case that not all material arrives in time to support to installation schedule, the project will shift priority of these materials to the projet following injection of the U2 ACU1 installation scope.	Francis Davis	Mark Tannous	25-Mar-16									
14306	16-33621: There is a risk that ESW PMOD work plans will not be completed on time due to lack of resources.	The work control milestone to have the "ESW PMOD to replace TMOD" work plan drafted and issued for Unit 2 and Unit 3 are upcoming (April 4, 2016 and April 18, 2016 respectively). These work plans had a dedicated preparer who is no longer available. As a result, there is currently no designated preparer for these work plans. In the case that the work plans are not drafted and completed in time, scope injection for this work becomes at risk and will delay the start of installation (SOI). This is a cost and schedule impact.	4	Active	Francis Davis	Mark Tannous	29-Apr-16	Monitor	30-Jun-16	3	1	4	12	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
14285	16-33621: There is a risk that a design change will be required if the ESW treatment chemistry test results are outside the design assumptions	The ESW PMOD on the SCA ACU replacement project water treatment chemistry results need to be confirmed. The project is currently moving forward on the assumption that the results will be satisfactory. However, if the results are outside the design assumptions, then a design change will be required which will delay the project and increase project costs.	4	Active	Francis Davis	Cole Arthurs	29-Apr-16	Monitor	30-Jun-16	2	1	4	8	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
14123	16-33621: There is a risk that the scope injection for U2 ACU1 will not be accepted	Work is planned for July 2016 to replace and implement a TOE solution on U2 ACU1. The scope injection form has already been submitted to work control for review. There is a risk that the request for scope injection will not be accepted and the project work will be delayed. This could increase project costs and push the project scheule such that future project work overlaps with Darlington refurbishment work.	4	Active	Francis Davis	Cole Arthurs	29-Apr-16	Avoid	30-Jun-16	1	1	2	2	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6404	In Progress	16-33621: Ensure readiness for U2 ACU1 RE/RE	There is a risk that the scope addition requests for U2 ACU1 RE/RE work will not be accepted due to readiness of the project. This action is to ensure all ECs are approved, all work plans are authorized, all WO tasks are set to ready, all holds are removed, and all materials are on site and available.	Ayman Abdalla	Francis Davis	30-Jun-16								
Project: DNGS Projects -																	
14178	31508 - EPS Electrical Installation Windows and Restrictions	There is a risk that due to the restrictions required for EPS related BDBE Phase I modifications and the remaining station work schedule, there may be delays to installation of the 120V PUPS modifacaitons on Units 1-4 extending into late 2016 or early 2017.	3	Active	Andrew Lukomski		26-Apr-16	Mitigate	31-Dec-16	2	1	5	10	2	1	5	10
			There are no Not Started, In Progress Actions associated with the risk.														
Project: DNGS Projects - 31518																	
14220	Design cannot meet milestone - 31518	Due to complexity and issues design may not be completed in the time frame allocated to meet the Refurbishment-tied installation dates.		Active	Rajbir Singh		12-May-16	Mitigate	31-Oct-18	3	3	4	12	3	1	4	12
			There are no Not Started, In Progress Actions associated with the risk.														
14220	Long term contracting strategy not firm prior to Detailed Design - 31518	EPC contract issued in 2014 was cancelled by supply chain due to issues on other work. Project progressed by issuing a design-only contract with design agency. Commercial and long-term strategy issues have delayed resolution of this issue. Onaoina risk that lack of procurement support will		Active	Rajbir Singh		12-May-16	Monitor	29-Jun-18	3	1	4	12	2	1	4	8
			There are no Not Started, In Progress Actions associated with the risk.														

2		impact current design schedule.																	
14211	Loss of Resources if Project delayed during Detailed Design - 31518	Risk of Losing station/contractor resources due to Refurbishment or changes to design agency personnel. This will impact the schedule and consume burn rate.		Active	Rajbir Singh		12-May-16	Accept	31-Mar-17	2	3	4	8	1	1	4	4		
			There are no Not Started, In Progress Actions associated with the risk.																
14213	Difficulty with Authority having Jurisdiction accepting the design package - 31518	Potential challenges obtaining AhJ (CNSC) approval of design elements. Previous Alternate Compliance recommendation accepted by CNSC now must be reversed and changed due to new scope and design concept. This will impact schedule and cost if re-work is required.		Active	Rajbir Singh		12-May-16	Mitigate	31-Mar-17	2	3	4	8	2	2	4	8		
			There are no Not Started, In Progress Actions associated with the risk.																
14216	Final design to be assessed to DLC/RLE conditions - 31518	Delay to project to complete review/analysis or incorporate design re-work if required.		Active	Rajbir Singh		12-May-16	Mitigate	31-Mar-17	2	3	4	8	1	1	2	2		
			There are no Not Started, In Progress Actions associated with the risk.																
14218	Inadequate Equipment vendor prior to Execution - 31518	Supplier for material cannot meet spec or not on Approved Suppliers list. on-going risk that some critical materials may be difficult to procure. There are a few qualified vendors of fire water, diesel-generator, etc, equipment on the OPG ASL. Responses have been slow during previous LLD material sourcing exercises.		Active	Rajbir Singh		12-May-16	Mitigate	29-Jun-18	2	3	4	8	2	1	4	8		
			There are no Not Started, In Progress Actions associated with the risk.																
14219	Code Changes during Project Life - 31518	Code changes that need to be implemented into the project after design has been completed.		Active	Rajbir Singh		12-May-16	Accept	29-Jun-18	2	2	3	6	2	1	1	2		
			There are no Not Started, In Progress Actions associated with the risk.																
14212	Lack of Support from Key Stakeholders during Project Life - 31518	Lack of support or changing requirements from key stakeholders delays the project leading to cost and schedule over runs this impacting the timely completion of the project.		Active	Rajbir Singh		12-May-16	Accept	31-Oct-19	1	2	4	4	1	1	4	4		
			There are no Not Started, In Progress Actions associated with the risk.																
Project: DNGS Projects - 80023																			
14313	80023 SG LCV Replacement Resource Risk to Obtain Long Lead Materials to Support Outage Installation	There is a resource risk to obtain long lead valves prior to installation.	2	Active	Francis Davis	S Naeem	29-Apr-16	Mitigate	29-Jul-16	3	1	5	15	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6549	Not Started	80023 - Obtain cost estimates for valves following approval of technical specification	Obtain cost estimate from vendors following approval of technical specification.	Francis Davis	S Naeem	29-Jul-16										
14315	80023 SG LCV Replacement Schedule Risk Related to Obtaining Vendor Information for Detailed Design	There is a risk that material vendor information may not be available in time to complete Detailed Design.	2	Active	Francis Davis	Sameer Naeem	29-Apr-16	Mitigate	25-Nov-16	3	1	5	15	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6554	Not Started	80023 - Contact Material Vendor for Drawings to Support Detailed Design	Design to contact material vendor early in Detailed Design process to obtain any required drawings, bill of materials, etc. required to complete Detailed Design on time. Any risks with obtaining information in time are to be communicated to the Project Manager early.	Francis Davis	S Naeem	24-Jun-16										
14310	80023 SG LCV Replacement Risk Due to Unknown Installation Costs	There is a risk that the installation costs may be higher than originally anticipated and planned for.	2	Active	Francis Davis	S Naeem	29-Apr-16	Mitigate	16-Dec-16	3	3	4	12	2	2	3	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6550	Not Started	80023 - Obtain cost estimate for installation costs	Obtain cost estimate for installation costs following completion of Detailed Design.	Francis Davis	S Naeem	25-Nov-16										
14314	80023 SG LCV Replacement Installation Risk Due to Avaialbility of Other Station Resources During Outage Installation	Due to the large size of the LCV internals being replaced, other station resources (e.g. crane, operators, etc.) are needed. Availability of these other station resources during a unit outage may impact the project.	1	Active	Francis Davis	S Naeem	29-Apr-16	Mitigate	30-Mar-18	3	1	4	12	1	1	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6553	In Progress	80023 - Add Work to Outage Scope	Work is to be added to D1831 and future outages in OMS prior to Major Outage Scope Freeze. Note - Work Orders have already been added in OMS for the D1831 outage.	Francis Davis	S Naeem	24-Mar-17										
	80023 SG LCV Replacement Scope Risk Due To Unknown Valve Body	The condition of the LCV valve bodies is unknown. It has been assumed that no replacement of the valve bodies is required, and only retrofit will be required (based on replacement of actuators, valve trim, and positioners only). However, if the valve body condition is found to be degraded, the scope	2	Active	Francis Davis	S Naeem	29-Apr-16	Mitigate	24-Jun-16	2	4	5	10	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									

ONTARIO

POWER

GENERATION

Risk Report by Project with Associated Actions

Report ID: 0707A    [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

14311	Condition		6551	In Progress	80023 - Assess LCV Valve Body Condition	Determine valve body condition by completing the following: - Discuss with SRE / Component Engineer regarding valve body condition and any specific valves where valve body degradation was noted. - Inspect a representative sample of valve bodies in the station to assess condition.	Francis Davis	S Naeem	24-Jun-16										
14304	80023 SG LCV Replacement Quality/Performance and Technical Risk with Valve Manufacturer	There is a risk that manufacturing issues could result in valve trims that don't fit leading to schedule delays and cost increases. EVENT The valve trims are manufactured incorrectly. CAUSE Poorly Procured or designed valvesIMPACT cost and/or schedule	2	Active	Francis Davis	S Naeem	29-Apr-16	Mitigate	25-Nov-16	3	2	3	9	1	1	1	1		
	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											
	6555	Not Started	80023 - Ensure Accurate Field Measurements are Taken by Equipment Vendor	Ensure valve manufacturer obtains accurate field measurements prior to fabrication of valve trim and other materials to be installed, to ensure the valve trim and other components fit into the existing valve bodies.	Francis Davis	S Naeem	24-Jun-16												
14309	80023 SG LCV Replacement Material Cost Risk Due to Lack of Information	There is a risk that procurement costs may be greater than originally anticipated based on actual material costs following development of technical specification.	2	Active	Francis Davis	S Naeem	29-Apr-16	Mitigate	29-Jul-16	2	4	4	8	1	2	1	2		
	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											
	6549	Not Started	80023 - Obtain cost estimates for valves following approval of technical specification	Obtain cost estimate from vendors following approval of technical specification.	Francis Davis	S Naeem	29-Jul-16												
14312	80023 SG LCV Replacement Schedule Risk if All Installation Required to be Completed During Outage	The original plan is based on completing retrofit of 4 LCV's per unit during outage, and the remainder of the 4 retrofits per unit online. Also, not more than 4 LCV's were to be modified during a specific unit outage. This plan was developed in consultation with stakeholders during the COMS process. However, if it is determined following the first outage installation that the remainder of the LCV's also need an outage to modify, then this will increase the project schedule.	1	Active	Francis Davis	S Naeem	29-Apr-16	Monitor	13-Jul-18	1	1	5	5	1	1	1	1		
	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											
	6552	Not Started	80023 - Review Installation Strategy (Innage vs. Outage) Following AFS	Following first outage installation and AFS (currently planned for D1831), review with project stakeholders to confirm that remaining installations can be completed online.	Francis Davis	S Naeem	13-Jul-18												
Project: Engineering Services (Project) - 82825																			
14397	The extent of software validation testing may increase based on the outcome of the software design	The extent of software validation testing may increase based on the outcome of the software design, due to potential additions to the source code and number of programs that require rebuild, resulting in engineering cost increase.		Active	Bryon Engelage	Octavian Dumitru	25-Apr-16	Monitor	30-Sep-20	4	2	5	20	4	2	5	20		
	There are no Not Started, In Progress Actions associated with the risk.																		
14394	Insufficient internal engineering expertise available to support the software design process	Insufficient internal engineering expertise available to support the software design process, due to expected retirements throughout the definition phase, resulting in the need to use external resources that will increase the engineering cost.		Active	Bryon Engelage	Octavian Dumitru	25-Apr-16	Monitor	29-Nov-19	4	2	4	16	4	2	4	16		
	There are no Not Started, In Progress Actions associated with the risk.																		
14396	Future plant modifications with impact on control computers may need to be included in the current scope of software change	Future plant modifications with impact on control computers may need to be included in the current scope of software change when they are identified, resulting in design cost increase.		Active	Bryon Engelage	Octavian Dumitru	25-Apr-16	Monitor	31-Mar-20	4	1	3	12	4	1	3	12		
	There are no Not Started, In Progress Actions associated with the risk.																		
Project: Extended Operations -																			
	PNGS ExO - 30MO - Regulatory - Engineering - Cobalt Adjuster Rod	Issue: Pickering NGS Units 6, 7, 8 Cobalt Adjuster Rod irradiation Limit is 2.2 FPY. CNSC approval will be required to increase this irradiation limit to support a 30 month (2.5 year) outage interval on these	3	Active	Mike Ruffolo	Kristina Bramma	17-Mar-16	Mitigate	30-Sep-16	2	2	2	4	1	2	2	2		
	There are no Not Started, In Progress Actions associated with the risk.																		

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13610	Replacement [Window 82]	Impact: Components that do not fit must be replaced either with original parts that have been refurbished or with new parts that would have to be rush ordered both of which would impact the cost and schedule of the project by delaying critical path installation.	5342	In Progress	RAB Planning to include pre-installation and installation activities to mitigate delays	Project to work with installation vendor to ensure planning process and CWP's include pre-installation and installation activities to mitigate the risk of installation delays. Example: dimensional checks on bearings, mechanical components	Sorin Marinescu	Greg Maggs	30-Jun-16										
			5710	In Progress	Mitigation of Potential Rework Issues	To mitigate rework issues and cost, Project and Supply Chan to work with vendors to ensure necessary quality checks are included in the fabrication process and that CWP's incorporate necessary pre-installation and quality checks.	Sorin Marinescu	Greg Maggs	31-May-18										
11976	Trolley Refurbishment scope execution impacts Powertrack [Windows 39, 47, 52]	Event: Station staff schedules Trolley refurb work (also performed in the FFAA's) to the work windows designated for Power Track refurbishment adding additional staff to an already tight work environment. Cause: As per the Blue Ribbon initiative Trolley refurb work beign grouped with Power track Refurb. Impact: Both cost and schedule would be impacted if this were to occur as there could be co-ordination/delay issues.	2	Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Mitigate	31-Oct-17	2	2	4	8	1	2	3	3		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5727	In Progress	Address Interface Requirements between Refurb and DNGS	Address interface requirements between Refurb and DNGS as part of execution/implementation strategy, regarding trolley refurb (station scope). Then implement any required actions identified in execution/implementation strategy.	Sorin Marinescu	Greg Maggs	30-Jun-16										
			5728	In Progress	Interface Issues with Trolley Refurb (Station Scope) During Execution	Project to monitor execution and implement contingency if required to address issues during execution.	Sorin Marinescu	Greg Maggs	31-Oct-17										
11977	Discovery Work on Power Track Execution [Windows 39, 47, 52]	Event: Discovery Issue during Power Track Execution Cause: Field discovery issues such as configuration management or equipment degradation. Impact: Execution delay to resolve configuration or equipment conditions	2	Active	Sorin Marinescu	Greg Maggs	26-Apr-16	Mitigate	31-May-16	2	2	3	6	2	2	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5726	In Progress	Detailed Work Planning to Address Potential Discovery Work Issues	Project to address potential discovery work issues by involving both contractor and station stakeholders to review and assess potential discovery risks and issues, during detailed work planning.	Sorin Marinescu	Greg Maggs	31-May-16										
13381	Power Track ES MSA Staffing Agreement Impacts Execution Costs [Window 39, 47, 52]	Event: ES MSA contractor is unable to re-assign Power Track staff to other active projects during standby periods of the execution schedule. Cause: Each Power Track execution is made up of 17 work windows ranging from 4 to 28 days spread out over 6 months. In between each work window some staff may be able to work on preparation for the next window or may be reassigned to other projects, staff that cannot be doing prep work or be re-assigned will need to be paid standby time. Impact: Additional cost for standby time pay that the project will be responsible for.	2	Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Monitor	31-Oct-17	3	2	1	6	3	2	1	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5719	In Progress	Develop and Implement a Re-Assignment Strategy	Develop a project specific re-assignment strategy, working with the contractor.	Sorin Marinescu	Greg Maggs	31-May-17										
			5720	In Progress	Co-ordinate Re-Assignment Strategy	Co-ordinate trades re-assignment strategy with other Refurb projects and Work Control.	Sorin Marinescu	Greg Maggs	31-Oct-17										
13433	Breathing Air modification does not fully mitigate requirements during Execution [Window 39, 47, 52]	Event: Both Contractor team and Fuel Handling Maintenance and/or station staff working in Fuelling duct at the same time puts a significant load on the breathing air system. Cause: Trolley reliability failure occurs simultaneously with Power Track execution work causing both teams to be forced to work in th Fueling Duct simultaneously. Impact: Cost and schedule may be impacted if Breathing Air cannot support both activities simultaneously thereby increasing the amount of standby time the proejct must pay for Contractor staff.	2	Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Monitor	31-May-17	2	2	3	6	1	2	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5714	In Progress	SDLU Group to address the requirements for Breathing Air modifications necessary	Breathing Air mods to be planned and implemented to address Fuel Handling requirements during Powertrack execution.	Sorin Marinescu	Greg Maggs	31-May-17										
13609	Powertrack Engineering Support During Execution [Window 39, 47, 52]	Event: Engineering support is required during execution, examples: To modify Power Track frame, scaffolding, or other possible necessary modifications discovered during execution. Cause: Power Track contract is Procurement and Construction, as the project is "Like for Like". Therefore any Engineering support required would likely be provided by OPG engineering and not covered under current contract baseline. Impact: If this risk is realized OPG engineering support will be required, impacting cost and schedule.	2	Active	Sorin Marinescu		11-Apr-16	Mitigate	31-May-16	3	2	1	6	2	2	1	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5341	In Progress	Assess and Address the requirements for Engineering Support	Complete an assessment of requirement for Engineering support during execution, during detailed work planning. The project will address contingency requirements for Engineering support if it is found to be required during field execution phase.	Sorin Marinescu	Greg Maggs	31-May-16										
	Powertrack field execution requiress additional trades staff to be hired and trained	Event: Contractor staff recieve dose that limits their ability to perform RAD work requiring additional trade staff to complete execution work. Cause: Duration of Power Track refurbishment results in staff reaching dose limits	2	Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Mitigate	30-Jun-17	2	2	1	4	1	2	1	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									

13383	due to ALARA requirements for dose impacting project Schedule and Cost [Window 39, 47, 52]	Impact: Hiring of additional staff to maintain sufficient staff levels will be an additional cost on the project.	5717	In Progress	Develop ALARA plan with RP and Contractor	Develop ALARA plan with RP and contractor, taking into consideration the required resources and impact on project.	Sorin Marinescu	Greg Maggs	31-May-16								
			5718	In Progress	Ensure Actions from ALARA Plan are Implemented	Project to ensure actions from ALARA plan are properly implemented including implementation of additional staff as required.	Sorin Marinescu	Greg Maggs	30-Jun-17								
13422	RE-work and re-installation caused by Quality Issues with RAB ball screws impacting both project Cost and Schedule [Window 82]	Event: Quality issues with RAB Ball screws are discovered during installation and/or commissioning. Cause: Fabrication quality or fit-up issues with Ball Screws. Impact: Both cost and schedule would be impacted as re-work and re-installation would be required.	2	Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Mitigate	31-May-18	2	1	2	4	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5176	In Progress	Ball Screws QA to Ensure Quality	The project to implement any additional required oversight identified to minimize installation risks for the ball screw assemblies. This will include ensuring that OPG Supply Chain Quality Assurance is in place during fabrication to ensure all dimensional and quality requirements are met. This is based on past OPEX from Candu refurbishments that had issues with replacement ball screws. Also, following removal of the existing ball screws, maintain them in storage as a back-up option.	Sorin Marinescu	Greg Maggs	31-May-18								
			5716	In Progress	Review of Quality Assurance Requirements with focus on RAB Ball Screws	The project will work with Supply Chain to review the Quality Assurance requirements, with a particular focus on RAB Ball Screws.	Sorin Marinescu	Greg Maggs	31-Oct-16								
13435	Identification of Tooling Requiring Modifications to Station [Window 39, 47, 52]	Event: Engineering support is required during work planning to verify design of an anchor point, addition of shieve, or other modification to station identified prior to execution to perform Power Track replacement. Cause: Power Track contract is only Procurement and Construction, as the project is "Like for Like". But modifications may be required to safely install tooling needed to perform replacement. Impact: Unplanned costs due to Engineering support would be required.	2	Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Mitigate	31-May-17	2	1	2	4	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5189	In Progress	Identify Any Required ECC Modifications for Tooling	Work with the contractor during the work planning process, to identify requirements for tooling that require modifications, so enough time is left for dealing with any ECC processes.	Sorin Marinescu	Greg Maggs	28-Jul-16								
			5713	In Progress	Implement any Required Modifications for Tooling	If required, implement a plan to address any modifications required for tooling, that were identified during the work planning phase.	Sorin Marinescu	Greg Maggs	31-May-17								
13425	RAB Cat ID Exceptions due to changes in material/design results in a cost impact to material procurement [Window 82]	Event: Significant Cat ID tech specs, or drawings exceptions are found for RAB Components. Cause: Changes in the material or design by the vendor since the original Cat ID had been created. Impact: Increased cost due to material/design changes being required.		Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Mitigate	31-May-18	1	2	1	2	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5715	In Progress	Mitigate Impact to Schedule and Cost Due to Potential Exceptions to Cat ID	Project to work with Supply Chain and Procurement Engineering during procurement process, to assess any Cat ID exceptions identified. Mitigating activities will be determined and the project will then work with Supply Chain to implement actions to mitigate the issues. Ex 1: Design acceptance of deviations. Ex 2: Use of premium time with vendor as required to address exceptions.	Sorin Marinescu	Greg Maggs	31-May-17								
Project: Minor Modifications - 83061																	
14295	83061 - PNGS Stator Cooling Water Dissolved Oxygen Reduction - Software categorization	Event: Software qualification of one or more components or group of components is required for the successful implementation of this modification Cause: Due to the low chemical addition rates required for alkalyzation of the stator cooling water the metering pump to be used may have a PLC or other software. Impact: Software qualification would extend the implementation schedule by several months. Estimated at 5-6 months.	3	Active	Chris Chan	Jonathan Liberda	13-Mar-16	Monitor	31-Dec-16	3	2	4	12	2	2	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6707	In Progress	83061 - PNGS Stator Cooling Water - Software qualification	Chemical addition equipment may require software qualification (possible due to needing a PLC or other equipment). Software group involvement in the preliminary design process will be used to expedite the approvals required.	Chris Chan	Jonathan Liberda	03-Jun-16								
	83061 - PNGS Stator Cooling Water Dissolved Oxygen Reduction - Software categorization Run by:	Event: There is no finding to confirm testing of the stator cooling water and equipment requirements require	3	Active	Chris Chan	Jonathan Liberda	13-Mar-16	Mitigate	31-Dec-16	2	1	4	8	1	1	4	4
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14293	water Dissolved Oxygen Reduction - Chemistry testing funding	There is no funding to perform testing on the stator cooling water and equipment coupons to ensure no adverse effects as a result of the alkalization of the system. (eg: precipitation) Cause: Due to the expedited nature of this modification, PNGS minor modifications (MMOD) will provide bridge funding until BCS approval. It is possible that MMOD have insufficient funding to perform testing. Impact: Delay to the project until BCS approval. Expected total resultant delay is 2-3 months.	6696	In Progress	83061 - PNGS Stator Cooling Water - Tracking progress of project funding	Track BCS approval by P&M and corporate Chemistry to ensure funding available when required.	Chris Chan	Jonathan Liberda	27-May-16										
14294	83061 - PNGS Stator Cooling Water Dissolved Oxygen Reduction - Construction schedule risk	Event: Implementation of any required work during outage, for example on the stator cooling head tank, is to be completed during the next available outage. Preferred outage is 1671. This does not meet the require milestone dates as per N-PROC-MA-0013 R16, in particular milestone 10 - Scope Freeze. Cause: There is a short timeline between request for the modification (February 2016) and expected implementation (Q4 2016 to Q1 2017). Impact: Outage scheduling is prepared to minimize nuclear safety risk, maintenance windows, and permitry evolutions. Late scope additions require re-review of several of these considerations.	4	Active	Chris Chan	Jonathan Liberda	13-Mar-16	Avoid	31-Dec-16	2	1	4	8	2	1	4	8		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6699	In Progress	83061 - PNGS Stator Cooling Water 1671 outage scope injection	Implementation of stator cooling water sparging is likely to have some installation scope requiring outage. 1671 outage scope freeze milestone has passed, and any new scope much be progressed using a scope change form.  This action is to socialize the additional scope with the 1671 turbine SWC prior to formal scope change and then to track the scope change to implementation upon detailed design approval.	Chris Chan	Jonathan Liberda	30-Jun-16	April 1, 2016, email was sent to the SWC for the turbine highlighting possible addition of some work on the stator cooling head tank.									
14292	83061 - PNGS Stator Cooling Water Dissolved Oxygen Reduction - Construction funding availability	Event: The business case summary (BCS) for project 83061 - Implementation of Pickering 018 Stator Cooling Water (SCW) alkalization and make-up water deoxygenation has not yet been approved despite the need for this modification to be implemented in later 2016 to early 2017. Impact: There are no funds available to support execution of this project until the BCS is approved.	3	Active	Chris Chan	Jonathan Liberda	01-Apr-16	Mitigate	30-Jun-16	3	1	2	6	3	1	2	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6721	In Progress	83061 - Stator Cooling Water - Track spending under MMOD	Due to the expedited nature of this modification MMOD will provide bridge funding to progress the engineering. This action is to track the following: Establishment of tracking Tempus work events for future re-assignment upon BCS approval Periodic assessment of BCS approval to assure construction financing availability.	Chris Chan	Jonathan Liberda	06-May-16	TWE are setup for all project staff BCS is currently with projects and modification, AISC part A is approved. AISC part B in development. Project charter is in final approvals									
14297	83061 - PNGS Stator Cooling Water Dissolved Oxygen Reduction - Material availability	Event: The modification may require custom fabricated materials, such as a double walled chemical storage tank. Cause: There is a short timeline between request for the modification (February 2016) and expected implementation (Q4 2016 to Q1 2017). Impact: Such custom fabrications may have a long lead time. Potential impact to schedule is 4-5 months.	3	Active	Chris Chan	Jonathan Liberda	13-Mar-16	Mitigate	07-Jan-17	2	1	3	6	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6722	In Progress	83061 - PNGS stator cooling water - Preliminary design scoping for long lead items	As part of the preliminary design, possible long lead materials are to be identified and procurement to be started as early as possible.	Chris Chan	Jonathan Liberda	24-Jun-16	Preliminary design will include a review for potential long lead items. This action will be reviewed at that point.									
14296	83061 - PNGS Stator Cooling Water Dissolved Oxygen Reduction - Alkalization system tie-in point	Event: #-41240-V2036 cannot be used, either by modification with a Tee or other means such as TMOD or TALT, to allow for alkalization when required and/or online chemical cleaning when required. Cause: The proposed tie-in point #-41240-V2036 for the stator cooling alkalization system is also used for online chemical cleaning. Impact: The addition of a new injection point into the stator cooling water system will increase the cost and schedule of this modification. The extent of the impact will depend on finding a new location for injection.	3	Active	Chris Chan	Jonathan Liberda	13-Mar-16	Monitor	31-Dec-16	2	2	2	4	2	2	5	10		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6705	In Progress	Alkalization tie-in point availability to SCW system	Confirm that the online chemical clean tie-in point can be used for permanent alkalization addition. Possible system configuration may require isolation during online chemical cleaning, requiring the use of a Tee.	Chris Chan	Jonathan Liberda	01-Jun-16	Walked down the tie-in point. There is room to add a Tee, need confirmation during detailed design it can be used.									
Project: Minor Modifications - 82839																			
	Technical Specification for the LP FWHX procurement of need to updated	Event: Technical specifications prepared by the design are not updated with the comments from SME. Cause: The technical specs were prepared under emergent modifications.	4	Active	Sudesh Sakhuja	Rahul Arora	31-Mar-16	Mitigate	20-Jun-16	3	1	3	9	1	1	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									



14336		Impact: The will delay the bidding process for the submission of revised bid from vendors based on the revised performance parameters.	6727	In Progress	Revision of technical specifications for the LP Feedwater Exchnager procurment	Plant design had confirmed to revise the tech specs which include the revised performance parameters from SME (Kipling Office). Weekly meeting will be held to track the progress.	Sudesh Sakhuja		08-Jun-16											
14337	There is a risk that cost will be higher due to potential discovery issues.	Event: The modification is replacement of LP FW HX during the unit planned outage window. Cause: Considering the size of the equipment and space availability for the replacement will be a challenge. Impact: There is a risk that cost will be higher due to potential discovery issues during the replacement of equipment. It is known that existing insulation is asbestos and as such it could not be removed for further assessment of component at this time.	2	Active	Sudesh Sakhuja		31-Mar-16	Mitigate	20-Dec-16	2	1	3	6	1	1	2	2			
There are no Not Started, In Progress Actions associated with the risk.																				
Project: Minor Modifications - 80130																				
14343	Completion of Design Packages	Event - Design Packages may not be available as scheduled. Cause - Design resources not assigned. Impact - Delay in overall schedule and completion of modification	3	Active	Sudesh Sakhuja	Jai Raina	01-Apr-16	Mitigate	24-Jun-16	3	1	4	12	1	1	2	2			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			6724	In Progress	Working with project design	Working with Project design for support and the design resources will be outsourced.	Sudesh Sakhuja	Jai Raina	28-Oct-16											
14342	Delay in Schedule due to increase in scope	Event - Discovery during detailed design for unknown assumptions in preliminary design. Cause - Insufficient detail in the preliminary design. Impact - The schedule may be delayed by 3-6 months	3	Active	Sudesh Sakhuja	Jai Raina	01-Apr-16	Mitigate	10-Oct-16	1	2	4	4	1	2	2	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			6726	In Progress	Validation of Assumptions during Prelimenary design	During Preliminary design field walk downs will be held and the assumptions will be validated for any unknown findings. Opex from Fukushima will be reviewed and Level 1 logic will be tracked to keep the project on track	Sudesh Sakhuja	Jai Raina	24-Oct-16											
Project: Minor Modifications - 83056																				
14348	83056 - Pickering 014 Conveyor Stop Cylinder Replacements: Funding availability	Event: There is no funding approved to start work. Cause: Project is recently included on 2016 Project Start List. Event: Delay to project until BCS approval will cause an overall delay to the whole Modification.	4	Active	Chris Chan	Ali Shah	05-Apr-16	Mitigate	15-Apr-16	4	4	4	16	4	4	4	16			
			There are no Not Started, In Progress Actions associated with the risk.																	
14349	83056 - Pickering 014 Conveyor Stop Cylinder Replacements: Work Protection is available	Event: Confirm if Work Protection is available to install the modification. Cause: Work Protection shall be available to provide an isolation in the conveyor tube. Impact: To avoid any delay during installatona and commissioning.	4	Active	Chris Chan	Ali Shah	05-Apr-16	Mitigate	22-Apr-16	4	4	4	16	4	4	4	16			
			There are no Not Started, In Progress Actions associated with the risk.																	
14350	83056 - Pickering 014 Conveyor Stop Cylinder Replacements: Installation of isolation device is feasible	Event: Isoaltion device is feasible to install Cause: Isolation device must be safely installed to support the modification Impact: Delay to the project execution.	4	Active	Chris Chan	Ali Shah	05-Apr-16	Mitigate	22-Apr-16	3	2	2	6	2	2	4	8			
			There are no Not Started, In Progress Actions associated with the risk.																	
Project: Nuclear Waste Management (Project) - 60162																				
14143	Contractual AFS date delayed	Contractual AFS date is Feb 23, 2017. All change notices processed to date did not adjust the AFS date, however, current production schedule is showing April 2017 AFS. This is a result of delays in completing the building foundation and a longer than expected structural steel erection window.	4	Active	Sunantha Broekhuysse		11-Apr-16	Mitigate	30-Apr-16	5	1	4	20	3	1	4	12			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			6476	In Progress	60162	The recovery plan was presented by the vendor to OPG, the vendor will be entering the plan into P6. This has brought back the AFS to Apr 2016. The T-ALT will be converted into a TMOD as recommended by the DA.	Kevin Jayawardene		30-May-16											
	AFS risk due to delays in	The Safety Report / Safety Report Annex update and other supporting documentation, which is part	4	Active	Sunantha Broekhuysse		07-Apr-16	Accept	30-Apr-16	3	2	5	15	3	2	5	15			

13249	Licensing deliverables	or the licensing requirements need to be submitted and accepted by the CNSC before the in-service of the building.																		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			6478	In Progress	60162	A separate update before Feb 2017 to the CNSC needs to be discussed with licensing to confirm CNSC approval will be in place for building AFS. The Shielding Analysis now forecasted to Sept of 2016 and the project team is working with NSAD/Vendor to better the date.	Kevin Jayawardene		30-Sep-16											
14110	Risk of Fire Protection Code Alternative, Third Party Review, and Building Permit alternatives revision	Per SCR N-2015-27723, an amendment of the Fire Hazard Assessment (FHA) to address zirconium dust that will be present in the containers is required (FHA revision to consider potential combustibles in DSO). Any change in the FHA could have a potential impact on the Fire Protection Code Alternative, Third Party Review, and Building Permit Alternatives; revisions of the latter reports may delay the building in-service date.	3	Active	Sunantha Broekhuys		07-Apr-16	Accept	31-May-16	1	1	5	5	1	1	5	5			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
					6477	In Progress	60162	NW Design has characterized in a report the physical attributes of the nuclear waste in DSOs. The Project team and NW Design issued a new SOW for a revision to the FHA. NW Design has also identified the need to assess low level waste (LLW) in the FHA.T here will be a separate FHA report to assessment LLW. Project team and NW Design issued a new SOW for a revision to the FHA. The Vendor is obtaining an estimate, the due date for OPG acceptance is June 30th.	Kevin Jayawardene		30-Jun-16									
12990	CNSC approval of building code exemption	There is a risk of design changes if CNSC does not approve the code exemptions / equivalencies for washrooms, standpipe and fire access.	4	Active	Sunantha Broekhuys		02-May-16	Accept	31-Mar-16	1	1	1	1	1	1	1	1			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
					6479	In Progress	60162	Similar exemptions / equivalencies have been approved by CNSC for the DWMF and other buildings. CNSC correspondence with Laurie Swami for signing. CNSC has requested additional information for the approval of fire system design, the project team is I/P of submitting a response.	Kevin Jayawardene		30-May-16									
Project: Nuclear Waste Management (Project) - 60203																				
13014	Resource Availability	Risk of delays due to OPS/ Design/ Performance engineering resource availability. I.E. (delayed review of RFI, design submissions comment/ dispositions, design acceptance, COMS/ walk down support.)		Active	Bianca Radakovic		05-May-16	Mitigate	01-Aug-16	5	1	5	25	4	1	4	16			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
					6467	In Progress	60203	Alert resources of upcoming submissions & timelines and escalate resource issues to management	Bianca Radakovic		31-May-16	Ongoing Action								
					6470	In Progress	60203	Attend weekly design alignment meetings to discuss schedule, resource needs and priorities.	Sunantha Broekhuys		31-Jul-16	Ongoing Action								
					7076	In Progress	60203	1. Develop new work flow with vendor to spread out design reviews.	Bianca Radakovic		31-May-16									
					7086	In Progress	60203	Execute recovery plan for outstanding 50% design reviews.	Jason M Wight		16-May-16									
14449	Outstanding design issues preventing OPG acceptance	Various unresolved issues that may prevent final acceptance of the design per the schedule including: Lack of vendor equipment data, Power supply Tie in, Shielding rework, Stormwater requirements, IAEA camera locations.		Active	Bianca Radakovic		05-May-16	Mitigate	31-May-16	5	1	5	25	4	1	4	16			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
					7087	In Progress	60203	Advance procurement phase to obtain vendor drawings for major equipment.	Bianca Radakovic		30-Jun-16									
					7088	In Progress	60203	Develop conceptual design for power tie-in and incorporate into phase 2 design.	Bianca Radakovic		30-Jun-16									

			<a href="#">7089</a>	In Progress	60203	Obtain design concurrence on which EC's can be accepted now and which will be addressed in phase 2 design.	Jason M Wight		30-Jun-16										
				Active	Rafi Asadi		05-May-16	Mitigate	30-Jun-16	4	1	5	20	3	1	4	12		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6491</a>	In Progress	60203	Devise licensing plan and explore staggering license submission to commence CNSC review sooner.	Bianca Radakovic		30-Jun-16										
			<a href="#">6492</a>	In Progress	60203	Perform additional oversight and alert management of schedule risk.	Bianca Radakovic		30-Jun-16										
				Active	Bianca Radakovic		05-May-16	Mitigate	31-May-16	4	1	5	20	3	1	4	12		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6281</a>	In Progress	Vendor Data	1.Define critical equipment with the design agency. - Complete 2. Devise a strategy with supply chain to allow project to obtain equipment vendor data and engineering support. 3. Obtain NW Design Authority approval for gaps	Bianca Radakovic		31-May-16										
				Active	Bianca Radakovic		05-May-16	Mitigate	31-May-16	4	1	5	20	3	1	5	15		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6471</a>	In Progress	60203	OPG environment to determine environmental laws and applicability to NWMD.	Stephen Dickson		15-May-16										
			<a href="#">6472</a>	In Progress	60203	OPG design revise DR to eliminate ambiguities	Jason M Wight		31-May-16										
			<a href="#">6473</a>	In Progress	60203	OPG environment to address issues with MOE and set up meeting with municipality.	Lillian Yiu		31-May-16										
			<a href="#">6474</a>	In Progress	60203	Devise strategy with MOE & environment to determine which scope can proceed while approval is outstanding	Bianca Radakovic		31-May-16										
				Active	Bianca Radakovic		05-May-16	Mitigate	31-May-16	3	2	5	15	3	1	4	12		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6296</a>	In Progress	Building Collapse Study	Conduct Building collapse analysis in paralell to shielding analysis completion to enusre a structural solution exists that wont compromise the DSC integrity and to eliminate downstream churn.	Bianca Radakovic		31-May-16										
				Active	Bianca Radakovic		05-May-16	Mitigate	30-Sep-16	3	2	5	15	2	1	4	8		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6282</a>	In Progress	PB Cancellation / SB4 Design Re-work	Early communication with sponsor to alert to potential impacts and expedite decision	Bianca Radakovic		30-Sep-16										
				Active	Bianca Radakovic		05-May-16	Mitigate	15-Jun-16	3	1	3	9	3	1	2	6		

13017			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			4629	In Progress	60203	Complete shielding analysis with experienced vendor.	Rafi Asadi		15-Jun-16										
			6463	In Progress	60203	Engage NSATD & operations in key decisions and assumptions.	Bianca Radakovic		15-Jun-16										
13011	Storage Building Shielding	There is risk that the storage building will be required to be shielded heavily and constructed as a concrete bunker. Requiring design re-work and increasing project cost significantly.The cause of this risk is due to shielding analysis acceptance/requirements see risk ID 00013017. Building concrete bunkers will have additional engineering/Detailed design rework and construction cost.		Active	Sunantha Broekhuysse		05-May-16	Mitigate	01-Aug-16	4	2	1	8	3	2	1	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6464	In Progress	60203	Pursue changing 1% occupancy assumptions to reduce/eliminate shielding requirements.	Rafi Asadi		31-May-16										
			6465	In Progress	60203	Redo shiledding analysis with experienced vendor with proven performance.	Rafi Asadi		31-May-16										
			6466	In Progress	60203	Allocate contingency in BCS.	Bianca Radakovic		30-Aug-16										
Project: Nuclear Waste Management (Project) - 60217																			
13020	Quality of Current Cost Estimate	The current cost estimate for this project is Class 4, created internally based on a cost estimate provided by Tetra Tech as part of the Feasibility Study. There is a risk that the lower class cost estimate provided by the EPC vendor does not align with this cost estimate due to deviations in the scope proposed by the Feasibility Study. This may result in insufficient or excess funds being requested based on the current estimate of project costs.	4	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Mitigate	20-May-16	3	3	4	12	2	2	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			4723	In Progress	Base Cost Estimate on Vendor's Proposal	Prepare the project cost estimate on the basis of the EPC vendor's cost estimate given in their proposal. Complete negotiations to ensure the cost is in accordance with the scope and is not excessive. This will allow the project cost estimate to be in line with the vendor's proposal, and will ensure that sufficient funds will be requested with appropriate contingency.	Sharon Maddock	Steven Sahakian	20-May-16	Vendor proposal expected 06-May-16.									
13477	Sample Stations Building Accomodation for Equipment	There is a risk that the existing sample station buildings (MISA huts) cannot accomodate the new equipment necessary due to size constraints.	3	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Mitigate	22-Mar-17	3	3	4	12	2	2	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5196	Not Started	Review Design to Evaluate Need; Revise Scope if Necessary	Evaluate during early stages of the design phase. If structural changes (either to the MISA huts or sumps) or excavations are required, assess solutions and revise the scope accordingly. Ensure that sufficient contingency is assigned to support this need and to address this risk.	Sharon Maddock	Steven Sahakian	22-Mar-17										
13474	Sample Stations Structural Change Requirements	There is a risk that structural changes / excavations are required for the installation of Parshall flumes, sump pumps, power cables, and communication lines if current facilities do not support. The recommendation has not been evaluated in the Feasibility Report in sufficient detail.	3	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Mitigate	22-Mar-17	3	2	3	9	2	2	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5196	Not Started	Review Design to Evaluate Need; Revise Scope if Necessary	Evaluate during early stages of the design phase. If structural changes (either to the MISA huts or sumps) or excavations are required, assess solutions and revise the scope accordingly. Ensure that sufficient contingency is assigned to support this need and to address this risk.	Sharon Maddock	Steven Sahakian	22-Mar-17										
13484	Neglecting Other (Related) Modification Designs in Sample Stations Upgrade Design	There is a risk that the design of this modification is completed without consulting the concurrent or recently completed designs of other modifications which are related to and/or interface with the sample stations. This may result in an inadequate design.	2	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Avoid	22-Mar-17	3	1	3	9	2	1	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5201	Not Started	Review Design with Other DTLs and RSEs	Review the design with the DTLs and RSEs of such modifications at the 0%, 20%, 50%, and 95% design stages, as a minimum.	Sharon Maddock	Steven Sahakian	22-Mar-17										
	Lack of Operations and Maintenance Support for Confined Space Entries	There is a risk that Operations and Maintenance support is not available when required for multiple confined space entries. This could delay the project schedule.	2	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Avoid	17-Jul-17	3	1	3	9	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									

<a href="#">13486</a>			<a href="#">5202</a>	Not Started	Use Construction Islands for L&ILW Work	Perform all construction work for L&ILW Sample Stations # 1, 2, 3, 4a, 4b, and 6 in construction islands. For design-related confined space entries, use personnel provided by the vendor.	Sharon Maddock	Steven Sahakian	17-Jul-17										
<a href="#">13487</a>	No Electrical Isolation in Construction Islands	There is a risk that guaranteed electrical isolation, that ensures safe work in construction islands, is not provided.	2	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Avoid	17-Jul-17	3	1	3	9	1	1	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">5203</a>	Not Started	Submit Work Requests	Submit Work Requests for load verification for electrical equipment inside sample stations and sumps. WRs to be submitted sufficiently in advance to facilitate completion of load verification before start of construction.	Sharon Maddock	Steven Sahakian	17-Jul-17										
<a href="#">13480</a>	Less than Planned Simultaneous Sample Stations Work	There is a risk that work is allowed on less number of sample stations at a time than planned to reduce Operations overload. This could impact scheduling and result in a longer construction time.	2	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Mitigate	17-Jul-17	2	1	3	6	1	1	3	3		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">5198</a>	Not Started	Consult Early with Operations	Start early discussion with Operations and address any concerns in this regard. Build float in the schedule to address this risk.	Sharon Maddock	Steven Sahakian	17-Jul-17										
<a href="#">13482</a>	Lack of Vendor Specialization in Flow Measuring/Sampling	There is a risk that the vendor does not have or provide designers specialized in the field of flow measuring and sampling. This may result in an inadequate design.	4	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Avoid	22-Mar-17	3	2	1	6	2	1	1	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">5199</a>	Not Started	Ensure Designers are Qualified	RFP includes the requirement of designers experienced in this field. Ensure that requirement is followed by the vendor when reviewing the design.	Sharon Maddock	Steven Sahakian	22-Mar-17										
<a href="#">13483</a>	Conflicting Work in Sample Stations Area from Other Projects / Maintenance	There is a risk that construction on other projects / maintenance takes place at the same time as this project's construction. This may result in delaying the construction island turnover or in accessibility issues.	2	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Avoid	17-Jul-17	3	1	2	6	3	1	1	3		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">5200</a>	Not Started	Consult WWMF Scheduling for Field Work	Thoroughly review the schedule during construction planning in conjunction with plans for other field activities. Involve Operations and Maintenance, RSEs, and Project Leads on other projects to avoid this risk.	Sharon Maddock	Steven Sahakian	17-Jul-17										
<a href="#">13489</a>	Misinterpretation of OHSA Roles within the Contract	There is a risk that the vendor is not quite clear about the OHSA roles and responsibilities as some of the work is to be conducted in a Zone 2 operating area (SS5) while the rest is in construction islands. As a result, the vendor may end up following their own health, safety, and environment plans and procedures in Zone 2 or conversely, OPG procedures in construction islands.	2	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Avoid	17-Jul-17	2	2	2	4	1	2	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">5205</a>	In Progress	Prepare RFP Documentation Appropriately	Identify the roles clearly in the SOW document. Prepare two separate ES MSA Worksheets.	Sharon Maddock	Steven Sahakian	01-Apr-16	Roles clearly identified in the SOW and two ES MSA Worksheets were prepared. A pre-bid walkdown and meeting was held to clarify the roles. The contract will be split between separate ES MSA appendices for Owner-Only and Owner-Constructor.									
			<a href="#">5206</a>	Not Started	Turnover Construction Islands Through Appropriate Procedures	Turnover construction islands through the OPG-wide Owner-Only Project Guide (OPG-GUID-08965-0004) and the site-specific Temporary Turnover of Authority Care and Control (W-INS-08130-00002) instruction, which will be revised prior to construction island work on this project. Ensure all steps are followed. Also included in these is to provide pre-job briefs, which will be completed before starting work on SS5. Do not start work in the UFDSF Zone 2 operating area until all work in L&ILW construction islands has been completed.	Sharon Maddock	Steven Sahakian	17-Jul-17										

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<a href="#">1437</a>		direction of the project has been changed a few times in 2015. Cost may increase or the project may need a new BCS should the sponsor's direction change on building LLSBs on the North Site.	There are no Not Started, In Progress Actions associated with the risk.														
Project: Nuclear Waste Management (Project) - 60167																	
<a href="#">13558</a>	Design Completion Delay	There is a risk for late design completion due to technical risks associated with the modifications; the implementation schedule will consequently be affected.	3	Active	Julie Lawrence		05-May-16	Mitigate	30-Sep-16	5	4	5	25	1	1	4	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5280</a>	In Progress	Weekly Review of Schedule with Contractor	Weekly review of the schedule with contractor to ensure project milestones are met.	Julie Lawrence		29-Jul-16	Draft schedule received from contractor. Risk score to remain at 5 Baseline schedule was received April 14 from Designer. OPG has reviewed and accepted with minor comments: DCS required for first 3 MODS prior to date provided in schedule. UPS modification must be completed prior to Sept 15, 2016							
			<a href="#">5317</a>	In Progress	Recovery Plans for Modifications	Prepare recovery plans for modifications that are at risk of not meeting milestones.	Julie Lawrence		21-Jun-16	Spray cooler elbow modification - EC to be scoped into W16P2 outage schedule Feedram modification EC TCD JUN8- Delay will require recovery schedule MCC 2/3 modificaotn EC TCD 25MAY - Delayed will require recovery schedule							
			<a href="#">5321</a>	In Progress	Weekly Designer Meetings with NWDE DTL, DE's & Contractor	Weekly designer meetings with vendor:  To identify and address issues related to document quality To identfy and address any discrepancies between design drawings and field conditons To address technical issues related to modifications that may impact in design completion delays	Julie Lawrence		21-Jun-16	Weekly designer meeting are ongoing. If urgent matter for resolution then designer contacts OPG design when needed.							
<a href="#">13603</a>	Assigned Internal Resources Not Meeting Project Schedule	There is a risk that assigned internal resources cannot meet the project schedule leading to schedule delays.	3	Active	Julie Lawrence		06-May-16	Mitigate	15-Sep-17	5	3	5	25	3	2	3	9
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5318</a>	In Progress	Weekly Progress Meetings	Weekly progress meetings to be held to review deliverable status. Issues will be escalated when swift resolution is not met to ensure appropriate priority is assigned to project deliverables.	Julie Lawrence		15-Sep-17	challenge continues to obtain OPS/MTCE support . Weekly meetings with Project Sponsor and Manager of Projects to review top project priorities Escalation is in progress. OPS & MTCE unable to provide support in a timely manner based on availability of resources and other priority work. REF SCR N-2016-02422 and N-2016-02424							
<a href="#">13606</a>	Configuration Management Issues	There is a risk of project expriences configuration management issues. Drawings and actual field conditions may not match leading to incorrect design.	3	Active	Julie Lawrence		06-May-16	Mitigate	21-Jun-16	5	5	4	25	1	5	4	5
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5321</a>	In Progress	Weekly Designer Meetings with NWDE DTL, DE's & Contractor	Weekly designer meetings with vendor:  To identify and address issues related to document quality To identify and address any discrepancies between design drawings and field conditons To address technical issues related to modifications that may impact in design completion delays	Julie Lawrence		21-Jun-16	Weekly designer meeting are ongoing. If urgent matter for resolution then designer contacts OPG design when needed.							

			<a href="#">5322</a>	In Progress	Detailed Field Walkdowns	Perform detailed field walkdown with contractor and subcontractors to verify design drawings and field conditions match.	Julie Lawrence		21-Jun-16	Walkdown of Lime system identified configuration mgmt issue N-2016-08211. Walkdown of spray cooler elbow identified configuration mgmt issue N-2015-23669. Issue added to ITF								
<a href="#">13576</a>	EPC Costs Greater than Estimated in Release	There is a risk that EPC estimates are greater than the amount estimated in the release. This may be due to underestimation and/or mismanagement of project funds; consequently the project progress is impacted.	4	Active	Julie Lawrence		06-May-16	Mitigate	15-Sep-17	4	5	1	20	2	1	4	8	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">5288</a>	In Progress	Weekly Monitoring of Actual Costs	Actual costs to be monitored on a weekly basis while ensuring deliverables are being completed	Julie Lawrence		15-Sep-17	Oncore reports shows increased spend causing concern of deliverables vs spend. New DSP commenced design and removed DSP costs not settled to date. Raise financial risk to 5.								
			<a href="#">5289</a>	In Progress	ES MSA Vendor Progress per Schedule Monitored	ES MSA vendor progress per their schedule is monitored closely to ensure OPG is getting value for the money	Julie Lawrence		15-Sep-17	Vendor progress is struggling to maintain schedule. closer review required May 2016								
			<a href="#">5315</a>	In Progress	Review of Detailed Designs	Review detailed designs to ensure MDR requirements are met and vendor is not providing more than the DR requires.	Julie Lawrence		21-Jun-16									
<a href="#">13615</a>	Inaccurate Labour Cost Estimates	There is a risk that inaccuracies in labour cost estimates (i.e. over-optimistic execution schedule) will lead to construction costs being higher than estimated.	2	Active	Julie Lawrence		06-May-16	Mitigate	15-Sep-17	4	4	2	16	2	1	4	8	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">5347</a>	Not Started	Review of Construction Estimates and Associated Contingency	Construction estimates are challenged and reviewed against other recent construction projects. Ensure specific contingency set aside for cost estimate/level of effort errors.	Julie Lawrence		15-Sep-17	ES Fox is currently in the process of reviewing their proposal from April 2015 and will be submitting a revised estimate								
<a href="#">13616</a>	Legacy Issues with Existing Equipment Tie-ins	There is a risk that legacy issues with existing equipment tie-ins may result in field changes.	2	Active	Julie Lawrence		06-May-16	Mitigate	27-Feb-17	4	2	4	16	2	1	4	8	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">5348</a>	Not Started	Constructability Walkdowns	Perform constructability walkdowns on design to identify and address legacy issues with equipment tie-ins.	Julie Lawrence		30-Sep-16									
<a href="#">13604</a>	Design Resources Unavailability	There is a risk that design resources could be diverted from this project to higher priority projects resulting in schedule delays.	3	Active	Julie Lawrence		06-May-16	Mitigate	15-Sep-17	3	2	5	15	2	1	4	8	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">5319</a>	In Progress	Design Review Meetings	DTL and Project Lead to discuss resource issues. Issues should be escalated when swift resolution is not met.	Julie Lawrence		15-Sep-16	SCR-N-2015-27664 captured unavailability of Design Resources to support this project Since submission of this SCR augmented staff has been assigned to the project -								
<a href="#">13572</a>	Long Lead Time Items Procurement Delay	There is a risk that delay in procurement of long lead time items due to inability to complete design phase may result in schedule delays.	4	Active	Julie Lawrence		06-May-16	Mitigate	29-Mar-16	3	2	4	12	2	2	3	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">5281</a>	In Progress	Early Identification and Cost Estimation of Long Lead Items	Instruct contractor to identify and cost estimate any long lead items early in design review.	Julie Lawrence		30-Jun-16	Specifications are in process of being submitted by DSP. All tech specs should be accepted by OPG by end of May								
	Construction Errors Leading to Delays	There is a risk that construction errors leads to schedule delays.	2	Active	Julie Lawrence		06-May-16	Mitigate	15-Sep-17	3	3	4	12	2	2	3	6	



13613			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5344	Not Started	Review ITP & WP and Instruct Contractor on Likely Errors	Review ITP accurately and instruct contractor of any errors that may likely occur. Ensure OPG hold points are included in ITP.	Julie Lawrence		15-Sep-16								
			5345	Not Started	OPG Field Engineering Oversight	Ensure OPG field engineering oversight is supporting construction planning. Ensure field engineering oversight support all fieldwork schedule as part of work plan.	Julie Lawrence		15-Sep-17								
13618	Unavailability of Staff During Execution	There is a risk that OPG, Contractor, or Trades resources are unavailable to meet schedule milestones during execution.	2	Active	Julie Lawrence		06-May-16	Mitigate	15-Sep-17	3	2	4	12	1	1	3	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5350	Not Started	Addressing Staff Unavailabilty Concerns	To address staff unavailability concerns ensure work orders are scheduled properly, regular communication is maintained with stakeholders, union halls are notified early on upcoming work, and supplemental staff is hired ahead of time when necessary.	Julie Lawrence		15-Sep-17								
13622	Commercially Available Technology Not Implemented	There is a risk that commercially available technology will not be implemented, and cosequently project cost and schedule may be impacted.	2	Active	Julie Lawrence		06-May-16	Mitigate	21-Jun-16	3	4	4	12	1	1	4	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5360	In Progress	Procurement of Commerically Available Technology	Designs shall be reviewed and vendor will be challenged to procure commercially available technology. In the event the technology is not available OPG will review the proposal and the MDR(s) may require revisions as a result.	Julie Lawrence		21-Jun-16								
13574	Planned Work Not Aligning with Outage Schedule	There is a risk that planned work does not meet with the outage due to poor planing and/or work requests not being approved. The impact may cause project delays.	3	Active	Julie Lawrence		06-May-16	Mitigate	15-Sep-17	3	3	3	9	2	2	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5286	In Progress	Ensure Approved Planned Work Aligns with Outage Schedule	Align approved work requests with the outage schedule to complete the planned work during outage.	Julie Lawrence		15-Sep-17								
			5287	In Progress	Monthly Assessment of Planned Work Schedule	Assess the status of planned work schedule weekly	Julie Lawrence		15-Sep-17	Weekly Reports are reviewed in a weekly meeting with work planning, project representative, and contractor.							
13605	Poor Quality Vendor Documents	There is a risk that poor quality documents from the vendor may require additional rounds of review by OPG thereby delaying the schedule.	3	Active	Julie Lawrence		06-May-16	Mitigate	21-Jun-16	3	1	3	9	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5320	In Progress	Schedule Interim Review	Schedule interim review to identify and resolve issues before final documents are submitted to OPG.	Julie Lawrence		21-Jun-16								
			5321	In Progress	Weekly Designer Meetings with NWDE DTL, DE's & Contractor	Weekly designer meetings with vendor:  To idenitfy and address issues related to document quality To idenitfy and address any discrepancies between design drawings and field conditons To address technical issues related to modifications that may impact in design completion delays	Julie Lawrence		21-Jun-16	Weekly designer meeting are ongoing. If urgent matter for resolution then designer contacts OPG design when needed.							
	Regular Oversight Unavailable	There is a risk that regular oversight is unavailable leading to construction errors.	2	Active	Julie Lawrence		06-May-16	Mitigate	15-Sep-17	2	3	4	8	1	2	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

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13614			5345	Not Started	OPG Field Engineering Oversight	Ensure OPG field engineering oversight is supporting construction planning. Ensure field engineering oversight support all fieldwork schedule as part of work plan.	Julie Lawrence		15-Sep-17								
			5346	Not Started	Field Walkdowns with OPG Project Lead and Contractor Project Lead	Ensure field walkdowns are performed with OPG project lead and Contactor project lead to maintain project oversight.	Julie Lawrence		15-Sep-17								
13573	Undefined Design Scope	There is a risk that the design scope is not clearly defined and understood by the vendor causing more reviews and leading to delays in unapproved design and project schedule delays.	4	Active	Julie Lawrence		06-May-16	Mitigate	15-Sep-17	2	2	3	6	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5284	In Progress	Weekly Project Status Meetings	Recurring weekly meetings to review project status (Monday PM to PM, Tuesday internal OPG, Thursday Vendor PM to all design stakeholders)	Julie Lawrence		15-Sep-17								
			5285	In Progress	Timely Response by Project Team	Timely response to reviews, RFIs, comments and dispositions, and regular attendance at weekly meetings.	Julie Lawrence		15-Sep-17	timely responses to reviews, RFIs comments and dispositions and regular attendance at weekly meeting is not consistent. Resource loadings are not aligned to support the project. Escalation is in progress with Operations and Maintenance resource requirements. Design Engineering not has augmented staff to support effective date 8JAN15							
13617	Project Execution Schedule Conflicts with Non-incinerator WWMF Outage Work	There is a risk that schedule conflicts with non-incinerator related WWMF outage work leading to construction delays.	2	Active	Julie Lawrence		06-May-16	Mitigate	15-Sep-17	2	1	2	4	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5349	In Progress	Coordination of Execution Activities with Outage Planning	Coordinate execution activities with outage planning.	Julie Lawrence		15-Sep-17	many scope injection to planned outages for pre-execution tasks taking place. Project needs to address scope issues during outage planning to avoid scope injection planning activities and meetings are ongoing weekly for W16P1 and W16P2 outages							
Project: Nuclear Waste Management (Project) - 80034																	
13721	Cost Increase due to Waste in LLSBs cannot be removed	There is a risk that some of the waste in the buildings cannot be moved, this would increase the cost of installing the new fire detection system.	3	Active	Amar Sood		22-Apr-16	Accept	29-Dec-17	5	1	4	20	5	1	4	20
			There are no Not Started, In Progress Actions associated with the risk.														
14171	Resource risk due to other priority work	There is a risk that due to other priority work, OPG resources or ES MSA contractor resources may not be available during construction. This may negatively impact the project schedule.	2	Active	Amar Sood		22-Apr-16	Mitigate	01-Sep-16	4	3	5	20	3	2	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
14170	Schedule impact due to reduced available space for emptying LLSBs	This is a risk of reduction of available space for emptying LLSBs due to continuing receiving of new waste.		Active	Amar Sood		22-Apr-16	Accept	30-Jun-17	4	4	4	16	4	2	4	16
			There are no Not Started, In Progress Actions associated with the risk.														
13724	Schedule delay due to winter weather impact on outdoor work	There is a risk that outdoor work may be significantly delayed due to inclement weather during winter time.	3	Active	Amar Sood		22-Apr-16	Mitigate	29-Dec-17	4	3	3	12	3	1	1	3
			There are no Not Started, In Progress Actions associated with the risk.														
13723	Schedule delay due to LLSB overhead door problems	There is a risk that the schedule may be negatively impacted by operability of overhead door for LLSBs 1 through 10.	3	Active	Amar Sood		22-Apr-16	Mitigate	29-Dec-17	2	1	2	4	1	2	3	3
			There are no Not Started, In Progress Actions associated with the risk.														



Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

Project: Nuclear Waste Management (Project) - 60218																			
13726	Delay in Closeout of POs 220438 and 229265 due to Outstanding Payouts and Rate Settlements	There is a risk that the closeout of POs 220438 and 229265 is delayed due to Performance Fee payouts, the outstanding rate increase, and PMT (project management) rates being negotiated between OPG Supply Chain and the vendors, Black & McDonald and RCM Technologies.	1	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Accept	29-Jul-15	3	1	2	6	3	1	2	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5695	In Progress	Follow Up with Supply Chain	OPG Supply Chain to complete settlement of payouts and rates which will allow for ES MSA POs to be closed. Follow up with Supply Chain on the status of this.	Sharon Maddock	Steven Sahakian	30-Sep-15	COMPLETED (09-Sep-15): Followed up with Supply Chain. They are in the last stages of settling these payouts and rates and will follow up with Projects upon completion. Now depends on EPSCA unions posting their rates. Action to close once POs can be closed.									
Project: Nuclear Waste Management (Project) - 60219																			
13943	Delay in Closeout of PO 228027 due to Outstanding Scope Addition Work	There is a risk that the closeout of PO 228027 is delayed due to outstanding WUFDSE Room 129 Overpressurization work, included as a scope addition to this PO, documented by PCA: PO-228027-2014-002. Installation of the louver, damper, and actuator is completed but software changes and tie-in to the HUND system still remain.	3	Active	Sharon Maddock	Steven Sahakian	04-May-16	Mitigate	29-Jul-16	3	1	3	9	1	1	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5794	In Progress	Communicate with Project Lead and Vendor	Communicate with the Project Lead and vendor on this status of this work to ensure it will be completed.	Sharon Maddock	Steven Sahakian	29-Jul-16	New PO line item to be issued to transfer work to project 60145 by 29 July 2016. This will remove all risk associated with this project.									
13728	Delay in Closeout of POs 221230 and 228027 due to Outstanding Payouts and Rate Settlements	There is a risk that the closeout of POs 221230 and 228027 is delayed due to Performance Fee payouts, the outstanding rate increase, and PMT (project management) rates being negotiated between OPG Supply Chain and the vendors, ES Fox (EPC) and Black & McDonald (conceptual engineering).	1	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Accept	29-Jul-15	3	1	2	6	3	1	2	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5695	In Progress	Follow Up with Supply Chain	OPG Supply Chain to complete settlement of payouts and rates which will allow for ES MSA POs to be closed. Follow up with Supply Chain on the status of this.	Sharon Maddock	Steven Sahakian	30-Sep-15	COMPLETED (09-Sep-15): Followed up with Supply Chain. They are in the last stages of settling these payouts and rates and will follow up with Projects upon completion. Now depends on EPSCA unions posting their rates. Action to close once POs can be closed.									
Project: Nuclear Waste Management (Project) - 80032																			
14234	Pending Changes (EC-118441) could impact Software EC Completion	The changes from the reconfiguring the Generator Control Logic (as part of EC 118441) in not expected to be complete before mid May 2016. However, the Software Qualification (EC133290) for this project is to be completed by August 30, following the Software Integration Testing. The current timelines for integrating the 2 ECs has the potential to delay Engineering completion, and also result in some rework for completing the Software EC.	3	Active	David Calkin	Rajkumar Ramaswamy	29-Apr-16	Mitigate	30-Jun-16	4	4	5	20	2	1	3	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			7005	In Progress	Complete Software for EC118441	Complete software portion of EC118441- Generator Control Logic.	Sharon Maddock	Lashan Munasinghe	29-Jul-16	In-progress									
14416	Impact of this BMS modification on interfacing Data Handling System has not been verified	The communication protocol between the New BMS and the Data Handling System has not been confirmed. If this design is not confirmed the alarms from the BMS may not be available at the Data Handling System.	4	Active	Rajkumar Ramaswamy	Parames Misra	29-Apr-16	Mitigate	30-Jun-16	4	1	4	16	1	1	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6979	In Progress	Develop Test Bed to confirm communication protocol between DSF BMS and Datahandling System	Fox Sub-contractor to develop test bed to confirm the communication protocol between BMS and Data Handling Sysytem.	David Calkin	Rajkumar Ramaswamy	30-Jun-16										
	EPC Contract cost could increase due quality of the estimate.	The EPC estimate is a Performance Fee proposal. Inadequate scope control could result in scope/cost growth		Active	David Calkin	Rajkumar Ramaswamy	29-Apr-16	Mitigate	29-Aug-16	3	1	3	9	3	1	3	9		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									

14060				6294	In Progress	Conduct bi-weekly verification of the design work progress.	Provide adequate project oversight to manage cost growth. Schedule regular bi-weekly progress meetings and review design deliverables.	David Calkin	Rajkumar Ramaswamy	30-Aug-16	Weekly project review meetings are scheduled for a set of standard agenda items, to monitor the earned value. All Engineering deliverables are milestone based, and hence the risk is low. However, the OPG Project/ Engineering staff will be at the Engineering Contractors site to physically review the the progress, and ensure OPG receives value for money. The Engineering contractor will also upload all deliverables (monhly basis) to a sharepoint site, to enable OPG monitor the design progress.									
13747	Software Categorization and Qualification issues not fully resolved, adequate documentation not available	The initial screening has indicated that the software needs to be Cat 2. The Building Management System (BMS) communicates alarms to the WVRB Control Room, for operator action during evenings and weekends, when the Processing Building is unmanned. The WVRB Control Room is designated as Cat 2. The BMS is primarily designated Cat 2, only because it is providing input to the Cat Software (WVRB). Currently the Incinerator Upgrades project is working on reducing the Cat 2 designation of the WVRB software. This would imply that the BMS software categorization could also be lowered.Additionally, no adequate Software System Requirements/ Design Description documentation is available.	4	Active	Bana Berro	Parames Misra	22-Apr-16	Monitor	29-Sep-15	2	1	4	8	2	1	4	8			
			There are no Not Started, In Progress Actions associated with the risk.																	
Project: Nuclear Waste Management (Project) - 60145																				
14042	Wraparound Engineering Completion	There is a risk that Wraparound Engineering (ECC Transitioning to Nuclear ECC) will be delayed due to outstanding design documents.	3	Active	Sharon Maddock	Lashan Munasinghe	29-Apr-16	Mitigate	31-Oct-16	3	2	4	12	2	2	3	6			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			6022	In Progress	Obtaining Revised As-Builts from Designer of Record	Designer of Record (WalterFedy) has revised and provided all As-Builts with Field Changes incorporated. Several As-Builts from Designer of Record (Areva) are outstanding.	Sharon Maddock	Lashan Munasinghe	29-Jul-16											
Project: Nuclear Waste Management (Project) - 80056																				
14055	AFS Vehicle Modification Dates will not be achieved because of GEN4 Trunnion issues.	AFS vehicle modification dates will not be achieved for LiftKing Vehicles,LT1366K on July 28, 2016, LT13558K on January 12, 2017, LT1025K on June 15, 2017 due to GEN 4-2 Trunnion failure issues which has delayed the start of the first vehicle modification from September 15, 2015. Operation will not place GEN4s back into service until the Trunnion issue been resolved to allow the release of the LiftKing vehcles for modifications.	4	Active	Sunantha Broekhuysse	Paul Menard	04-May-16	Accept	29-Apr-16	5	5	5	25	1	1	1	1			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			6284	In Progress	Operation to Release LiftKing vehicles to start vehicles modifications.	Operation will not release Liftking Vehicles until the GEN4 Trunnion Failure issues have been resolved to their requirements.	Sunantha Broekhuysse	Paul Menard	28-Jun-16	Received verbal confirmation on May 3, 2016 from Sponsor, LT1366K will be ready to ship to the vendor for Modification on June 28, 2016, thus re-starting the project that has been on hold since September 15, 2016.										
			6285	In Progress	Provide LiftKing Revise Plan due to delays caused by GEN4 trunnion failure issue.	Provide a Project Revise Plan once Operation release the GEN4s back into Operation to allow the LiftKing vechilce to be modified.	Sunantha Broekhuysse	Paul Menard	18-May-16	Waiting for Operations provide a release date of the 3 LiftKings in order to provide a revised fabrication schedule. On May 3, 2016, Sponsor verbally advised that LT1366K will be ready to ship to the Vendor for modification on June 28, 2016 thus re-starting the project from September 15, 2015. Project will require two weeks to prepare a revised acceptable schedule and initiate a PCRAF for June AISC approval.										
	Extend Liftkting Vehicle Modification duration due to Vendor's shoo availability.	Three vehicle modification at the vendor is expected to take 4 months each. The duration and the timing on each vehicle modifications was agreed with the vendor based on a start of modification starting September 15. 2015 and ending April 16. 2017. Pending vendor's shoo loading the overall	3	Active	Sunantha Broekhuysse	Paul Menard	04-May-16	Mitigate	31-May-16	2	1	3	6	1	1	3	3			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										

<a href="#">14335</a>		modification duration may increase.	<a href="#">6284</a>	In Progress	Operation to Release LiftKing vehicles to start vehicles modifications.	Operation will not release Liftking Vehicles until the GEN4 Trunnion Failure issues have been resolved to their requirements.	Sunantha Broekhuysse	Paul Menard	28-Jun-16	Received verbal confirmation on May 3, 2016 from Sponsor, LT1366K will be ready to ship to the vendor for Modification on June 28, 2016, thus re-starting the project that has been on hold since September 15, 2016.								
Project: Nuclear Waste Management (Project) - 60168																		
<a href="#">14077</a>	Inadequate Quality of Fabricated MPTP-TDO Packages	Due to potential lack of fabricator experience, there is a risk that the quality of the 2 fabricated MPTP-TDO packages will not be suitable to OPG. Potential quality problems can impact cost, schedule, and scope of the project.		Active	Antonio Criminisi		29-Apr-16	Mitigate	30-Jun-17	1	1	3	3	1	1	1	1	
There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">14075</a>	Increased Cost for MPTP-TDO Trailer Design	Risk that existing MPTP-TDO trailer design may not be suitable for current operations and require further changes, therefore increasing project cost and scope.		Active	Antonio Criminisi		29-Apr-16	Mitigate	28-Oct-16	1	1	1	1	1	1	1	1	
There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">14076</a>	Delay in Issuing Purchase Order for MPTP-TDO Trailer	There is a risk that engineering assessment on MPTP-TDO Trailer determines the need for additional engineering work on pre-existing Trailer design, therefore increasing scope and impacting schedule.		Active	Antonio Criminisi		29-Apr-16	Mitigate	28-Oct-16	1	1	1	1	1	1	1	1	
There are no Not Started, In Progress Actions associated with the risk.																		
Project: Nuclear Waste Management (Project) - 60152																		
<a href="#">14079</a>	Scope Changes	Unexpected design changes arise that result in increased scope related to the remaining two MPTP-SF's. These include required Engineering Change Control activities, procurement costs, and required Material changes.		Active	Amar Sood		29-Apr-16	Mitigate	31-May-18	2	2	1	4	2	2	1	4	
There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">14081</a>	Fabricator Resource Issues	ES-MSA fabricator encounters resource issues during the fabrication of the MPTP-SF.		Active	Amar Sood		29-Apr-16	Mitigate	31-Mar-18	2	1	2	4	2	1	2	4	
There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">14080</a>	Schedule Delay to MPTP-SF Fabrication	The vendor is unable to complete the fabrication and delivery on schedule due to quality/technical issues.		Active	Amar Sood		29-Apr-16	Mitigate	30-Mar-18	1	1	1	1	1	1	1	1	
There are no Not Started, In Progress Actions associated with the risk.																		
Project: Nuclear Waste Management (Project) - 60155																		
<a href="#">14084</a>	Detailed Engineering Schedule Delays Encountered	Possible error / omission is discovered in OPG's Preliminary Engineering Package by the Vendor during detailed engineering.ECC wrap around with the Vendor. The detailed design for the ISO's is being done for the first time and there are possibilities of schedule impacts.		Active	Amar Sood		29-Apr-16	Mitigate	31-Aug-16	3	1	3	9	3	1	3	9	
There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">14085</a>	Unexpected Technical Issues Arise	Technical issues and challenges are raised during the vendor Detailed Design activities and identification of potential international fabricators for the packages.		Active	Amar Sood		29-Apr-16	Mitigate	30-Sep-16	3	3	3	9	3	3	3	9	
There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">14082</a>	Increase of Planned Costs	Detailed Engineering costs increase due to potential design changes or re-work due to errors found in the OPG Preliminary Engineering package.		Active	Amar Sood		29-Apr-16	Mitigate	30-Sep-16	3	1	1	3	3	1	1	3	
There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">14083</a>	Increase to Vendor Scope of Work	Vendor identifies additional work as part of Detailed Engineering activities in order to comply with Engineering Change Control Governance (ECC).		Active	Amar Sood		29-Apr-16	Mitigate	30-Sep-16	3	1	1	3	3	1	1	3	
There are no Not Started, In Progress Actions associated with the risk.																		
Project: Nuclear Waste Management (Project) - 80131																		
<a href="#">14084</a>	Detailed Engineering Schedule Delays Encountered	Possible error / omission is discovered in OPG's Preliminary Engineering Package by the Vendor during detailed engineering.ECC wrap around with the Vendor. The detailed design for the ISO's is being done for the first time and there are possibilities of schedule impacts.		Active	Amar Sood		29-Apr-16	Mitigate	31-Aug-16	3	1	3	9	3	1	3	9	
There are no Not Started, In Progress Actions associated with the risk.																		

14085	Unexpected Technical Issues Arise	Technical issues and challenges are raised during the vendor Detailed Design activities and identification of potential international fabricators for the packages.	3	Active	Amar Sood		29-Apr-16	Mitigate	30-Sep-16	3	3	3	9	3	3	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
14082	Increase of Planned Costs	Detailed Engineering costs increase due to potential design changes or re-work due to errors found in the OPG Preliminary Engineering package.	3	Active	Amar Sood		29-Apr-16	Mitigate	30-Sep-16	3	1	1	3	3	1	1	3
			There are no Not Started, In Progress Actions associated with the risk.														
14083	Increase to Vendor Scope of Work	Vendor identifies additional work as part of Detailed Engineering activities in order to comply with Engineering Change Control Governance (ECC).	3	Active	Amar Sood		29-Apr-16	Mitigate	30-Sep-16	3	1	1	3	3	1	1	3
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Nuclear Waste Management (Project) - 60127																	
14261	Lack of Resource Priority	There is a risk that, due to the minor impact this work has on the facility, required resources will be allocated to greater priority work leading to schedule delays.	3	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Mitigate	15-Mar-17	4	1	4	16	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6456	In Progress	Facilitate Proper Planning and Ongoing Communication with Project Team	Plan remaining items appropriately and ensure schedule reflects actions/deliverables. Communicate with project team regularly.	Sharon Maddock	Steven Sahakian	15-Mar-17	Risk realized. Design resources have been allocated to higher priority work, pushing the schedule by approximately 2 months at the earliest.							
14262	New or Resurfacing Legacy Issues	There is a risk that, due to the history of legacy issues with this project, further issues will be identified preventing AFS or closeout.	3	Active	Sharon Maddock	Steven Sahakian	27-Apr-16	Mitigate	15-Mar-17	2	1	2	4	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6457	In Progress	Review Project Information, Plan Appropriately	Review project history, issues, and outstanding items; and consult with stakeholders. Plan outstanding work appropriately to ensure processes are followed and all issues are identified and resolved.	Sharon Maddock	Steven Sahakian	13-Jan-17	AFS Strategy Memo documents legacy history, issues, and outstanding items preventing AFS and closeout. Discussion with previous Project Lead, DTL, RSE, DA, and the facility have brought to light all issues and the plan forward. Nuclear ECC process to be followed going forward. Post Response Risk Score to be achieved as AFS approaches.							
Project: Nuclear Waste Management (Project) - 60183																	
14426	Project Completion Risk	Remaining open items at risk include sampling station re-location, removal of temporary cameras, public address, SMR, and jersey barriers, and the completion of paving and bollards. Resolution process regarding the items listed above is being addressed with OPG and ESFOX Management. Resolution is required by mid-May to meet CNSC commitment of 30 June 2016.	3	Active	Sunantha Broekhuyse		04-May-16	Monitor	21-May-16	2	2	3	6	2	2	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			7075	In Progress	Project Cost Overruns	PCRAF required to draw down contingency. ██████████ ██████████ ██████████ Projects/ES FOX senior management challenge resolution in progress, to be resolved by mid-May to meet CNSC commitment of 30 June 2016.	Sunantha Broekhuyse		31-May-16								
Project: PNGS Projects - 40976																	
13810	13-40976 - FH Outage and IOP- Material availability Cost and schedule impact	Much of the material like , FM/FT cable harnesses and Ajax pump motors for the FH scope has not been procured ever or recently and therefore there is a risk to schedule and cost when not readily available - long lead times, engineering evaluation (ECC ) required, etc.	4	Active	Craig Vervey	Rathin Bagchi	20-Apr-16	Mitigate	30-Dec-15	4	3	4	16	4	3	4	16
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6685	In Progress	Project material availability in time for execution- FM/FT cable harnesses	Cable harness -To followup with supply chain for Po issuance and delivery dates for U58 cable harnesses Ajax Pump motors - Supply chain to provide firm delivery dates	Craig Vervey	Rathin Bagchi	30-May-16								



			<a href="#">6851</a>	In Progress	Project material availability in time for execution- Ajax Pump Motors	To follow up with supply chain for firm delivery dates for Ajax pump motors	Craig Verwey	Rathin Bagchi	30-Jun-16	Vendoer ASL audit I/p.							
<a href="#">13811</a>	13-40976 - FH Outage Work- Access Issues - Schedule and Cost impacts	Resources / contractors are 'onboarded' basedon outage schedule. If the windows change - delayed after the onboarding starts there will be delay costs for contractor resource who can not be re-assigned, this risks exists for each outage.		Active	Craig Verwey	Rathin Bagchi	20-Apr-16	Mitigate	31-Dec-15	4	3	4	16	4	3	4	16
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">6686</a>	In Progress	Obtain firm excution windows to mobilize contractor resources- P1681 FT catenary hoses/Thrust bearing/Rolling shield	Organize challenge meeting with outage organization to obtain committed start date before mobilizing contractor resources on site for P1681/P1671/P1751/P1761 outages and IOP Mods.	Craig Verwey	Rathin Bagchi	30-Sep-16	P1681 challenge meeting with outage organization for FT Hoses complete. P1681 Thrust bearing and rolling shield challenge meeting to be held by April 30/2016 FT MAC valves IOP schedule meeting with FH complete. On going action to complete future outages /IOP execution scheduling .							
<a href="#">14376</a>	13-40976 FH Mod: FM 90 Degree Rotation Mod - Design Solution	The design solution was made as per the solution in Pickering A unit 1 & 4, which are working. however, the solution is not working after the modification was installed in Unit 6.		Active	Craig Verwey	Andy Yan	20-Apr-16	Accept	28-Oct-16	5	2	3	15	5	2	3	15
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">6839</a>	In Progress	Correct Design Solution	Correct Design solution:  Identify cause of design solution failure. Explore the correct design solution Approve design solution is correct. Revise the design EC's with correct solution.	Craig Verwey	Andy Yan	01-Jul-16	Identification of design solution failure is in progress.							
			<a href="#">6840</a>	Not Started	Reschedule installation Windows	The installation of 90 degree rotation mod is to be re-scheduled in IOP once the correct design solution is in place:  Identify the installation windows. Schedule WO's in IOP Remove any hold to keep WO's in the plan.	Craig Verwey	Andy Yan	30-Sep-16								
<a href="#">14215</a>	13-40976 - FH Mod: FT MAC Valves - No Fuel Window Availability	Installation of this mod requires no fuel windows on the respective unit. Therefore, the status of the unit and its fuelling requirements may cause delay to schedule and carrying costs to the project. Due to materials issue as per SCR N-2016-06776, new installation no fuel windows are required.	4	Active	Peter Loi		18-Apr-16	Mitigate	29-Jul-16	3	4	4	12	2	4	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">6683</a>	In Progress	Vendor Commitment to Complete Work in No Fuel Window	Through ES MSA RFP process, ensure selected vendor can complete work within no fuel windows agreed upon by FH stakeholders.	Peter Loi		29-Jul-16								
			<a href="#">6812</a>	In Progress	New No Fuel Window Concurrence from Stakeholders	Obtain commitment from FH, Work Control and Ops for new no fuel window to execute work. Unit 5 to be scheduled for WW42 other units in a 3 week continuous window in Q1 of 2017.	Peter Loi		29-Jul-16	Initial meeting held with stakeholders. U5 to be completed first in 2016WW42. Followed by rest of the units in Q1 of 2017. S. Li contacted.							
<a href="#">1</a>	13-40976 - FH Mod: FT MAC Valves - Materials Availability	The delivery, receive/inspection and staging of transition plates may be delayed due to CAT-ID health issue (Q level not aligned with DNGS and flagged incorrectly as non pressure boundary), expiration of TSSA registration and existing inventory are defected and do not fit. Reference SCR: N-2016-06776. As a result of this risk, the delivery of the materials in time for installation is at risk.	3	Active	Peter Loi		18-Apr-16	Mitigate	01-Jun-16	3	4	4	12	2	4	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">6684</a>	In Progress	Supply Chain and Procurement Engineering Support to Review CAT-ID	Request Supply Chain to quarantine existing inventory, review CAT-ID health and resolve Q Level and pressure boundary issues. Initiate new RFQ and review/process new PO for 96 transition plates.	Peter Loi		13-May-16	Existing inventory drawn that do not fit have been quarantined. RFQ received. PE review in progress.							

1223			<a href="#">6693</a>	In Progress	Transition Plate RFQ Oversight	Work with supply chain and manufacturer Kinetricks to ensure Quantity of Plates is increased to cover entire install (96 qty), send drawings/info to Kinetricks regarding plates that fit and Expedite Delivery to meet T-5 milestone.	Peter Loi		30-Sep-16	Drawings of plate that fits test manifold sent to Kinetricks. Kinetricks to respond April 1st. Quantity of RFQ increased to 96. RFQ Review in progress.							
			<a href="#">6813</a>	In Progress	Transition Plate Prototype for Manufacturer	Provide transition plate that fits manifold to Kinetricks for testing and verification of required dimensions prior to manufacturing new order.	Peter Loi		29-Apr-16	Smith/Hein from station contacted to file UTP to allow plate to leave station.							
14366	13-40976 - FH Mod: Sump Level Switches - Scheduling Risk	Work to be completed in IOP. Other work for sump repairs also scheduled for this year. Due to confine space and resource availability, conflicting work may delay execution .	3	Active	Peter Loi		18-Apr-16	Mitigate	31-May-16	3	3	4	12	2	3	4	8
	<b>Action#</b>	<b>Status</b>	<b>Action Title</b>	<b>Action Description</b>	<b>Owner</b>	<b>Delegate</b>	<b>Due Date</b>	<b>Comments</b>									
	<a href="#">6822</a>	In Progress	Reschedule Work	Internal project meeting to understand sump repair project schedule/scope. To avoid conflicts and eliminate redundant work, request work control to schedule WOs at tail end of sump repair project. Obtain concurrence from SRE and Maintenance leads.	Peter Loi		29-Apr-16										
13855	13-40976: King Kong Refurbishment - Installation Schedule/Cost Risks	If window for King Kong outage not provided or shorter than required, may result in increased costs to fast track O/H of King Kong or re-scheduling which will increase costs and which may delay the completion of installation so as to increase the cost of installation.		Active	Craig Vervey	Andy Yan	27-Apr-16	Mitigate	31-Oct-16	3	3	3	9	2	2	2	4
	<b>Action#</b>	<b>Status</b>	<b>Action Title</b>	<b>Action Description</b>	<b>Owner</b>	<b>Delegate</b>	<b>Due Date</b>	<b>Comments</b>									
	<a href="#">5586</a>	Not Started	Schedule Installation Window for King Kong Refurbishment	The King Kong needs to be out of service for refurbishment. Once the design is completed, We will take following actions: <ul style="list-style-type: none"><li>Schedule installation WO's in IOP as per MA-22.</li><li>Work with Operators to arrange King Kong usage to have enough installation windows</li><li>Reserve contingency fund.</li></ul>	Craig Vervey	Andy Yan	31-May-16										
14367	13-40976 - FH Mod: Sump Level Switches - Interfacing Equipment	Mod is to relocate position of floater and replace existing switch. All existing interfacing equipment ie. mounting bracket, wiring/cables will be reused. Risk of increasing project cost/delay schedule if there are any issues with existing equipment.		Active	Peter Loi	Peter Loi		Mitigate	30-Jun-16	2	4	4	8	2	2	2	4
	<b>Action#</b>	<b>Status</b>	<b>Action Title</b>	<b>Action Description</b>	<b>Owner</b>	<b>Delegate</b>	<b>Due Date</b>	<b>Comments</b>									
	<a href="#">6826</a>	In Progress	Field Verification	Request FH to walk down job with Field Eng to verify condition of existing equipment. Field Eng to modify WO/MR as required.	Peter Loi	Peter Loi	06-May-16										
13808	13-40976 - FH Outage and IOP - AS found conditions resulting in increased cost and schedule	As found conditions - well outside the original design basis / requirements may result in increased effort, time and costs to bring back to design if even possible. Thrust bearing as built conditions. Cable harness connector orientation at equipment side different from design details.		Active	Craig Vervey	Rathin Bagchi	20-Apr-16	Mitigate	25-Sep-15	3	2	2	6	3	2	2	6
	<b>Action#</b>	<b>Status</b>	<b>Action Title</b>	<b>Action Description</b>	<b>Owner</b>	<b>Delegate</b>	<b>Due Date</b>	<b>Comments</b>									
	<a href="#">6687</a>	Not Started	design resolution of as built conditions in the plant which are beyond Design tolerance limits	To obtain design resolution for Thrust bearing as built condition not aligned to design documents if any. Projects to approach plant design with as found conditions in U8 thrust bearings and get design resolution for installation (as Left condition)	Craig Vervey	Rathin Bagchi	31-May-16	As found conditions can be found during execution windows only.									
	<a href="#">6847</a>	In Progress	Design resolution of as built conditions in the plant which are beyond Design tolerance limits	To obtain design resolution for U7 thrust bearing As built condition.	Craig Vervey	Rathin Bagchi	30-Oct-16	Actual as built condition details can be documented during P1671 execution window only.									
	<a href="#">6849</a>	Not Started	To obtain as built condition of U8,7,6 FM cable harness connector orientation at equipment side.	Field engineering to obtain FM cable harness equipment side connectors as built condition and review with design documents for any deviation. FH maintenance to fix the deviation as per work request initiated by projects.	Craig Vervey	Rathin Bagchi	30-May-17										
	13-40976: King Kong Refurbishment - Overall	The originalk estimate was based on OPEX (Nuclear Waste) for similar scope. Preliminary estimates from FMCA were much greater than estimated. (2.2x)		Active	Craig Vervey	Andy Yan	27-Apr-16	Mitigate	29-Apr-16	3	2	2	6	3	2	2	6



13818	kerurdisment - Overall costs higher than original estimated cost.																				
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											
			5529	Not Started	Award a Procurement and Construction PO	Once detailed engineering is completed, a PC contract is to be awarded to one of ES-MSA contractors to procure the material and refurbish the King Kong.	Craig Verwey	Andy Yan	30-Sep-16												
13061	13-40976 FH Mod: FM 90 Degree Rotation Mod - Installation Schedule/Cost Risks	Execution windows (No Fuel Windows) are limited. The scheduled installation windows may be cancelled due to the unit condition, which which will result in schedule delay and increase costs..		Active	Craig Verwey	Andy Yan	02-May-16	Mitigate	30-Dec-16	2	2	2	4	2	2	2	4				
			There are no Not Started, In Progress Actions associated with the risk.																		
13094	13-40976 -FH Outage and IOP -Availability of FH Resources - delays	FH resources (MM's CM's OPs) may not be available as planned, resulting in delays and increased costs.(outage and IOP)		Active	Craig Verwey	Rathin Bagchi	20-Apr-16	Mitigate	31-Dec-15	2	1	2	4	2	1	2	4				
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											
			6850	In Progress	To secure FH resources for project execution	Projects to secure FH resources (MFHP,CFHP and OPs) based on planned IOP/Outage schedule.	Craig Verwey	Rathin Bagchi	23-Dec-16	On going process and project will coordinate with FH for resources availability as per planned execution schedule. resources for P1681 project execution are secured.											
13856	13-40976: King Kong Refurbishment - Lack of Specific Design Expertise - Cost and schedule impact	OPG design or the ESMSA vendors may not have the required experience / resources required for heavy duty vehicle refurbishment. This could result in quality, scheudle and cost impacts.		Active	Craig Verwey	Andy Yan	27-Apr-16	Mitigate	29-Apr-16	2	2	2	4	2	1	2	4				
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											
			5606	In Progress	Oversight Commercial Grade Design Agency	Work with Supply Chain to award engineering service to a design agency by consideration of technical ability and OPG nuclear experience. OPG Nuclear Waste Design team will work closely with the selected design agency to ensure that design deliverables meet OPG ECC requirement.	Craig Verwey	Andy Yan	29-Jul-16	OPG Nuclear Waste Design team engaged to review the SOW and participate the proposal evaluation. Contracting is complete											
14224	13-40976 - FH Mod: FT MAC Valves - Interference of Existing Equipment	Existing equipment and tubing in some panels need to be relocated prior to installation of new MAC valves. Delays in relocation will delay the install.	3	Active	Peter Loi		18-Apr-16	Mitigate	29-Jul-16	2	2	2	4	1	2	2	2				
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											
			6694	In Progress	Relocation of Interfering Equipment Details	Field Eng to walkdown all panels during installation planning/assessing phase to identify/evaluate any relocation issues and ensure a plan with all required materials is in place prior to install. Details of relocation plan to be updated in associated WOs. Work packages to be rolled out to vendor.	Dwight Lindsay		29-Jul-16	Preliminary walkdown identified interference on 056, 078 and U8W panels. Field Eng waiting for design to send BOM info on existing tubing and fittings in the panels.											

Project: PNGS Projects - 40691

<a href="#">13063</a>	Outage Schedule	Unit outages may shift to accommodate other station priorities resulting in additional contractor mobilization/ demobilization costs as well as delays to the project schedule.		Active	David Calkin		19-Apr-16	Mitigate	31-Dec-19	3	2	3	9	2	1	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			4595	In Progress	40691	Develop commissioning requirements in the commissioning WPLs (B).	William Donnelly		17-Sep-15	0									
			4596	In Progress	40691	Perform review/verification and obtain approval according to associated procedures/governance (A,B).	William Donnelly		10-Dec-15	0									
			4597	In Progress	40691	Ensure lessons learned/OPEX from PB SG project and PB Main Generator relay upgrade project are incorporated (A,B,C).	William Donnelly		10-Dec-15	0									
			4598	In Progress	40691	Review/accept vendor test plans/procedures and reports to ensure design requirements are met (A,B)..	William Donnelly		17-Sep-15	0									

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			<a href="#">4599</a>	In Progress	40691	Develop test requirements in the bench test WPLs and obtain approval (A).	William Donnelly		10-Dec-15	0										
			<a href="#">4600</a>	In Progress	40691	Ensure interface IESO-HSL and document required for SIA (C).	William Donnelly		15-Sep-16	0										
Project: PNGS Projects - 40974																				
<a href="#">13079</a>	13-40974 Cost Risk - Estimate Quality	This project will be executed as two phases: Cost of Phase 1, wireless pendant addition - in execution phase and within budget / estimate. The scope and budge were defined through PCA process. Cost of Phase 2, critical parts, is only a Class IV estimated based on a conceptual design report and as a result actual costs may be more..		Active	Craig Vervey	Andy Yan	20-Apr-16	Mitigate	31-May-16	2	2	2	4	2	2	1	4			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			<a href="#">4715</a>	Not Started	Obtain Class 2 Estimate	Obtain vendor quote (class 2 estimate) after engineering phase completed in order to prepare a new release BCS if required.	Craig Vervey	Andy Yan	26-Aug-16	0										
<a href="#">13080</a>	13-40974 IFB Crane Scheudle and Cost Risks - Limited Design Resources	Internal Design resources are not readily available to commence preliminary engineering work for new AIFB and IFB-A scope (Phase 2 - critical parts). This will impact project schedule and if resources need to be contracted out, this will result in schedule and costs increases.		Active	Craig Vervey	Andy Yan	27-Apr-16	Mitigate	30-Oct-15	2	1	2	4	2	1	2	4			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			<a href="#">5524</a>	In Progress	Engage Design Resource	Engage OPG design early for comitment of resources and allocate funds for external contract to complete engineering work.	Craig Vervey	Andy Yan	31-May-16	Contracting design activities with a design agency is in progress.										
Project: PNGS Projects - 40987																				
<a href="#">13816</a>	13-40987 - Supertool replacement -cost and schedule impact	Revision to the technical requirements may result in increase costs and schedule.		Active	Craig Vervey	Andy Yan	20-Apr-16	Mitigate	30-Dec-16	3	3	3	9	3	2	1	6			
			There are no Not Started, In Progress Actions associated with the risk.																	
<a href="#">13815</a>	13-40987 Supertool replacement- Delays impacting cost and schedule	The installation windows in IFB's are limited. The delays of installation will result additional cost during the execution phase.		Active	Craig Vervey	Andy Yan	27-Apr-16	Mitigate	30-Dec-16	3	2	2	6	3	2	2	6			
			There are no Not Started, In Progress Actions associated with the risk.																	
<a href="#">13098</a>	13-40987 - IFB Supper Tool FME environment - cost and schedule	Work over the fuel bays (IFB-B and AIFB) are level 1 FME areas. THIS will result in additional effort / cost to execute and /or retrevials if things are dropped, resulting in increased costs and schedule.		Active	Craig Vervey	Andy Yan	20-Apr-16	Mitigate	30-Dec-16	2	2	2	4	1	1	1	1			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			<a href="#">6855</a>	In Progress	Prevent FME		Craig Vervey	Andy Yan	30-Nov-16	Provide instruction to prevent FME in WO tasks.										
<a href="#">13817</a>	13-40987 Supertool replacement- operational suitability. Cost and Schedule Risk	There is a risk that the supertool will not operate per technical requirements resulting in re-work and delays.		Active	Craig Vervey	Andy Yan	02-May-16	Mitigate	28-Oct-16	2	2	2	4	1	1	1	1			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			<a href="#">6845</a>	In Progress	Verify Design Solution	Following actions are taken to ensure that the design will meet the design intent;  Conduct COMS process. Participate the Factory Acceptance Test (FAT).	Craig Vervey	Andy Yan	12-Aug-16	COMS process completed. Preparation of FAT documents are in progress. The FAT has been scheduled.										
Project: PNGS Projects - 41024																				
<a href="#">13136</a>	Scope - Changes	Scope is based on assessments done in the conceptual design phase. Extent of engineering activities , number of spares required, and scope of sample installations may change as it is not defined in the project charter. This will impact project cost and schedule.		Active	Aditi Bhardwaj		02-May-16	Mitigate	30-Jun-16	3	2	5	15	2	1	5	10			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			<a href="#">6907</a>	In Progress	Scope - Changes	Ongoing surveillance of the contractor and coordination with the sponsor to review project scope. Review project scope for controllers once feasibility study and preliminary engineering is complete. General contingency will be assigned to address this risk.	Aditi Bhardwaj		30-Jun-16											

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13541	Installation schedule changes	Current schedule assumes sample installation work will take place in either IOP or Unit outages. This could change if the station directs the project to do some installation work in IOP or in other Unit outages than planned.		Active	Aditi Bhardwaj		02-May-16	Mitigate	30-Jun-16	3	1	5	15	2	1	5	10	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6911	In Progress	Installation schedule changes	Project team to work closely with the assessing and station engineering to determine the best route to be taken in order to proceed with the installation changes.	Aditi Bhardwaj		30-Jun-16									
13137	Quality Risk	Quality of engineering packages from contractor may not be as per OPG expectations based on OPEX due to contractor unfamiliarity with NICR process as discovered in preliminary engineering phase, which could impact the schedule and cost		Active	Aditi Bhardwaj		02-May-16	Mitigate	30-Jun-16	3	1	4	12	2	1	3	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6797	In Progress	41024	Project team will clearly delineate expectations and quality of deliverables to contractor and OPG site support staff. Review experience and past references of similar projects completed in the past.	Aditi Bhardwaj		30-Jun-16									
13540	Design schedule changes	Various stakeholders (Projects Design, Plant Design, Reactor Safety, Maintenance, and others) are involved in review of the engineering deliverables which could impact the schedule if certain stakeholders do not provide timely feedback.		Active	Aditi Bhardwaj		02-May-16	Mitigate	01-Nov-16	3	1	4	12	2	1	4	8	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6798	In Progress	41024	Project meeting/updates are made weekly to discuss engineering deliverables.	Aditi Bhardwaj		30-Jun-16									
13533	Design vendor resources	There is a risk that the Design vendor resources may change or be assigned to other higher priority OPG projects based on preliminary engineering phase which will delay engineering		Active	Aditi Bhardwaj		02-May-16	Mitigate	01-Nov-16	2	1	4	8	1	1	3	3	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6801	In Progress	41024	Projects to ensure that engineering does not get delayed due to other OPG projects of higher priority, with weekly to biweekly updates for deliverables.	Aditi Bhardwaj		30-Jun-16									
13534	Performance of replacement SDS1 isolation amplifiers	There is a risk that the replacement components may not fit/function as expected as they have been reverse engineered and have a different connector than the old isolation amplifier. This would require rework/testing which would impact cost and schedule.		Active	Aditi Bhardwaj		02-May-16	Mitigate	30-Jun-16	2	1	3	6	1	1	2	2	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6915	In Progress	Performance of replacement SDS1 isolation amplifiers	Project team along with Station Engineering will be monitoring the sample installation closely currently its scheduled for WW27 IOP for 2016.	Aditi Bhardwaj		30-Jun-16									
Project: PNGS Projects - 41027																		
13267	49299/49158/41027 - Risk of additional scope to ensure functionality of BDBE modifications (BCS)	The EPC vendor will perform a functionality assessment study to ensure all of the project modifications will function following a BDBE. If the EPC vendor assessment identifies a gap in functionality post BDBE which requires additional scope to close, it will result in increased cost and schedule for the projects, possibly putting the CNO milestone to complete Fukushima action items by 2017 at risk. As a result of functionality assessments (including SMAs) being done to ensure mods. installed/planned will function post BDBE, gaps may be identified that need to be addressed, leading to additional scope to implement solutions.	3	Active	Cleve Desouza	Cleve Desouza	02-May-16	Mitigate	30-Nov-17	3	4	4	12	3	3	2	9	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			5490	In Progress	49299/49158/41027 - Mitigate functionality assessment implementation	Team of subject matter experts work with EPC vendor engineering team to challenge and disposition any threat for unwarranted scope growth that could result from functionality assesement. This action will continue over the entire duration of the work package and will be statused monthly.	Cleve Desouza		31-May-16	OPG is working with HSL and ARES to go through any potential issues that were presented in order to reduce the risk of scope growth.								
	49299/49158/41027 - Risk of schedule delays due to outage	As a result of unforeseen outage work program delays, resources or installation windows may become unavailable, which could impede our ability to meet outage related milestones and incurred undesired cost.	3	Active	Cleve Desouza		10-May-16	Monitor	23-Dec-17	4	1	3	12	4	1	3	12	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								

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13267	BDBE modifications (BCS)	schedule for the projects, possibly putting the CNO milestone to complete Fukushima action items by 2017 at risk. As a result of functionality assessments (including SMAs) being done to ensure mods. installed/planned will function post BDBE, gaps may be identified that need to be addressed, leading to additional scope to implement solutions.	5490	In Progress	49299/49158/41027 - Mitigate functionality assessment implementation	Team of subject matter experts work with EPC vendor engineering team to challenge and disposition any threat for unwarranted scope growth that could result from functionality assesement. This action will continue over the entire duration of the work package and will be statused monthly.	Cleve Desouza		31-May-16	OPG is working with HSL and ARES to go through any potential issues that were presented in order to reduce the risk of scope growth.									
13971	49299/49158/41027 - Risk of schedule delays due to outage	As a result of unforeseen outage work program delays, resources or installation windows may become unavailable, which could impede our ability to meet outage related milestones and incurred undesired cost.	3	Active	Cleve Desouza		10-May-16	Monitor	23-Dec-17	4	1	3	12	4	1	3	12		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6920	In Progress	49299/49158/41027 - Manage Schedule Changes due to Outage	Use OPEX from previous outage delays to ensure adequate resources to support approved outage schedule Ensure adequate funding to execute work with contingency for limited delays Inform OCC Manager, Outage Section Manager, Outage Manager and Project Sponsor of any delays  - attend weekly outage meetings and stability of slated installation windows on outage schedule - re-allocate resources in response to outage window changes to minimize cost and time impacts - communicate and escalate key management personnel unresolved outage scheduling issues	Cleve Desouza		23-Dec-17										
13649	49299/49158/41027 - INADEQUATE SCOPE DEFINITION MAY CAUSE INACCURATE ESTIMATES (BCS)	As a result of inadequate definition and understanding of scope/requirements may cause adverse contract cost and time to complete modification.	3	Active	Cleve Desouza		02-May-16	Mitigate	08-Jul-16	3	2	3	9	2	1	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5499	In Progress	Scope Clarification/Stability	This action is to ensure that the currently defined scope of the project remains intact and that all stakeholders invovled have a clear understanding of the scope of the projects and the work to be done to meet requirements of the scope. OPG projects to ensure EPC vendor and all stakeholders involved have a clear understanding of the scope. Projects will challenge any new scope suggested and also provide clarification of the scope, as appropriate.	Cleve Desouza		30-Dec-16	With EPR (including DG Storage) detail design nearly complete, better understanding the design elements lead to increase estimate. Impact on the cost is in the order of \$6M. - Full scale testing is also being undertaken to further confirm hydraulic capability of the EME pump network. PCRAF is being prepared.									
14347	49158 - Risk to EME Building Construction due to Buried Utilities	Due to the existence of at least 2 utility cables (including the main fibre-optic networking cable connecting the 777 Brock Rd. location to the main plant) running beneath the planned construction location for the new EME building, there is a risk that the construction could be delayed by the relocation and retermination of these cables/utilities.	3	Active	Cleve Desouza	Nima Khezri	02-May-16	Monitor	31-Jul-16	2	1	3	6	2	1	3	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6922	In Progress	49158 - Investigate Buried Utilities and Develop a Path Forward	Prepare a plan in order to perform additional work to investigate the buried cables. Scanning and excavation will be performed.	Cleve Desouza	Nima Khezri	31-May-16	2016-04-26: In approximately 2-4 weeks, additional information should be available so that a path forward can be decided for how to deal with the buried cables.									
14415	49158 - Risk of Delay to NV18/V16 Material Delivery	Due to the fact that the procurement of pressure boundary qualified Storz fittings may take longer than initially expected, there is some risk that the installation and AFS of the NV18/V16 modifications may be delayed. The original schedule was based on a material delivery date of May-June, at this time the last items	3	Active	Cleve Desouza		02-May-16	Accept	26-Jul-16	2	2	3	6	2	2	3	6		
			There are no Not Started, In Progress Actions associated with the risk.																



13270	49299/49158/41027 - US-CAN exchange rate retrofit for contract due to currency exchange difference	There is a risk of cost increase as a result of the exchange rate difference between the Canadian Dollar and the US Dollar (USD), which may lead to higher cost on the PO.	2	Active	Cleve Desouza		02-May-16	Accept	08-Jan-17	4	1	1	4	4	1	1	4
			There are no Not Started, In Progress Actions associated with the risk.														
13746	49299/49158/41027 - Availability of Resources (BCS)	As a result of a high volume of deliverables and station priorities, receiving sufficient OPG station resources may be challenging, leading to an impact in schedule and cost.	2	Active	Cleve Desouza		10-May-16	Monitor	06-Oct-16	2	2	2	4	2	2	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6917	In Progress	49299/49158/41027 - Manage Availability of Resources	OPG Projects will challenge the EPC vendor to work with station work management to avoid conflict with station schedule and resource planning. OPG Projects will also ensure that the EPC schedule utilizes staggered reviews, where possible, to minimize OPG work group resource requirements. Routinely monitor resource balance and challenge project team (including EPC) vendor to plan work with consideration for minimizing resource conflict or identify if risk is imminent.	Cleve Desouza		06-Oct-16								
13750	49299/49158/41027 - Changes to cost of modifications (BCS)	As a result to the potential refinement of industry, regulatory, and station approach, as well as incomplete modification packages at the time of estimation, there may changes to the cost of the modifications.	2	Active	Cleve Desouza		10-May-16	Accept	30-Nov-17	2	2	2	4	2	2	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
14096	49299/49158/41027 - Risk of IOP Work Being Removed from Scope	As a result of the fact that there is a good deal of upcoming IOP work and that this work is scheduled differently from outage work, there is a risk that Fukushima-related IOP work may be ranked as low-priority and removed from IOP scope.	3	Active	Cleve Desouza		10-May-16	Monitor	31-Aug-17	2	1	2	4	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6919	In Progress	41027/49158/49299 - Monitor IOP Work Status and Communicate Priority	In order to ensure that important Fukushima-related work makes it into IOP scope, each MTL to communicate with SRE and work week leader in order to align priority around the Fukushima scheduled IOP tasks such that they remain on the IOP plan. A system is to be developed to track IOP work order tasks in order to ensure that they remain in the IOP plan.	Cleve Desouza		31-Aug-17								
14279	49299/49158/41027 - Risk of Change to Sub-Vendor for Engineering and Close-Out Support	As a result of contractor considering new sub vendor for engineering and close-out support, there may be a potential for improper hand-off, misrepresentation and understanding of scope, which if occur may lead to undesirable impact on cost and schedule.	4	Active	Cleve Desouza		10-May-16	Monitor	08-Jun-16	2	1	2	4	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6921	In Progress	49299/49158/41027 - Manage Change of Sub-Vendors with Contractor	Work with contractor to manage change of sub-vendors and ensure a smooth transition.	Cleve Desouza		08-Jun-16								
13145	49299/49158/41027 - VENDOR QUALITY ISSUES (BCS)	As a result of vendor quality, modifications may not be accepted, leading to increased cost and delays.	3	Active	Cleve Desouza		10-May-16	Monitor	06-Oct-16	1	1	3	3	1	1	3	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6918	In Progress	49299/49158/41027 - Monitor Vendor Submission Quality	Work with vendor where possible to ensure submission quality is acceptable. Help to remedy issues in the case that a submission is not accepted.	Cleve Desouza		06-Oct-16								
13749	49299/49158/41027 - Changes to EME deployment time (BCS)	There is a risk that following the Probabilistic Risk Assessment (PRA) reviews, new requirements for deployment time of EME equipment will be identified, leading to a potential impact on the design of the modifications and or scope.	1	Active	Cleve Desouza		02-May-16	Accept	30-Nov-17	1	3	3	3	1	3	3	3
			There are no Not Started, In Progress Actions associated with the risk.														
Project: PNGS Projects - 49299																	
	49299/49158/41027 - Risk of additional costs to	The EPC vendor will perform a functionality assessment study to ensure all of the project modifications will function following a PRA. The EPC vendor assessment identifies and	3	Active	Cleve Desouza	Cleve Desouza	02-May-16	Mitigate	30-Nov-17	3	4	4	12	3	3	2	9
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13267	or additional scope to ensure functionality of BDBE modifications (BCS)	modifications will function following a BDBE. If the EPC vendor assessment identifies a gap in functionality post BDBE which requires additional scope to close, it will result in increased cost and schedule for the projects, possibly putting the CNO milestone to complete Fukushima action items by 2017 at risk. As a result of functionality assessments (including SMAs) being done to ensure mods. installed/planned will function post BDBE, gaps may be identified that need to be addressed, leading to additional scope to implement solutions.																
			5490	In Progress	49299/49158/41027 - Mitigate functionality assessment implementation	Team of subject matter experts work with EPC vendor engineering team to challenge and disposition any threat for unwarranted scope growth that could result from functionality assesement. This action will continue over the entire duration of the work package and will be statused monthly.	Cleve Desouza		31-May-16	OPG is working with HSL and ARES to go through any potential issues that were presented in order to reduce the risk of scope growth.								
13971	49299/49158/41027 - Risk of schedule delays due to outage	As a result of unforeseen outage work program delays, resources or installation windows may become unavailable, which could impede our ability to meet outage related milestones and incurred undesired cost.	3	Active	Cleve Desouza		10-May-16	Monitor	23-Dec-17	4	1	3	12	4	1	3	12	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6920	In Progress	49299/49158/41027 - Manage Schedule Changes due to Outage	Use OPEX from previous outage delays to ensure adequate resources to support approved outage schedule Ensure adequate funding to execute work with contingency for limited delays Inform OCC Manager, Outage Section Manager, Outage Manager and Project Sponsor of any delays  - attend weekly outage meetings and stability of slated installation windows on outage schedule - re-allocate resources in response to outage window changes to minimize cost and time impacts - communicate and escalate key management personnel unresolved outage scheduling issues	Cleve Desouza		23-Dec-17									
13649	49299/49158/41027 - INADEQUATE SCOPE DEFINITION MAY CAUSE INACCURATE ESTIMATES (BCS)	As a result of inadequate definition and understanding of scope/requirements may cause adverse contract cost and time to complete modification.	3	Active	Cleve Desouza		02-May-16	Mitigate	08-Jul-16	3	2	3	9	2	1	2	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			5499	In Progress	Scope Clarification/Stability	This action is to ensure that the currently defined scope of the project remains intact and that all stakeholders invovled have a clear understanding of the scope of the projects and the work to be done to meet requirements of the scope. OPG projects to ensure EPC vendor and all stakeholders involved have a clear understanding of the scope. Projects will challenge any new scope suggested and also provide clarification of the scope, as appropriate.	Cleve Desouza		30-Dec-16	With EPR (including DG Storage) detail design nearly complete, better understanding the design elements lead to increase estimate. Impact on the cost is in the order of \$6M. - Full scale testing is also being undertaken to further confirm hydraulic capability of the EME pump network. PCRAF is being prepared.								
13270	49299/49158/41027 - US-CAN exchange rate retrofit for contract due to currency exchange difference	There is a risk of cost increase as a result of the exchange rate difference between the Canadian Dollar and the US Dollar (USD), which may lead to higher cost on the PO.	2	Active	Cleve Desouza		02-May-16	Accept	08-Jan-17	4	1	1	4	4	1	1	4	
			There are no Not Started, In Progress Actions associated with the risk.															
	49299/49158/41027 - Availability of Resources (BCS)	As a result of a high volume of deliverables and station priorities, receiving sufficient OPG station resources may be challenging, leading to an impact in schedule and cost.	2	Active	Cleve Desouza		10-May-16	Monitor	06-Oct-16	2	2	2	4	2	2	2	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								



<a href="#">13746</a>			<a href="#">6917</a>	In Progress	49299/49158/41027 - Manage Availability of Resources	OPG Projects will challenge the EPC vendor to work with station work management to avoid conflict with station schedule and resource planning. OPG Projects will also ensure that the EPC schedule utilizes staggered reviews, where possible, to minimize OPG work group resource requirements. Routinely monitor resource balance and challenge project team (including EPC) vendor to plan work with consideration for minimizing resource conflict or identify if risk is imminent.	Cleve Desouza		06-Oct-16											
<a href="#">13750</a>	49299/49158/41027 - Changes to cost of modifications (BCS)	As a result to the potential refinement of industry, regulatory, and station approach, as well as incomplete modification packages at the time of estimation, there may changes to the cost of the modifications.	2	Active	Cleve Desouza				10-May-16	Accept	30-Nov-17	2	2	2	4	2	2	2	4	
											There are no Not Started, In Progress Actions associated with the risk.									
<a href="#">14096</a>	49299/49158/41027 - Risk of IOP Work Being Removed from Scope	As a result of the fact that there is a good deal of upcoming IOP work and that this work is scheduled differently from outage work, there is a risk that Fukushima-related IOP work may be ranked as low-priority and removed from IOP scope.	3	Active	Cleve Desouza				10-May-16	Monitor	31-Aug-17	2	1	2	4	2	1	2	4	
			Action#	Status	Action Title	Action Description			Owner	Delegate	Due Date	Comments								
			<a href="#">6919</a>	In Progress	41027/49158/49299 - Monitor IOP Work Status and Communicate Priority	In order to ensure that important Fukushima-related work makes it into IOP scope, each MTL to communicate with SRE and work week leader in order to align priority around the Fukushima scheduled IOP tasks such that they remain on the IOP plan. A system is to be developed to track IOP work order tasks in order to ensure that they remain in the IOP plan.			Cleve Desouza		31-Aug-17									
<a href="#">14279</a>	49299/49158/41027 - Risk of Change to Sub-Vendor for Engineering and Close-Out Support	As a result of contractor considering new sub vendor for engineering and close-out support, there may be a potential for improper hand-off, misrepresentation and understanding of scope, which if occur may lead to undesirable impact on cost and schedule.	4	Active	Cleve Desouza				10-May-16	Monitor	08-Jun-16	2	1	2	4	2	1	2	4	
			Action#	Status	Action Title	Action Description			Owner	Delegate	Due Date	Comments								
			<a href="#">6921</a>	In Progress	49299/49158/41027 - Manage Change of Sub-Vendors with Contractor	Work with contractor to manage change of sub-vendors and ensure a smooth transition.			Cleve Desouza		08-Jun-16									
<a href="#">13145</a>	49299/49158/41027 - VENDOR QUALITY ISSUES (BCS)	As a result of vendor quality, modifications may not be accepted, leading to increased cost and delays.	3	Active	Cleve Desouza				10-May-16	Monitor	06-Oct-16	1	1	3	3	1	1	3	3	
			Action#	Status	Action Title	Action Description			Owner	Delegate	Due Date	Comments								
			<a href="#">6918</a>	In Progress	49299/49158/41027 - Monitor Vendor Submission Quality	Work with vendor where possible to ensure submission quality is acceptable. Help to remedy issues in the case that a submission is not accepted.			Cleve Desouza		06-Oct-16									
<a href="#">13749</a>	49299/49158/41027 - Changes to EME deployment time (BCS)	There is a risk that following the Probabilistic Risk Assessment (PRA) reviews, new requirements for deployment time of EME equipment will be identified, leading to a potential impact on the design of the modifications and or scope.	1	Active	Cleve Desouza				02-May-16	Accept	30-Nov-17	1	3	3	3	1	3	3	3	
											There are no Not Started, In Progress Actions associated with the risk.									
<a href="#">14346</a>	49299 - Risk of Adverse Commissioning Result for MV Tool UPS	As a result of items which were not tested in the FAT for the MV Tool UPS, there is a small risk that it might fail the SAT. The FAT was performed with a load bank at a power factor of 1, while the SAT is to be performed at a 0.8 power factor.	3	Active	Cleve Desouza	Alex Maxim			02-May-16	Accept	30-Nov-16	1	3	3	3	1	3	3	3	
											There are no Not Started, In Progress Actions associated with the risk.									
Project: PNGS Projects - 41044																				
<a href="#">13149</a>	Project scope change	There is a risk project scope to change due to SG cubicle spare relays failing the seismic test resulting in overall project cost increase and impact on the AFS.		Active	David Calkin				19-Apr-16	Accept	30-Dec-16	4	4	4	16	3	3	4	12	
			Action#	Status	Action Title	Action Description			Owner	Delegate	Due Date	Comments								
			<a href="#">4566</a>	In Progress	41044	Field walkdowns and as-Built validation of the existing design documentation.			Ana Soare		30-Dec-16	0								
			<a href="#">4568</a>	In Progress	41044	Review request and prepare scope changes as required (A,B,C).			Ana Soare		30-Jan-16	0								

13152	SG Outage Schedule	SG outage may shift to accommodate other station priorities or be extended due to SG condition (OPEX from 034-SG2) resulting in additional contractor mobilization/ demobilization costs as well as delays to the project schedule.		Active	David Calkin		19-Apr-16	Accept	31-Jul-18	4	4	4	16	3	3	4	12
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4573	Not Started	41044	Develop commissioning requirements in the commissioning WPLs (B).	William Donnelly		12-Sep-16	0							
			4574	Not Started	41044	Perform review/verification of the bench test/commissioning and obtain approval according to associated procedures/governance (A,B).	William Donnelly		12-Sep-16	0							
			4575	In Progress	41044	Ensure lessons learned/OPEX from PB SG project and PB Main Generator relay upgrade project are incorporated (A,B)	William Donnelly		13-Mar-15	0							
			4576	Not Started	41044	Review/accept vendor test plans/procedures and reports to ensure design requirements are met (A,B).	William Donnelly		06-Oct-14	0							
			4577	Not Started	41044	Develop test requirements in the bench test WPL and obtain appoval (A).	William Donnelly		19-Dec-14	0							
13157	Material Shipping/Delivery Schedule	There is a risk the material shipping/delivery schedule may change due to delays on CGD and seismic testing for SG cubicle spares resulting in delay of delivery of spare relays to site that may impact the AFS and the SG outage critical path.		Active	David Calkin		19-Apr-16	Mitigate	31-Jul-18	4	4	4	16	3	3	4	12
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4586	Not Started	41044	Monitor manufacturing process and delivery schedule..	William Donnelly		12-Feb-15	0							
Project: PNGS Projects - 49132																	
13166	Lack of resources	There is a potential of changing priorities or changing supporting personnel for this project by the Stakeholders (i.e. performance engineering , environmental ) and/or Project team. This will affect project schedule and cost. In addition, station resources(Ops, MC) may not be available when needed.		Active	Amar Sood		02-May-16	Mitigate	28-Oct-16	3	3	4	12	2	3	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4661	In Progress	49132	Conduct regular project meetings with stakeholders to monitor resource issues. Utilize premium time or external resource to mitigate the impact on schedule.	Amar Sood		28-Oct-16	This action is extended due to project AFS delays.(ref SCR N-2015-29043)							
Project: PNGS Projects - 49146																	
13173	Resource (labour) Availability	Availability of required resource(s) limited when needed. Operations staff may need to support higher priority work if project spans across outages. ++++ The station resources were not available to support TP1 and TP2 600V commissioning and caused delays. Contractor is following IOP plan and Projects provided help as needed and is closely monitoring station resources. S. Feng 18DEC2015. ***** TP2 600V commissioning complete, TP2 commissioning to be completed (Replaced 2 GFCI)		Active	Amar Sood		02-May-16	Mitigate	29-Apr-16	3	1	3	9	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4745	In Progress	49146	Obtain the commitment of station resources during critical phases of project.	Amar Sood		15-Aug-15	0							
13175	Vendor Capability	The design documents and work plans produced by vendor may not meet the requirements of OPG. This will result in rework and delay in schedule. ++++ *****		Active	Amar Sood		02-May-16	Mitigate	15-Jun-16	3	1	3	9	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4751	In Progress	49146	Allocate sufficient time in schedule to review vendor documents	Amar Sood		30-Sep-15	0							
	Regulatory Certainty	Assessment of Regulatory impact not complete with possible issues. The 13 structures inside the Powerhouse has been assessed by a third party (PLC), comments returned to PLC and we are waiting on PLC disposition of comments and the this can have a financial and schedule impact to the project. ++++ +		Active	Amar Sood		02-May-16	Mitigate	15-Jun-16	3	2	3	9	2	1	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4752	In Progress	49146	Allocate contingency for potential overtime work required to complete deliverables to ensure no significant schedule delays.	Amar Sood		30-Sep-15	Contingency allocated in approved BCS.							

13176		PLC has performed a thorough walkdown of the 13 structures on site and prepared report for recommendation. OPG and MSA contractor have reviewed and provided comments on the report. Pending on the final report recommendation, Projects will discuss with stakeholders regarding the scope of modification. S. Feng, 18DEC2015. ++++ ++++ PLC report completed, SOW for contractor in progress and mini FHA required to disposition the structures  The PLC report has been accepted by HSL (Designer of Record). Projects will evaluate the recommendations in the PLC report and determine the path forward. This review will be completed within the next 4 weeks and the SOW will be issued shortly afterwards. J. Fung 24 Feb 2016																
14019			3	Active	Amar Sood		02-May-16	Mitigate	15-Jun-16	3	2	3	9	2	1	3	6	
There are no Not Started, In Progress Actions associated with the risk.																		
Project: PNGS Projects - 49161																		
13195	49161/80052 - Delay in System Configuration completion causing design delay	Event: Potential additional Scope and delay in System Configuration / OEM design completion Cause: OEM is late in delivering design deliverables Impact: EPC is being delayed since drawings are not available. Facilities is being delayed as final design docs not available.		Active	Ahmed Smaili	Alex Maxim	07-May-16	Mitigate	30-Jun-16	3	2	2	6	2	1	1	2	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6417	In Progress	Fuku Tele: OEM design/drawing completion	Track OEM to complete all their design deliverables. Cost/Schedule contingency in place. Weekly meetings in place to track OEM deliverables. high priority drawings received, commented and updated. Low-priority drawings being reviewed.	Philip Yu	Alex Maxim	30-Jun-16	High priority drawings which MSA needs has been delivered. OEM visited canada on April 5-7 to explain and work collaboratively with MSA to update/review design. Update drawings to be complete by OEM on April 29th.								
13198	49161/80052 - Equipment from vendor not delivered in time due causing design and AFS delays	Event: Equipment and equipment design from vendor not delivered in time.  There are also new equipment (trolley and ISO base) slated for purchase in 2016. . Impact: Equipment cannot be installed by EPC until it has arrived. The equipment has be all available and tested before AFS		Active	Ahmed Smaili	Alex Maxim	07-May-16	Mitigate	30-Jun-16	3	1	2	6	2	1	2	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6195	In Progress	Vendor delivery of telecom equipment	Track OEM and ensure delivery of final equipment set as stiuplated in contract. Cost/Schedule contingency in place. Weekly meetings in place to track OEM deliverables. OEM has given schedule for the delivery of equipment	Philip Yu	Alex Maxim	30-Jun-16									
14138	49161 - Final cost not yet firm for modificaion external to PNGS.	Event: Budget for all modifications external to PNGS such as 700U, CEOF and PLC SMC not received from real estate department. Cause: Final design not yet firm with OEM for those areas. Impact: Potential increase in costs.		Active	Ahmed Smaili	Alex Maxim	07-May-16	Mitigate	30-Jun-16	3	2	2	6	2	2	2	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6417	In Progress	Fuku Tele: OEM design/drawing completion	Track OEM to complete all their design deliverables. Cost/Schedule contingency in place. Weekly meetings in place to track OEM deliverables. high priority drawings received, commented and updated. Low-priority drawings being reviewed.	Philip Yu	Alex Maxim	30-Jun-16	High priority drawings which MSA needs has been delivered. OEM visited canada on April 5-7 to explain and work collaboratively with MSA to update/review design. Update drawings to be complete by OEM on April 29th.								
			6418	Not Started	Fuku Tele: Engage Real Estate to obtain final cost	Engage Real-Estate once the OEM design is complete to get final estimate for pricing	Philip Yu	Alex Maxim	30-Jun-16	Awaiting for final CEOF/700U and new 800 Kipling design from OEM.								
13197	49161/80052 - System functionality does not meet the requirements causing rework.	Event: System functionality does not meet the requirements Cause: New technology is being used for telecom system. Impact: If system does not meet the requirements, rework will be required to assess other potential solutions.		Active	Ahmed Smaili	Philip Yu	07-May-16	Mitigate	31-Oct-16	1	3	3	3	1	2	2	2	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6050	Not Started	Site Acceptance test to ensure equipment works on site	Final Site Acceptance Test to confirm equipment is working properly, including weak reception areas identified in PoC test such as MCR.	Philip Yu	Alex Maxim	30-Jun-16									

Project: PNGS Projects - 80052																			
<a href="#">13195</a>	49161/80052 - Delay in System Configuration completion causing design delay	Event: Potential additional Scope and delay in System Configuration / OEM design completion Cause: OEM is late in delivering design deliverables Impact: EPC is being delayed since drawings are not available. Facilities is being delayed as final design docs not available.		Active	Ahmed Smaili	Alex Maxim	07-May-16	Mitigate	30-Jun-16	3	2	2	6	2	1	1	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6417</a>	In Progress	Fuku Tele: OEM design/drawing completion	Track OEM to complete all their design deliverables. Cost/Schedule contingency in place. Weekly meetings in place to track OEM deliverables. high priority drawings received, commented and updated. Low-priority drawings being reviewed.	Philip Yu	Alex Maxim	30-Jun-16	High priority drawings which MSA needs has been delivered. OEM visited canada on April 5-7 to explain and work collaboratively with MSA to update/review design. Update drawings to be complete by OEM on April 29th.									
<a href="#">13198</a>	49161/80052 - Equipment from vendor not delivered in time due causing design and AFS delays	Event: Equipment and equipment design from vendor not delivered in time. [REDACTED] There are also new equipment (trolley and ISO base) slated for purchase in 2016. . Impact: Equipment cannot be installed by EPC until it has arrived. The equipment has be all available and tested before AFS		Active	Ahmed Smaili	Alex Maxim	07-May-16	Mitigate	30-Jun-16	3	1	2	6	2	1	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6195</a>	In Progress	Vendor delivery of telecom equipment	Track OEM and ensure delivery of final equipment set as stiuplated in contract. Cost/Schedule contingency in place. Weekly meetings in place to track OEM deliverables. OEM has given schedule for the delivery of equipment	Philip Yu	Alex Maxim	30-Jun-16										
<a href="#">13225</a>	80052 - Scope increase as a result of stakeholder input.	Event: Additiona scope due to stakeholder requesting for more equipment. Cause: Stakeholder has verbally identified additional radios chargers and laptops are required. Impact: Additional cost will be required to purchase these equipment		Active	Ahmed Smaili	Alex Maxim	07-May-16	Mitigate	31-Aug-16	4	1	1	4	3	1	1	3		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6416</a>	Not Started	Fukushima Telecom: Hold stakeholder meeting to determine final equipment numbers	Complete stakeholder meeting during detailed design to ensure stakeholders obtained adquate amount of handheld equipment, laptops and faxes	Philip Yu	Alex Maxim	31-Aug-16										
<a href="#">13197</a>	49161/80052 - System functionality does not meet the requirements causing rework.	Event: System functionality does not meet the requirements Cause: New technology is being used for telecom system. Impact: If system does not meet the requirements, rework will be required to assess other potential solutions.		Active	Ahmed Smaili	Philip Yu	07-May-16	Mitigate	31-Oct-16	1	3	3	3	1	2	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			<a href="#">6050</a>	Not Started	Site Acceptance test to ensure equipment works on site	Final Site Acceptance Test to confirm equipment is working properly, including weak reception areas identified in PoC test such as MCR.	Philip Yu	Alex Maxim	30-Jun-16										
Project: PNGS Projects - 49163																			
<a href="#">13200</a>	See Project 49146 for Shared Risk Register	Due to project similarities, projects 49163, 49146 and 49302 share the same risk register. This risk register is kept under 49146.		Active	Amar Sood		02-May-16	Mitigate	30-Jun-15	1	1	1	1	1	1	1	1	1	
			There are no Not Started, In Progress Actions associated with the risk.																
Project: PNGS Projects - 49302																			
<a href="#">13224</a>	See Project 49146 for shared risk register	Due to project similarities, projects 49163, 49146 and 49302 share the same risk register. This risk register is kept under 49146.		Active	Amar Sood		02-May-16	Mitigate	30-Dec-16	1	1	1	1	1	1	1	1	1	
			There are no Not Started, In Progress Actions associated with the risk.																
Project: PNGS Projects - 40990																			
<a href="#">13597</a>	Cost risk for parts and labour on PLC replacement	Once the detailed engineering phase is completed, there is a risk of increased costs. The current estimate is a Class 4 based on the conceptual design. Labour and parts costs will become more accurate after the detailed engineering.	2	Active	Craig Verwey	Andy Yan	20-Apr-16	Mitigate	30-Dec-16	2	2	2	4	2	2	2	4		
			There are no Not Started, In Progress Actions associated with the risk.																
	Risk of scope addition impacting cost and schedule	The scope of this modification will impact the project scope and schedule.		Active	Craig Verwey	Andy Yan	20-Apr-16	Monitor	29-Jun-15	2	2	2	4	1	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									

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13612			6843	In Progress	Preparation of new BCS	A new BCS is required to secure the funding once the project charter is approved.  Obtain the cost estimates. Prepare a new BCS Obtain BCS approved.	Craig Verwey	Andy Yan	31-Aug-16	Start to obtain cost estimates.										
Project: PNGS Projects - 40985																				
13623	Risk that Costs will Increase	For the replacement of obsolete chemical analyzers project, there is a risk that costs will increase due to estimate quality.	2	Active	Ahmed Smaili	Christine Misztal	29-Apr-16	Mitigate	01-Dec-17	3	3	3	9	1	1	1	1			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			5536	In Progress	Monthly forecasting	Overall project monthly forecast to identify potential cost issues. Review EPC vendor cost forecast monthly. Review project costs and/or Oncore costs weekly.	Ahmed Smaili	Christine Misztal	31-May-16	29APR2016: Monthly forecasting for overall project still in progress. Oncore costs reviewed at weekly update meeting with contractor. Contractor project cost to complete to be provided by end of the May and is to incorporate identified trend for assessing and quality control costs. 31MAR2016: Monthly forecasting for overall project still in progress. Oncore costs are reviewed at weekly update meeting with contractor. Potential trend identified with estimate for assessing and quality control costs. This trend will be monitored for the next month to confirm impact to project forecast. 25FEB2016: Monthly forecasting still in progress. PCRAF approved at Feb AISC to adjust cash flows to forecasted values. Overall PO spend is reviewed weekly with contractor. 31JAN2016: Monthly forecasting still in progress. PCRAF to be submitted to Feb AISC to adjust cash flows to forecasted values. Overall PO spend is reviewed weekly with contractor.										
	Risk to Overall Project Schedule due to delayed design revisions	There is a risk that the schedule for the replacement of obsolete chemical analyzers project will not be maintained due to delayed design revisions	2	Active	Ahmed Smaili	Christine Misztal	29-Apr-16	Mitigate	01-Dec-17	3	3	3	9	2	3	3	6			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										

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13693		and/or obtain further design input to address as-found conditions or configuration issues.																
			5533	In Progress	Discovery issues	Ensure walkdowns and field reviews are completed for first installations in advance.	Ahmed Smaili	Christine Misztal	30-Jun-17	29APR2016: U6 boiler cation EC accepted 15APR2016. Design walkdown for U1 and U4 held on 01APR2016. Walkdown for U1/4 liquid zone conductivity analyzers held 20APR2016. Field walkdowns are performed as required to review installation issues, in addition to T-3 walkdowns performed by the work performers as per MA-022. U7 moderator conductivity readiness challenge meeting scheduled for 04MAY2016. Field walkdowns for Fuel Bay conductivity and Bside conductivity analyzers will be completed in the upcoming month. 31MAR2016: U6 boiler cation EC to be submitted for acceptance by 06APR2016. Design walkdown was completed prior to EC revision. Design walkdown for U1 and U4 scheduled for 01APR2016. Field walkdowns are performed as required to review installation issues, in addition to T-3 walkdowns performed by the work performers as per MA-022. U7 moderator conductivity readiness challenge meeting scheduled for WW18 (May 2-6, 2016). 25FEB2016: Revision of 6 boiler cation ECs due to maintainability issues is progressing. Upcoming installation for U7 moderator conductivity analyzers is being reviewed in further detail due to first installation of this analyzer type. Readiness challenge meeting to be held. 31JAN2016: Path-forward determined for maintainability issues of boiler cation analyzers. 6 ECs require revision as a result. Lessons learned from U1, U5, and U6 H2 purity analyzer installations are being utilized for U4 H2 purity analyzer installation.								
Risk that Design Group is Lacking Experienced Personnel	There is a risk that resources lack experienced engineering/installation personnel for the replacement of obsolete chemical analyzers project. If realized, this risk can cause increased cost and delay in schedule due to re-work activities.	2	Active	Ahmed Smaili	Christine Misztal	29-Apr-16	Mitigate	01-Jan-17	3	3	3	9	2	3	3	6		
		Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									



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13694			4621	In Progress	Design Agency is lacking experienced personnel	Perform Oversight as per Project Oversight Plan.	Ahmed Smaili	Christine Misztal	31-May-16	29APR2016: 30 of 36 design packages approved by OPG. 2 ECs have signed C&D. ECs have been returned to EPC vendor to incorporate comments. TCD for revised package is 04MAY2016. 4 remaining ECs are progressing (2 packages will require sponsor input for recently discovered potential scope changes). Design quality has increased due to currently assigned design personnel (both EPC vendor and OPG), but latent design errors (e.g. annulus gas ECs) and inexperience in project history necessitate more extensive oversight and follow-up by OPG. 31MAR2016: 30 of 36 design packages approved by OPG. 2 of the remaining 6 ECs have been submitted for review and comments. 4 remaining ECs are progressing. Design quality has increased due to currently assigned design personnel (both EPC vendor and OPG), but latent design errors and inexperience in project history necessitate more extensive oversight and follow-up by OPG. 25FEB2016: 30 of 36 design packages approved by OPG. Extensive follow-up and oversight still required by OPG personnel in order to complete contract deliverables. Path-forward for remaining 6 ECs is progressing. 31JAN2016: 30 of 36 design packages approved by OPG. Extensive follow-up and oversight still required by OPG personnel in order to complete contract deliverables. Path-forward for remaining 6 ECs has been determined.									
	Risk of Delays Due to Late Material Delivery or Changes to Outage	For the replacement of obsolete chemical analyzers project, there is a risk that the schedule will be delayed due to late material delivery and changes in unit-outage schedule where analyzers are scheduled for installation.	2	Active	Ahmed Smaili	Christine Misztal	29-Apr-16	Mitigate	01-Jan-17	3	3	3	9	2	3	3	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									



**Report ID:** 0707A [Tech Tips](#)  
**Report Owner:** L. Greenland  
**Process Owner:** R. Smith  
**Data Refreshed:** 12-May-16 10:30 PM

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Project: PNGS Projects -																			
13659	Installation Schedule Delay due to Weather Condition	Schedule delay / Cost increase due to weather condition during lift or working on stack resulting delay that will impact critical path by 2 days.	3	Active	Ahmed Smaili		02-May-16	Accept	14-Jul-15	3	2	2	6	3	2	2	6		
			There are no Not Started, In Progress Actions associated with the risk.																
Project: PNGS Projects - 40703																			
13710	13-40703 PB IFB B Leak Mitigation: Technical, Tool Desgin / Function - Schedule / Cost impacts	Prototype Tooling will need to be designed and fabricated and then tested. If during field tests tooling does not perform as planned, re-designing and fabricating will result in additional costs and time. Cost and Schedule impacts.		Active	Craig Verwey	Angelo Ciociola	21-Apr-16	Mitigate	31-Jan-16	3	1	3	9	2	1	2	4		
			There are no Not Started, In Progress Actions associated with the risk.																
13709	13-40703 PB IFB Leak Mitigation: Increase to scope due to discvoery issues impacting schedule and costs.	Current scheudle and costs are based on known issues / cracks identified in 1983 PB IFB In-Service Report –P-IR-058-21500-01, page 18 of 77; and in 2010 AECL Assessment Document # 30-21500-ASD-001 page I-1 (NK30-REP-21500-0557128). As it is not possible to inspect for more cracks prior to moving the fuel and racks, additional cracks found during execution may increase schedule and costs.	2	Active	Craig Verwey	Angelo Ciociola	21-Apr-16	Mitigate	31-Oct-15	2	3	3	6	2	1	2	4		
			There are no Not Started, In Progress Actions associated with the risk.																
13708	13-40703 PB IFB Leak Mitigation: Technical, Material does not meet CSA	During preliminary engineering potential repair materail has been indentified. This material will need to be further qualified before use. There is a risk that the material selected may not meet CSA-N287.2-08, or be able to withstand the radiation fields that it will be exposed to. As post		Active	Craig Verwey	Angelo Ciociola	21-Apr-16	Mitigate	30-Nov-15	3	1	2	6	2	1	2	4		
			There are no Not Started, In Progress Actions associated with the risk.																



Risk Report by Project with Associated Actions

<a href="#">13711</a>	standard.	maintenance testing or commissioning can not be done on this repair, material will need to validated through lab tests. If multiple materials have to be tested to find the right one, this may impact costs and schedule.															
<a href="#">13665</a>	13 - 40703 PB IFB Leak Mitigation: IFB-B Access / availability - Schedule & Costs Impacts	Repairs will require access to the IFB and use of the Gantry Crane. As FH also needs regular access to these to maintain fuelling activities, conflicts / restricted access can result in delays which will impact cost and schedule. Repairs will also require moving of Fuel and storage frames which will require FH resources and time. Delays or resource issues will also impact schedule and costs.	2	Active	Craig Verwey	Angelo Ciociola	21-Apr-16	Mitigate	30-Mar-16	2	2	2	4	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
Project: PNGS Projects - 49124																	
<a href="#">13734</a>	Cost Increase due to project delay 13-49124	There could be additional interest costs per month if the final AFS gets delayed.	3	Active	Amar Sood		02-May-16	Mitigate	16-May-16	2	2	2	4	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Project: PNGS Projects - 80069																	
<a href="#">14044</a>	Bypass Work Control milestones	There is a risk that Work Control may not allow work to be scheduled in the planned time frame as some Integrated On-line Work Schedule dates will be missed.		Active	Sunantha Broekhuysse		20-Apr-16	Accept	31-Mar-16	5	1	5	25	5	1	5	25
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">6422</a>	In Progress	Break Plan Request to start field work in May 2016	Award of PO has slipped by 12 weeks. Request management support to allow for a break plan or infusion plan to start field modification by May / June 2016.	Sunantha Broekhuysse		29-Apr-16	Anticipate PO will be accepted by vendor before April 25. Require confirmation with Management for breakplan or infusion support to allow accelerated finalize schedule with the vendor.							
			<a href="#">6425</a>	In Progress	Issue PO base on work plan to start Field Modification by May 2016	Once management accepts to proceed with a breakplan or infusion plan, work with vendor and Work Control to allow start of field modification by May / June 2016.	Sunantha Broekhuysse		06-May-16	Requesting management support to allow for a break plan or infusion plan.							
<a href="#">13876</a>	Discovery work	There is a risk of discovery work related to unknown buried services and/or existing condition of buried services during excavation which may increase cost.	3	Active	Sunantha Broekhuysse		20-Apr-16	Mitigate	30-Jun-16	4	2	4	16	2	2	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">13959</a>	Configuration Management	There is a risk of configuration management issues, which may be observed during excavation, and as a result add scope to the project to fix.		Active	Sunantha Broekhuysse		20-Apr-16	Accept	30-Jun-16	4	2	3	12	4	2	3	12
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">13960</a>	Transportation route conflict	There is a risk of construction delays due to conflicts with delivery schedules for DSCs (Dry fuel Storage Containers) via the transportation route through the North Yard.		Active	Sunantha Broekhuysse		20-Apr-16	Mitigate	02-Sep-16	3	1	3	9	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">6430</a>	Not Started	Interface North side field execution with NWMD to limit delays.	Need to interface with NWMD on contruction on the north side to avoid DSC transportation delays and field execution delays.	Sunantha Broekhuysse		15-Jul-16								
<a href="#">14022</a>	Contaminated soil	There is a risk of contaminants in the soil which will add cost for proper handling and disposal.		Active	Sunantha Broekhuysse		20-Apr-16	Monitor	30-May-16	3	2	3	9	2	2	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">6427</a>	Not Started	How to address contained soil	Finding contaminated soil is low risk. Should be prepared out what to do with contaminated soil if found and the cost affiliated with this for forecasting purposes.	Sunantha Broekhuysse		20-May-16								
	Pipe failures	There is a risk of pipe failures through several failure modes (such as poor material condition, ground movement, etc.) in sections of pipe outside of current scope, which may occur and add scope to the project.		Active	Sunantha Broekhuysse		20-Apr-16	Monitor	30-Jun-16	2	2	4	8	2	2	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

13962			6428	Not Started	Address scope change through PCA	Due to the condition of the existing fire pipe system, the project maybe asked to repair other location of fire system not part of the scope of work.	Sunantha Broekhuyse		16-Dec-16	No increase in scope of work at this time.										
13877	Schedule delays due to weather	There is a risk of schedule delays during construction due to poor weather conditions, which may prolong field work.		Active	Sunantha Broekhuyse		20-Apr-16	Mitigate	30-Jun-16	3	1	2	6	2	1	2	4			
There are no Not Started, In Progress Actions associated with the risk.																				
13878	Passing isolation	There is a risk of existing isolation valves passing, which will prevent adequate work protection from being applied and consequently prevent initiation of field work. This will incur extra cost to correct.		Active	Sunantha Broekhuyse		20-Apr-16	Mitigate	29-Jul-16	2	1	3	6	1	1	2	2			
Action#	Status	Action Title	Action Description				Owner	Delegate	Due Date	Comments										
6431	Not Started	Confirming with Operations the existing condition of isolation valves	Take proactive action to take a look of the valve and arrange to change accordingly.				Sunantha Broekhuyse		22-Apr-16											
13879	Trade resource availability	There is a risk that trade resources availability may be limited due to Darlington/Bruce refurbishment and Infrastructure projects in 2016.		Active	Sunantha Broekhuyse		20-Apr-16	Mitigate	29-Feb-16	2	1	3	6	1	1	1	1			
There are no Not Started, In Progress Actions associated with the risk.																				
13880	Expedite schedule	There is a risk that certain sections of piping will have to be expeditiously completed in order to minimize availability of fire water and critical access routes. This will result in increased cost to the project.		Active	Sunantha Broekhuyse		20-Apr-16	Mitigate	28-Oct-16	2	1	3	6	1	1	2	2			
There are no Not Started, In Progress Actions associated with the risk.																				
13961	Quality/Safety impact	There is a risk of quality issues and/or safety related events, which may occur during installation, and cause delays to the project.		Active	Sunantha Broekhuyse		20-Apr-16	Mitigate	29-Jul-16	2	1	3	6	1	1	2	2			
Action#	Status	Action Title	Action Description				Owner	Delegate	Due Date	Comments										
6429	Not Started	Provide oversight to ensure quality and safety issues are prevented from occurring	Need to provide proper oversight on quality and safety issues.				Sunantha Broekhuyse		16-Dec-16	Need to issue PO before addressing.										
14024	Confined space requirements	There is a risk that the excavated area in the South yard may be treated as confined space due to the hazard of chlorine lines in the area.		Active	Sunantha Broekhuyse		20-Apr-16	Mitigate	30-Jun-16	2	1	3	6	1	1	2	2			
Action#	Status	Action Title	Action Description				Owner	Delegate	Due Date	Comments										
6426	Not Started	Work with Conventional Safety to isolate chlorine lines during execution.	Review confined space requirement with Vendor and OPG Conventional Safety.				Sunantha Broekhuyse		06-May-16	Waiting to issue PO before addressing.										
Project: PNGS Projects - 49279																				
13900	13-49279 - Wet Scrape - Resource Availability - Design Agency	Timely Design Agency support is required in order for successful commissioning of project. RFP/Proposal cycle started end of Sept 2015 to secure Design Agency support for P1641 Wet Scrape. In addition, there has been staff terminations at Design Agency at this time. It is not know if knowledgeable staff are available at this time.	1	Active	Michael Lo	Michael Lo	19-Apr-16	Mitigate	30-Oct-15	3	3	3	9	1	1	1	1			
There are no Not Started, In Progress Actions associated with the risk.																				
13890	13-49279 - Wet Scrape - Outage delay resulting in Schedule and Cost Risk	A final commissioning run is required to complete AFS for this mod. This is scheduled in P1641 outage. If this work is delayed, or de-scoped from outage, there will be cost and schedule impact.		Active	Craig Verwey	Michael Lo	02-May-16	Monitor	23-Sep-15	1	1	1	1	1	1	1	1			
There are no Not Started, In Progress Actions associated with the risk.																				
Project: PNGS Projects - 40978																				
13891	13-40978 - PN FM Vault Cameras: Schedule, Closeout Phase -Schedule Risk	Project is in ECC and project closeout phase with several AR's still outstanding. Delays in completing AR's by owed to groups may result in delay of ECC close-out beyond the 6 month window.	3	Active	Craig Verwey	Angelo Ciociola	21-Apr-16	Mitigate	31-Aug-15	2	1	1	2	2	1	1	2			
There are no Not Started, In Progress Actions associated with the risk.																				
Project: PNGS Projects - 46634																				
	13-46634 Not enough available outage window for scope execution during	There is a risk that outage schedule does not have enough execution window to complete planned scope in P1641 and P1711 outages. This results in cost & schedule impact to projects.	4	Active	Craig Verwey	Rathin Bagchi	18-Apr-16	Mitigate	18-Nov-15	3	2	4	12	1	1	3	3			
Action#	Status	Action Title	Action Description				Owner	Delegate	Due Date	Comments										

14020	P1641/P1711 outages.		6690	In Progress	Project 13-46634 scope execution windows for U4 & U1	Coordinate with outage group to confirm Schedule execution window for P1711 outage scope for Project 13-46634 Coordinate with outage/FH to confirm project scope execution window for U4 East catenary cables	Craig Verwey	Rathin Bagchi	31-Aug-16	U4 W Cat cables are scheduled during P1641.  U1 scope is scheduled for P1711 U4E cat cable scope is potential for P1841 outage.								
14008	Discovery and configuration management issues found during Installation - Schedule and Cost Impacts	There is a risk that discovery issues and related configuration management issues will occur during overhaul and replacement of FH SPV equipment in the field. The remaining scope is the U4(E) Catenary cable replacements, and the U1 (E & W) Thrust Bearing and FM cable harness replacement.	2	Active	Craig Verwey	Rathin Bagchi	20-Apr-16	Mitigate	17-Nov-15	1	1	1	1	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6692	In Progress	Discovery issue resolution	To perform detail walkdown in U1/U4 before execution to identify any discrepancies in as built condition compared to design documents. Obtain design resolution from plant design prior to start of execution.	Craig Verwey	Raymond Naidu	23-Dec-16	As found conditions in U4 catenary cables obtained through field walk down and design disposition complete. On going action to obtain as found condition in U1 and obtain design disposition as required.								
Project: PNGS Projects - 41043																		
14301	41043 - U - OEM not replying to OPG query in timely manner	OEM not replying to OPG query in timely manner. Completion of design will require technical information/clarification from Solar, Any delay in response from solar will delay the completion of the design package and extend the overall project schedule.		Active	Partha Chatterjee		02-May-16	Mitigate	16-May-16	5	2	5	25	4	2	4	16	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6540	In Progress	41043 - U	Issue the Service PO to solar for engineering support. Once the PO is issued arrange commitment from the senior management of Solar to support this project on priority basis.	Partha Chatterjee		02-May-16									
14176	41043 - A - Auxiliary may require upgrade	There is risk that the performance of the existing auxiliary systems may not be satisfactory due to ageing factor. The performance of any aux system if out of specifications will require modifications, this will impact the cost & schedule of the project.	4	Active	Partha Chatterjee		02-May-16	Monitor	16-May-16	4	4	5	20	4	4	5	20	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6361	In Progress	41043 - Auxiliary may require upgrade	The sponsor is reviewing the OEM report for the health of the existing EPGs. Any required modification to the existing auxiliary system will be performed under a separate project. The deficiency of the existing aux system if any will be confirmed by performance engineering. Depending on outcome auxiliary system modifications or maintenance may be required prior to engine swap.	Dan Gleeson		16-May-16									
			6702	In Progress	41043 - A - Auxiliary may require upgrade	Performance (base line) will be determined for the existing system. The new engine will be tested to match the existing base line.	Partha Chatterjee		30-May-16									
14181	41043 - C - Software Qualification	Vendor is not familiar with OPG SQA requirements for Cat II software. SQA needs to be performed for the new speed module. Qualification process may require extensive engineering input from Solar.	4	Active	Partha Chatterjee		02-May-16	Mitigate	08-Aug-16	4	1	5	20	3	1	3	9	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6358	In Progress	41043 - Software Qualification	Any change in the software will be performed under OPG oversight via approved SMP. Software changes to be approved by design. All software QA will be performed by a third party with support from solar. PO for software qualification report will be issued by mid April 2016.	Partha Chatterjee		29-Jul-16									
14183	41043 - E -Secure early production spot at solar San Diego - Complete	Negotiating terms and conditions and review of technical specification with solar may impact March production spot.	4	Active	Partha Chatterjee		02-May-16	Mitigate	15-Mar-16	4	2	5	20	2	1	4	8	
			There are no Not Started, In Progress Actions associated with the risk.															
	41043 - N - T5 governor limit for derating T4701 to T4001	Since T5 governor limit for derating T4701 to T4001 impacts turbine capacity under high ambient conditions it may not be able to achieve 3.5MW at 35 C		Active	Partha Chatterjee		02-May-16	Mitigate	16-May-16	4	3	5	20	4	2	4	16	



Risk Report by Project with Associated Actions

14275	derating 14701 to 14001 impacts turbine capacity under high ambient temperature conditions	conditions it may not be able to achieve 2.5MW at 35 C.																	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6486	In Progress	41043 - N - T5 limit for derating T4701 to T4001 impacts turbine capacity under high ambient temperature conditions	Project to coordinate with Solar to confirm any mismatch between existing T4001 Engine curve and derated T4701 Engine curve. Performance engineering is reviewing the total load requirement. At present the existing EPG are not tested at 2.5 MW load.	Partha Chatterjee		30-May-16										
14276	41043 - O - Air supply requirements for T4701 is greater than T4001 Engine	Since air supply requirements for bearing seals, air assist is greater than the requirements for existing T4001 Centaur, Air receivers may not have sufficient capacity for 5 black start attempt. Design requirements may not be met. Further mods to air supply system may be needed.		Active	Partha Chatterjee		02-May-16	Mitigate	16-May-16	4	3	5	20	5	3	4	20		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6488	In Progress	41043 - O - Air supply requirements for T4701 is greater than T4001 Engine	Projects to coordinate with Solar and obtain the air supply requirement for the new engine and compare with the existing air supply data to confirm any issue with the 5 black start. Depending on the outcome, further actions may be required. Projects to verify the Licensing requirement for 5 black start.	Partha Chatterjee		16-May-16										
14277	41043 - P - New engine T4701 may not be compatible with existing EPG Auxiliary system	New engine T4701 may not be compatible with existing EPG Auxiliary system for example: 1. Bleed valves and guide vane actuators not compatible. 2. Turbine does not align with existing shaft positions. 3. Air intake and exhaust systems are not compatible. 4. Significant software mods required to accomidate new turbine fuel and control requirements. 5. Incompatibility with new engine mounted sensors (Vibration, speed and temperature)		Active	Partha Chatterjee		02-May-16	Mitigate	16-May-16	4	4	5	20	4	2	5	20		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6360	In Progress	41043 - Auxiliary may require upgrade	Design contractor will review with OEM upfront for any compatibility issues with new engine in operation. Projects will discuss any findings from the compatibility report with OEM and sponsor to confirm the path forward. Depending on the outcome further action may be required.	Partha Chatterjee		16-May-16										
14264	41043 - H - Maintenance resource for feild execution	Since the same maintenance crews are supporting existing SG and EPG work, there may be a resource issue to support the EPG engine field installation work . As per present status EPG 1 Installation is scheduled to start Jul 15 2016, but this schedule may be advanced if the EPG 1 design is completed earlier. MC resources need to be adjusted to support the field installation based on the SG/EPG cycle plan .	3	Active	Partha Chatterjee		02-May-16	Accept	15-Jun-16	4	2	4	16	3	2	4	12		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6462	In Progress	41043 - H - Maintenance resource for feild execution	Project will update work control and maintenance on a continuous basis for any changes in the schedule for the engine installation. The design schedule is expected to be finalized by mid April 2016 (after completion of preliminary engineering) and the EPG 1 installation schedule will be reviewed to expedite the installation window.	Partha Chatterjee		15-May-16										
			6525	In Progress	41043 - H - maintenance resource for feild execution	Maintenance section manager to review the new schedule and confirm the resource requirements.	Sunil Ahuja		30-May-16										
14266	41043 - I - Extra resources required to complete EPG1 preinstallation work	Extra resources are required to complete EPG1 preinstallation work (workplans, assessing, TPARs)		Active	Partha Chatterjee		02-May-16	Mitigate	29-Jun-16	4	2	4	16	4	2	3	12		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6490	In Progress	41043 - I - Extra resources required to complete EPG1 preinstallation work	Projects will coordinate with performance engineering to get help from SME to draft the EPG workplans/TPARs.	Partha Chatterjee		15-Jun-16										
14271	41043 - J - Lube oil system is not capable of rejecting T4701 heat load	Lube oil system may not capable of rejecting T4701(new engine) heat load causing the turbine to trip on high oil temperature.	4	Active	Partha Chatterjee		02-May-16	Mitigate	16-May-16	4	2	4	16	3	2	3	9		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6483	In Progress	41043 - J - Lube oil system is not capable of rejecting T4701 heat load	Ensure Cooler fins are clean and prior to commissioning test check operation of the control valves and the cooler.	Dan Gleeson		16-May-16										
1	41043 - K - Turbine Lube oil flow requirements of new T4701 turbine exceed the	Since Turbine Lube oil flow requirements of new T4701 engine may exceed the requirements of the T4001 engine, Turbine may trip on low lube oil pressure.	3	Active	Partha Chatterjee		02-May-16	Mitigate	16-May-16	4	3	4	16	3	2	4	12		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									



272	T4001		6482	In Progress	41043 - K - Turbine Lube oil flow requirements of new T4701 turbine exceed the T4001	Obtain flow data requirements from Solar and compare with existing capacity.Any issue discuss path forward with sponsor.	Partha Chatterjee		16-May-16										
14288	41043 - Q - Completing technical specification and engaging OEM prior to establishing clear design requirements	Completing technical specification and engaging OEM prior to establishing clear design requirements i.e. prior to obtaining DA and DOM approval on the MEC package which usually consists of modification details, MDR, RTM, Software quality, HFE requirement. Tested engine may not meet all the requirements stated in revised TS. In this case, Station will be asked to accept the engine taking deviation to the approved revised specification. Rework may be required.		Active	Partha Chatterjee		16-May-16	Accept	16-May-16	4	2	4	16	2	2	3	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6506	In Progress	41043 - Q - Completing technical specification and engaging OEM prior to establishing clear design requirements	Review FAT test results of the actual engine and any deviation from the TS will be reviewed with performance engineering. Revise TS once the MEC is authorized and obtain concurrence from OEM. TCD for completing the preliminary engineering is May 2016.	Mano Velayuthan		23-May-16										
14184	41043 - F -There is a risk that the Design Quality will not be up to standard	Due to an accelerated schedule, there may be re-work due to product quality not being up to the standard. Work management preparation milestones will be missed.	3	Active	Partha Chatterjee		02-May-16	Mitigate	15-Jul-16	3	1	5	15	2	1	4	8		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6354	In Progress	41043 - There is a risk that the Design Quality will not be up to standard	Signed Station Alignment memo with all key milestones and escalation mechanism.	Dan Gleeson		30-May-16										
			6706	In Progress	41043 - F -There is a risk that the Design Quality will not be up to standard	The design package will undergo cold body review so that any error in design is detected earlier.	Mano Velayuthan		30-May-16										
14289	41043 - R - OEM will only perform their standard test as part of the FAT	OEM will only perform their standard test as part of the FAT. OEM will not perform the test that we requested in TS due to time constraints. This means, OPG will need to accept the deviation from TS through concession. Additional testing to be performed during SAT.		Active	Partha Chatterjee		02-May-16	Accept	23-May-16	5	1	3	15	4	1	2	8		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6507	In Progress	41043 - R - OEM will only perform their standard test as part of the FAT	Additional testing on the engine will be performed during the SAT to meet all the design and specification requirements. The SAT procedure is expected to be ready by mid July 2016.	Partha Chatterjee		15-Jul-16										
14180	41043 - B -Seismic Qualification	Seismic Qualification of the engine is required. 1.OEM wil not be performing seismic analysis and therefore OPG will need to engage another company such as Curtis Wright to complete the Analysis. If any issue is discovered in respect to the seismic analysis the engine has to be accepted with additional review/study as OEM will not alter any change to their standard engine design. 2. The speed probe and the backup overspeed module needs to be seismically qualified which may delay the installation of the engine.	4	Active	Partha Chatterjee		02-May-16	Accept	15-Jul-16	3	1	4	12	2	1	3	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6359	In Progress	41043 - Seismic Qualification	Seismic Qualification Report for the new engine will be done via analysis by a third party (Curtis Wright) . Mass of the new engine is expected to be similar to the old hense the risk is low.	Mano Velayuthan		30-Jun-16										
			6520	In Progress	41043 - B -Seismic Qualification	The speed probe and backup overspeed module will also be done via analysis as the size and weight of these component are similar to the old one.	Partha Chatterjee		30-Jun-16										
14182	41043 - D -Commissioning limitations during FAT at Solar	1)Some commissioning may not be able to be performed due to operational restrictions or impracticalities during FAT. 2) During FAT the control software used to run the engine may not be the same as the site control system hence engine characteristics verified during FAT may not match the existing engine.	3	Active	Partha Chatterjee		02-May-16	Mitigate	29-Apr-16	3	1	4	12	3	1	3	9		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6357	In Progress	41043 - Commissioning limitations during FAT at Solar	Project will coordinate with design and OEM to finalize the commisioning strategy and requirements as part of the FAT and site testing. Any gaps in the testing will be documented VIA analysis.	Partha Chatterjee		16-May-16										
			6703	In Progress	41043 - D -Commissioning limitations during FAT at Solar	Additional load testing will be performed at site to confirm the new engine characteristics match the existing engine. SAT procedure to be ready July 16 2016.	Partha Chatterjee		15-Jul-16										

14186	41043 - G - Acceptance of new engine emmissions by enviroment group and MOE	With Fukushima project completion the existing emission level at Pickering is very close to the acceptable limit. The ministry may request OPG to reduce the emission level for any new modification. New engine may not meet the present emission standard requirements per federal/provincial. Enviromental group need to provide concurence on this issue.	3	Active	Partha Chatterjee		02-May-16	Mitigate	16-May-16	3	2	4	12	3	2	4	12
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6353	In Progress	41043 - Acceptance of new engine emmissions by enviroment group	After obtaining the emission data for the new engine from the FAT, Projects will coordinate with the environmental group to confirm the acceptance and identify any new emmissions modeling requirements by MOE. New actions may result depending on the outcome.	Partha Chatterjee		15-Aug-16								
14273	41043 - L - New turbine fuel requirements are not compatible with OPG existing fuel specification.	New turbine fuel requirements are not compatible with OPG existing fuel specification. Excessive contamination in the fuel will reduce the turbine life and may create problems with contol of fuel flow.		Active	Partha Chatterjee		02-May-16	Accept	16-May-16	3	4	4	12	3	2	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6484	In Progress	41043 - L - New turbine fuel requirements are not compatible with OPG existing fuel specification.	Performance engineering to review the fuel requirement with component engeneering and summarize any issue with fuel compatibility. As per initial review the delta in the fuel specification should not be a risk, Being reviewed by SME.	Dan Gleeson		30-May-16								
14274	41043 - M - Multiple modifacaton work during EPG outage may impact engine installation	In the EPG outage there are other modification/maintainence work scheduled with the engine replacement. If the window for engine installation is not properly planned it will impact the engine installation schedule.		Active	Partha Chatterjee		02-May-16	Accept	30-May-16	4	3	3	12	2	3	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6704	In Progress	41043 - M - Multiple modifacaton work during EPG outage may impact engine installation	SWC to prepare intergrated logic sequencing all the installation/testing activities. Seperate logic to be prepared for installation and commissioning activities.	Partha Chatterjee		16-May-16								
14298	41043 - T - OEM not providing technical documents	There may be a problem in meeting EPG reliability value as OEM will not be providing any customized technical documentation for the replacement engine it also may cause last minute changes to the approved design packages.		Active	Partha Chatterjee		02-May-16	Accept	02-May-16	4	1	3	12	3	1	3	9
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6514	In Progress	41043 - T - OEM not providing technical documents	Design contractor will try to obtain the reliability number through analysis. Additional actions may arise from the analysis. If required the EPG engine during final commissioning may need to undergo extended period of load run to obtain the reliability number.	Mano Velayuthan		16-May-16								
14290	41043 - S - Noise level of the new engine may be higher than the Original equipment	Noise level may be higher than the original equipment as the new engine has higher output. May need to modify our existing system to bring down the noise level to an accepted level.		Active	Partha Chatterjee		02-May-16	Mitigate	23-May-16	3	1	3	9	3	1	3	9
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6509	In Progress	41043 - S - Noise level of the new engine may be higher than the Original equipment	PPE requirement may need to be changed and station needs to provide acceptance to this deviation.	Partha Chatterjee		16-May-16								
Project: PNGS Projects - 40983																	
14340	Delays due to other work control priorities.	There is a risk that delays will be encountered in installation due to Work Control priorities and new scoring system to maintain scheduled work on the plan. In addition, some work will be scheduled on the cycle plan which may change based on station priorities.	2	Active	Sunantha Broekhuys	Paul Menard	20-Apr-16	Accept	16-Dec-16	2	1	3	6	2	1	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
14341	Operator resource support to apply work protection	There is a risk that Operator resources are not available for support in applying work protection.	2	Active	Sunantha Broekhuys	Paul Menard	20-Apr-16	Mitigate	15-Dec-17	2	1	2	4	2	1	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
Project: PNGS Projects - 41030																	
	Scope growth from PdM Charter Revision 02 NA44-PCH-01060-00001	After 4 years delay to PdM Improvement Project 13-41030, revision 02 for NA44-PCH-01060-00001 has been received by projects from the sponsor. The problem statement of the charter is not clearly defined with no clear success factors. The	3	Active	Ivan Ho		19-Apr-16	Mitigate	30-Jun-16	5	3	3	15	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														



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14369		The project schedule for the charter is not clearly defined. The monitoring and data collection requirements for critical ACU and Pumps are not clearly defined. In addition, Fire Retardant Fluid (FRF) has now been included in this charter which was not part of the original charter. There is a risk of further scope growth on this project. Depending on the requirements of this project, there is a risk of longer durations required to complete engineering (step backwards to complete Conceptual, Value Engineering, COMS, etc).																
Project: Pre-requisite Projects -																		
11808	Qualified vendors are not available	The risk is that qualified vendors are not available, which impacts the project schedule.		Active	Dragan Popovic		27-Oct-15	Monitor	31-Jan-14	2	1	2	4	2	1	2	4	
There are no Not Started, In Progress Actions associated with the risk.																		
11810	Infrastructure facilities are not available or are inadequate; e.g. congestion in common areas	The risk is proposed facilities are not available or are inadequate; e.g. leading to personnel congestion in common areas (such as Retube Command Centre) for the project duration.		Active	Michael Allen	Dragan Popovic	27-Oct-15	Monitor	31-Jan-14	2	2	2	4	2	2	2	4	
There are no Not Started, In Progress Actions associated with the risk.																		
11811	Project/Construction relatedFatality/Serious Injury during Readiness (Campus Plan) Phase of project	Risk is that such injuries may affect the project schedule, cause delays, result in financial impact and potential difficulty controlling the outcome (legal).		Active	Dragan Popovic		27-Oct-15	Mitigate	31-Jan-14	2	2	2	4	1	2	2	2	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			3214	In Progress	Project/Construction related Fatality/Serious Injury during Readiness (Campus Plan) Phase of project	Risk that such injuries may affect the project schedule, cause delays, result in financial impact and potential difficulty controlling teh outcome (legal)	Dragan Popovic		01-Jun-16	2014.09.18 Safety incidents are recorded (including SCRs), jointly reviewed and investigated with Lessons Learned shared among OPG and ESMSA vendor groups. Safety is a major focus of Project Control Centre daily reporting.								
Project: Pre-requisite Projects - 73365																		
12471	73365 CFVS - Lack of schedule float for weather delays	The weather during the spring months can be rainy and windy. If the winds are too high then craning activities cannot be performed. There is a risk that there is insufficient float in the schedule to account for poor weather conditions. If there is insufficient float then activities put on hold due to rain and/or high wind will cause a delay to schedule and increased costs for trades on standby and craning equipment rental.	3	Active	Jacque Ciccarelli	Samantha Thurston	04-May-16	Mitigate	29-Apr-16	4	2	4	16	3	1	4	12	
There are no Not Started, In Progress Actions associated with the risk.																		
14371	73365 CFVS - There is a risk that the Project EAC will exceed the current Project approved budget	It is forecasted that the Project EAC will exceed the current Project approved budget. The Vendor is continually submitting overtime requests and CTPs and PCAs that are outside of the currently approved budget. This risk will result in additional cost to the project exceeding the approved budget. Approval at Gate 4 or through a CCN will be required to increase project funding.	3	Active	Jacque Ciccarelli	Samantha Thurston	26-Apr-16	Mitigate	30-Jun-16	4	2	4	16	3	2	3	9	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			3090	In Progress	CFVS - Increased ES MSA contrator cost estimate	Review vendor costs during weekly quad chart review meeting. Request detailed CTP and PCA information from the vendor. Present PCAs and CTPs to PMOC for review and approval. Request additional funding through a CCN or at Gate 4 if required.	Samantha Thurston	Samantha Thurston	30-Sep-16	April 2016 update: Gate 3D funding was received for \$80.6M which is less than requested. The vendor continues to submit PCAs and CTPs above the Gate 3D estimate. Vendor continues to submit overtime requests to maintain the schedule without submitting corresponding CTPs to document the value for money.								
	73365 CFVS - Risk that the schedule is not realistic to achieve the AFS milestone	The current P6 schedule has multiple issues of concern including incorrect logic, incorrect activity ties, and incorrect durations. During three week lookahead reviews the contractor is constantly reporting that they are fixing logic errors and updating durations to maintain the AFS milestone date.	3	Active	Jacque Ciccarelli	Samantha Thurston	26-Apr-16	Mitigate	09-Sep-16	4	2	4	16	3	2	3	9	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								

14372	due to errors in the schedule	There is a risk that the schedule is not realistic to achieve the AFS milestone due to errors in the schedule.															
14374	73365 CFVS - Material Risk impacting execution schedule	Timely delivery of materials is at risk due to lack of availability of materials and late fabrication of prefabricated items. If material are delivered late there is a risk that it will delay the execution schedule. This will impact the schedule and cause increase in costs to make up the time.	3	Active	Jacquie Ciccarelli	Samantha Thurston	22-Apr-16	Mitigate	02-Sep-16	4	2	4	16	3	2	3	9
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6835	In Progress	73365 CFVS - Material tracking	OPG PM is continually tracking materials with the ES MSA vendor to ensure materials are brought on site as required. OPG has requested that the ES MSA vendor contact their fabrication shop to request that they expedite prefabrication when materials are available. ES MSA vendor has contacted their fab shop and they will expedite as required.	Jacquie Ciccarelli	Samantha Thurston	31-Aug-16	April 22: CTP was submitted for additional costs for HSL to modify documents in order to substitute stack material. OPG is reviewing the CTP request. Fox has been in contact with their fabrication shop to ensure they are on track to fabricate the required materials.							
			6871	In Progress	73365 CFVS - Tracking of Civil Construction Concerns	OPG PM is continuing to meet with the ES MSA PM to track the project schedule and material status. Tracking is performed as follows: Weekly Design status meeting with ES MSA vendor and their design subs, OPG design, OPG Projects and OPG nuclear safety to review the P6 engineering activities, meeting actions for ES MSA vendor, subs and OPG and ITF actions. Weekly Construction status meeting with ES MSA PM and construction foreman, OPG Project, OPG CMO and FE to review the P6 construction and procurement activities and ongoing field work. Daily construction conference calls each morning with OPG project team(PM,CMO,FE, PCC) and ES Fox PM and foreman to review the plan of the shift and review issues that require assistance. Weekly Quad Chart meeting with OPG PM and ES MSA PM to review risks, budget, and milestones. As required, Pour readiness meetings and overall schedule review meetings. ES MSA Vendor is also meeting daily with their sub vendors to review the schedule and find efficiencies where possible.	Jacquie Ciccarelli	Samantha Thurston	30-Sep-16	April 22: at the readiness meeting on April 14th OPG was notified that the Q1 pour date would push to April 20th. The date was then pushed 4 more times to Thursday, April 28th. The regular meetings provide OPG the opportunity to track the schedule and actions with the vendors and keep an open line of communication. April 29: ES MSA vendor is meeting with their civil sub vendors to discuss the remaining activities and create a path forward for efficiencies. They will report their findings to OPG today. The Q1 pour date pushed to Tuesday, May 3rd due to underestimated duration for formwork closing. May 2nd update: ES MSA vendor pushed the Q1 pour to Thursday, May 5th. May 3rd update: ES MSA vendor pushed the Q1 pour to Friday, May 6th due to close proximity to vacuum building making form closing difficult.							

<a href="#">13265</a>	73365 CFVS venting stack monitoring requirement potential need to purchase new stack monitor	Reactor Safety review of CFVS MDR requirements traceability matrix identified potential need for project to purchase a new stack monitoring portable device. Project action to date was only to obtain isolatable sample points to tie-in a portable device provided by others. Risk is that a new monitor will need to be designed and purchased and installed, or test connected and commissioned prior to AFS. Project is ~ 6 months from final AFS	2	Active	Jacque Ciccarelli	Samantha Thurston	15-Apr-16	Monitor	30-Jun-16	2	1	5	10	1	1	5	5	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">4899</a>	In Progress	73365 CFVS resolve need for CFVS Project to provide stack monitoring device	Communicate with stakeholders to identify issue and get support for resolving the requirement. 1. Review RTM requirement with design oversight, nuclear safety and emergency planning organizations and 2. Identify issue to steering committee, project and refurbishment engineering line organizations Identify options to meet potential requirement 1. identify potential existing devices and how they could be mobilized and integrated into CFVS procedures 2. identify requirements for device specification and existing equipemtn similar to device to determine potental cost and schedule Prepare plan to implement if resolution is that a new device will be required	Bill Devlin	Colin Barfoot	08-Apr-16									
<a href="#">14375</a>	73365 CFVS - Reach Rod Interferences	There is a risk that interferences in the field will impact the reach rod installation schedule. This will result in a delay to the schedule activities and increased costs to avoid or remove the interferences.	4	Active	Jacque Ciccarelli	Samantha Thurston	20-Apr-16	Mitigate	29-Jul-16	2	1	4	8	1	1	2	2	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6838</a>	In Progress	73365 CFVS - Path forward for Reach Rod Interferences	ES MSA vendor is working with OPG FE to scan the concrete walls within the reach rod installation area for rebar. ES MSA vendor will work on avoiding the interferences or removing the interferences if applicable.	Jacque Ciccarelli	Samantha Thurston	29-Jul-16	April 22: An emergency exit sign needs to be moved. A field change is required for this. The field change will take approximately 5 days to complete. Moving the sign should be completed within one shift. TCD for field change completion is April 29th.								
<a href="#">14377</a>	73365 CFVS - TPAR submission behind schedule for document updates	TPARs have not been submitted for many documents requiring updates for the CFVS AFS in September. This task is with the ES MSA vendor to complete. OPG procedures group has submitted SCR D-2016-10006 to document the late TPARs. If the TPARs are submitted late then there is a risk that this will cause a push to the AFS milestone.	4	Active	Jacque Ciccarelli	Samantha Thurston	04-May-16	Mitigate	20-May-16	2	1	4	8	2	1	4	8	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6841</a>	In Progress	73365 CFVS - TPAR submission and document update tracking	ES MSA vendor and OPG project teams are meeting to discuss the TPAR submission and document updating requirements. Ongoing tracking of these activities will be done to ensure the AFS milestone date is not at risk.	Jacque Ciccarelli	Samantha Thurston	26-Aug-16	April 22: OPG PM emailed the vendor MTL a list of documents requiring updates and requested an update on the status of the TPARs for those documents. OPG PM emailed the current status of the documents to the OPG procedures contact to ensure they are aware of the status. ES MSA vendor submitted request for weekend overtime for TPARs.								
<a href="#">14229</a>	73365 CFVS - Containment Filtered Venting System (CFVS) - PRV30 delay	The risk is that the final weight of PRV30 is not bounded by the stress and seismic analysis already performed for the CFVS system, resulting in design revisions and possible rework of fabricated components (eg. supports). This risk has been created due to late procurement of the component, and delayed acquisition of required information (weight & centre-of-gravity) from the manufacturer. This risk is documented in SCR N-2015-17029 and associated A/R 28180737. Also tracked via CFVS ITF Items 204 and 211.	3	Active	Tyler Wreford		15-Apr-16	Mitigate	13-Apr-16	2	1	3	6	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6870</a>	In Progress	73365 CFVS - PRV30 valve weight information requirement	ESMSA Vendor to perform a conservative bounding assessment to confirm this risk is low. ESMSA Vendor to work with component manufacturer to obtain required information (weight and CoG) as soon as possible (i.e. improve on current estimate).	Jacque Ciccarelli	Samantha Thurston	30-May-16									



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12058	73365 CFVS - Containment Filtered Venting System: (CFVS)Access to the work areas	The risk is that access to the work areas may be denied due to delays in obtaining the necessary access permit or changes in the station meaning access to the PRVM is not possible The risk is that the containment tie-in installation may be extended 1 day beyond the scheduled window. The consequence is aligned resources will incur standby/ delay cost, and if delay is longer than 1 day it could move the scope to another work week (delay of 8 weeks non critical path with a higher cost) .	2	Active	Jacque Ciccarelli	Samantha Thurston	15-Apr-16	Mitigate	30-Aug-16	1	2	2	2	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			3185	In Progress	CFVS - Access to PRVM to complete placing CFVS in service activites	Mitigating actions: 1. Develop appropriate CAD models and perform RELAP analysis. 2. conduct installation reviews with the construction group and vendor to examine potential issues. 3. Develop construction alternatives as required.  For final placing system in service, plan execution of 1 look per week to minimize impact of delays in no fuel windows needed to obtain PRVM access needed for isolation to do work.	Colin Barfoot	Colin Barfoot	28-Jul-16								
Project: Pre-requisite Projects - 73815																	
12085	Refurbishment Project Office (RPO) 10-73815: Security System Tie-ins	Security equipment being installed in the RPO requires tie-ins to the existing Darlington Entry Control System (ECS), Security Monitoring System (SMS) and Physical Barrier System (PBS). The ECS, SMS and PBS sub-systems are known to have existing configuration management issues, obsolete software and equipment. Integrating new security equipment into the Station's existing ECS, SMS and PBS introduces risk during the installation and commissioning phases for the Security ECs. The project may be required to upgrade existing software packages or components, which would require additional design effort and cost to ensure tie-ins are successful.	3	Active	Bill Devlin	Courtney Brisebois	28-Apr-16	Monitor	29-Feb-16	3	1	3	9	3	1	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
12444	Refurbishment Project Office (RPO) : Risk that Security Control Maintenance resources are	Risk that Security Control Maintenance resources are not available to support RPO Commissioning.	3	Active	Bill Devlin	Courtney Brisebois	28-Apr-16	Mitigate	16-Mar-16	5	1	1	5	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
12100	Refurbishment Project Office: Gaps in the Process for Procuring Spare Parts	There is a risk that there are gaps in the new spare parts process and that there will be churn in getting the spare parts into the OPG warehouse. The process of dealing with spare parts that are purchased by the EPC vendor is problematic as per OPEX from the revolving door project and Sally Port Project. This would result in additional costs for unforeseen delays.	2	Active	Bill Devlin	Courtney Brisebois	28-Apr-16	Accept	31-Mar-15	3	1	1	3	3	1	1	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			3092	In Progress	RPO - Spare Parts	Mitigating Actions: OPG will ask for a list of proposed spare parts from the vendor after design is complete. This list will be reviewed with NEF and Opperations.	Jacque Ciccarelli		30-Apr-15	Meeting Held October 21 to go over required actions to support AFS, including creating a spare parts list. This action will be tracked in the weekly design meeting.  Spare Parts List and Maintenance Plan are outstanding.							
Project: Pre-requisite Projects - 31555																	
14287	16-31555 - Building Structural Steel Delivery Dates	Event: Changes to the 100el slab thickness Cause: Design changes to an accepted EC Impact: Late fabrication and delivery of structural steel	4	Active	Anthony Colella	Anthony Colella	04-May-16	Mitigate	31-May-16	5	2	5	25	2	2	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6504	In Progress	16-31555 - Assess impact of structural steel delivery	Management team is actively involved in reviewing erection schedule with the JV, fabricator and erector. Review delivery dates and expedite to meet construction schedule. Discuss second shift and weekend/overtime work to advance delivery dates.	Anthony Colella	Anthony Colella	31-May-16								
	16-31555 D2O Storage Project: Quality Issues Resulting from Expedited	Event: Late start of new EPC Vendor Cause: Lack of resources at onset of PO release. Impact: Expedited construction schedule with many activities progressing in parallel.	4	Active	Anthony Colella	Zane Loughheed	04-May-16	Mitigate	18-May-16	4	3	5	20	3	3	5	15
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

ONTARIOPOWER GENERATION Risk Report by Project with Associated Actions

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Run by:



<a href="#">12289</a>	EPG3 - Commissioning of EPG3 may take longer than anticipated	Due to specialized resource requirements and complex permity requirements, the risk is that the commissioning of this new system may take longer and be more challenging than estimated impacting schedule. In addition, as of January 2016, OPG assumed the commissioning planning work from the Vendor which could result in additional challenges during the transition of responsibilities.	3	Active	John Ieraci	Mark Ciana	27-Apr-16	Mitigate	27-May-16	4	1	4	16	3	1	3	9
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">3022</a>	In Progress	Secure EPG3 Commissioning Resources	Secure EPG3 Commissioning Resources (MM/MC/OPS/Commissioning Plan Writers) by name	John Ieraci	Brian Krystolovich	20-May-16	Presently, Work Protection will be per OPG Standards. Commissioning planning and the effort to write the Detailed Commissioining Plans has been assumed by OPG as of January 2016. A team is being assembled and some delay has been encountered during this transition. Weekly meetings are being held with the Commissioning Team to monitor progress of these activities.							
			<a href="#">6578</a>	In Progress	Develop EPG3 Commissioning Permit Strategy	Commissioning Permit strategy to be developed and communicated.	John Ieraci	Brian Krystolovich	31-May-16	In Progress							
			<a href="#">6934</a>	In Progress	Add EPG3 Commissioning Activities to the IPG schedule	Commissioning Field Execution Activities are to be added to the Station IPG schedule to ensure resources are planned and available.	John Ieraci	Brian Krystolovich	31-May-16	Meeting with Vendor, station stakeholder I/P.							
<a href="#">12290</a>	EPG3 - Critical Spare Parts Unavailable for AFS	There is a risk that critical spares may not be available for the scheduled AFS due to the late identification of the spare parts list. The unavailability of spare parts would threaten the AFS being completed and a risk to meeting the Refurbishment breaker open commitment.	3	Active	John Ieraci	Mark Ciana	27-Apr-16	Mitigate	31-May-16	4	3	4	16	3	3	3	9
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">3309</a>	In Progress	Obtain Cost & Delivery Schedule For all Project Spare Parts	Project team to obtain costs and schedule of procuring spares by the Vendor and issue PO rev.	Mark Ciana		31-May-16	Parts lists created for Turbine-Generator and most sub-systems. Review process initiated with Maintenance, Design and the System Responsible Engineer. List will be vetted and concurrence obtained prior to issuance. Schedule & cost to follow once list finalized.							
<a href="#">13934</a>	EPG3: IESO Approval for new Generator may affect AFS date	Generator is subject to IESO registration. This was identified late. Engineering will request an IESO "exemption". If this "exemption" is not accepted, then the scheduled AFS date will be at risk because EPG3 could not be connected to the EPS bus during testing. In addition, if the exemption is not acceptable, then EPG1 and EPG2 can be impacted since the modifications required to support the EPG3 registration will impact the the other EPG's through a common relay.	3	Active	John Ieraci	Mark Ciana	27-Apr-16	Mitigate	31-May-16	3	2	4	12	2	2	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">6308</a>	In Progress	Issue IESO exemption Letter	Engineering to issue an IESO "exemption" letter that requests exemption from IESO requirements and await response to IESO	Mark Ciana	Mark Ciana	06-May-16	Engineering has issued the exemption letter to IESO and is with them for assessment. The exemption is only for the "speed of response" and DROOP requirements only. No request for an exemption for "under-frequency" response requirements was requested with this exemption letter. However, as part of the market registration application (see Action 6935) OPG has requested time from the IESO to the end of the year (2016) to review the justification to not meeting the "under-frequency response" requirements. If no justification can be provided, then the EPG3 may be subject to the under-frequency requirement which will result in a future modification.							
			<a href="#">6935</a>	In Progress	Complete IESO Market Registration for EPG3	IESO Market Registration of EPG3 to be completed.	John Ieraci	Mark Ciana	30-Sep-16	IESO Market registration application has been completed. IESO currently assessing the application.							
	EPG3: Risk to Software Qualification to Category 2	The equipmment was supplied without adequate documentation to support Cat 2 software qualification. The EPG Vendor has agreed SMT to qualify the EPG3 software/firmware to Cat 2	3	Active	John Ieraci	Mark Ciana	27-Apr-16	Mitigate	27-May-16	3	2	4	12	3	2	3	9

13954	Qualification to Category 2	Qualification. The EPC vendor has engaged SWI to qualify the EPG3 software/firmware to Cat 2. Some of the required information to complete qualification is either not available or proprietary. This issue could impact anticipated AFS, if not resolved in a timely manner. Extra effort required by ESFL/HSL/SWI could impact cost and schedule.	6938	Not Started	Obtain Software Version Numbers of Solar Skid Components that do not have Qualification Data Available	The following component software version numbers are to be obtained following the uncrating of the EPG3 skid and powering up the individual components. 1. Atas Copco - Air Compressor and Dryer Components; 2. Siemens Level Transmitter; 3. Precision Engine Controls (PEC) - Engine Bleed Valve and Engine Guide Vane Controls Once the software versions are known, then the Vendor (FOX/SWI) can request specific qualification data from these suppliers to progress the CAT 2 qualification	John Ieraci	Mark Ciana	31-May-16										
			6939	In Progress	Obtain Senior OPG Procurement Support to contact specific sub-Suppliers for Qualification Data	Certain EPG sub-component suppliers are unwilling to provide specific documentation and sales history to support software qualification to CAT 2 even though the hardware and software versions are known. Senior OPG procurement support may be required to help obtain this information. The following components may be affected: Caterpillar - Diesel Generator, ADEM A4 and EMCP Controllers; Dwyer - Dust Collector Timer Controller;	John Ieraci	Mark Ciana	31-May-16	Typical Memo being prepared to outline exactly what is to be requested from each sub-supplier to facilitate discussion with sub-supplier.									
			6940	In Progress	Ensure Certain Software Functional Tests are included in the appropriate EPG3 Commissioning Work Plans	The following software functional checks were not tested during the EPG3 FAT test: 1. Lube Oil Header Pressure Low; 2. Generator Protection Fault - (CAT 1); 3. Back Up Lube Oil Pump Fail; As a result, these functional tests must be included in the appropriate EPG3 commissioning work plan and done on site. This is necessary to support software Cat 2 qualification of the associated components.	John Ieraci	Brian Krystolovich	12-Aug-16										
14411	EPG3: Potential Claims	There are risks of potential claims on the project due to various charges that currently in dispute or being challenged including the following: <div></div> <div></div> <div></div> These potential claim could impact the final cost of the project if these potential claims/disputes are realized.	3	Active	John Ieraci	Mark Ciana	27-Apr-16	Monitor	31-Aug-16	4	3	2	12	3	2	2	6		
			There are no Not Started, In Progress Actions associated with the risk.																
12281	EPG3 - More Stringent Requirements for Work on/or near group 2 Safety Systems	There is a risk that the Station may impose more stringent requirements (or work methods) and oversight than anticipated for the electrical modifications planned on and in close proximity to Group 2 safety systems (EPS BUS, EPS Control Room) due to the complexity of the tie ins and commissioning. This may result in potential schedule delays and additional costs. ODM req'd.	3	Active	John Ieraci	Mark Ciana	27-Apr-16	Mitigate	02-May-16	3	1	2	6	2	1	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			3036	Not Started	ODM For Tie-in at EPS (Electrical)	ODM endorsement for tie-in at EPS (including back-out provisions and contingency strategies) prior to start of field work.	Mark Ciana		15-Jun-16	SIM for EPS tie-ins to be completed Jan 25, 2016 to communicate strategy and solicit input from senior managers. A formal ODM to be scheduled once senior manager comments and actions have been dispositioned. ODM to be scheduled for the next available opportunity (June 2016)									
131	EPG3: CSA N291 Concrete/Rebar Materials Testing Results Not	Late identification that CSA N291 requires concrete batch materials and rebar to be tested per specific requirements. A material testing lab is now engaged, however results are pending. There is a risk that the results will not be acceptable, yet the concrete and rebar has already been placed.	2	Active	John Ieraci	Mark Ciana	22-Mar-16	Accept	26-Aug-16	1	5	5	5	1	5	5	5		
			There are no Not Started, In Progress Actions associated with the risk.																



14250	Acceptable	This potentially means rework, with the associated impact to Project cost and schedule.																
Project: Pre-requisite Projects - 73380																		
14424	STOP Project work area interference with other outage work scope	Event: Installed shielding wall and scaffolding to support STOP installation found to be in the way of other outage work Cause: Lack of outage coordination on time and space usage Impact: Where other critical work has to proceed rework is required for removal and reinstallation of STOP scaffolding and shielding	3	Active	Dragan Popovic	Colin Barfoot	02-May-16	Mitigate	07-Jul-17	4	2	3	12	2	2	2	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			7014	In Progress	Prepare time and space matrix for used space for transient shielding and scaffolding builds	For the STOP and ESC piping reconfiguration modifications take detailed photographs of the installed scaffolding, tenting and ventilation, shield walls and other transient material that is needed at specific time and places to support ESC STOP modification installation. distribute information to Outage ECTL and refurbishment	Dragan Popovic	Colin Barfoot	09-Dec-16									
12228	73380 - Shield Tank Overpressure Protection(STOP) - Permitry	Event: Delay to project waiting for permit and related heat sink conditions Cause: Potential for delays due to time to establish permit requirements i.e. through IPTE process to drain ESC extension. On heat sinks due to outage work ESC can only be shutdown when heat sink conditions allow. Impact: Unit 4 initially only had one window for ESC tie-ins from April 8-27 including drain refill and testing duration when ESC could be shutdown, this was insufficient to complete prerequisite work and system tie in. Delays in completing draining during D1641 if reoccur will also delay execution. Update Second outage ESC drain window added March 2016 after moderator drain maintenance window.	2	Active	Bill Devlin	Colin Barfoot	29-Apr-16	Mitigate	31-Aug-17	3	1	3	9	3	1	2	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			3102	In Progress	STOP - Permitry	Mitigating actions: 1. Required permitry will be established with Station ahead of time. Update Nov.17: Regular HIT team meetings are ongoing to address STOP issues.	Colin Barfoot		28-Aug-15	Updated due date to ensure prior to the start of the D1531 outage that there have been no changes to the outage plan and scope which could cause issues to the risk item.								
12345	73380 - STOP- installation interferences with existing station equipment which require equipment relocation, removal or redesign of piping or supports	Event: During STOP installation of seismically qualified vent line or class 2 piping and supports or maintenance platform there may be interferences that were not identified during the design phase. Update to risk is need for new scope to relocate unit hydrogen igniter and Unit 4 electrical panel including 1) 4-57100-RE1 -- Gamma Monitor 2) 4-57100-RE11 -- Mosfet Sensor Cause: Due to equipment location being different between units and access not close enough to determine interferences during STOP design walk downs. Risk Impact: Since the lines are seismically analysed it will require a redesign and analysis, with added design costs and potential outage schedule delay	2	Active	Bill Devlin	Colin Barfoot	27-Apr-16	Mitigate	28-Oct-16	3	1	3	9	3	1	2	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			3184	In Progress	STOP - Installation interferences	Mitigating actions: 1. Detailed inspections will be performed as close as possible to the vault ceiling as soon as vault access is available. 2. tasks have been added in outage P6.	Colin Barfoot	Colin Barfoot	29-Jul-16	mitigated for unit 3, in progress for unit 4 installation of STOP modifications.								
14254	73380 ESC STOP Vault access restrictions	Event: Vault Access via vault coordinator control limits the number of personnel allowed to be in the vault due to breathing air and emergency egress reasons. Cause: Vault access is provided to work groups based on outage determined priority. Impact: During each outage ESC STOP execution was delayed for several days in aggregate due to priority based access restrictions.  Risk is that access delays will add to project and outage critical path.	3	Active	Dragan Popovic	Colin Barfoot	02-May-16	Accept	30-Jun-16	3	2	3	9	3	2	2	6	
			There are no Not Started, In Progress Actions associated with the risk.															
14111	73380 - Late scope addition to resolve ESC Pressure Pulse issues for D1641 execution	Event: Pressure Pulse identified in Unit3 ESC piping system by STOP SIR team will be addressed by Auto Pump Time delay and Pump discharge piping modifications with a new type nozzle check valve installation. Cause: Risks are associated with short timeline to complete design, work planning , assessing, procurement and execution and with first time use of this type and size of valve at OPG. Impact: design schedule does not support outage readiness milestones, recovery plan will be needed for all remaining units. Additional oversight and direct management with HIT team	3	Active	Jacque Ciccarelli	Colin Barfoot	11-May-16	Mitigate	01-Jul-16	3	2	2	6	3	2	2	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6225	In Progress	Implement ESC Pressure Pulse elimination modifications	Support execution of STOP HIT action plan to prepare for and implement new scope identified for pressure pulse elimination modifications in D1641 outage	Jacque Ciccarelli	Colin Barfoot	01-Jul-16									
	14316 - STOP RD Setpoint - Supporting Analysis for 440 kPa RD Not Yet Final	The risk is that the 440 kPa STOP Rupture Disc (RD) cannot be installed during the D1641 Outage because the supporting assessment concludes the bulkhead failure criteria to be less than 275 kPa.	4	Active	Gerry Martin		03-May-16	Mitigate	20-Apr-16	1	2	5	5	1	1	1	1	
			There are no Not Started, In Progress Actions associated with the risk.															

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Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

14316		<p>The STOP MDR requires the STOP setpoint to be selected such that the pressure pulse when relieving the shield tank does not fail containment, including the fuel transfer bulkheads installed during refurbishment. The overpressure failure limit for the bulkhead, as stated in the MDR, is 96.5 kPa(g). At this value, analysis shows it is not possible to meet the above requirement with a 440 kPa RD. However, additional analysis is currently being performed which will show, with a very high level of confidence, that the actual failure limit for the bulkheads is 275 kPa (same as the rest of containment). At this value, the MDR requirement is met with a 440 kPa RD.</p> <p>Current indication from the analysis is that the bulkhead failure limit is 275 kPa or higher, with very little risk that the analysis will conclude otherwise.</p> <p>The Outage Milestone Recovery TCD for issuance of the EC revision (to increase the RD setpoint to 440kPa), is 21-Mar-2016. The TCD for the bulkhead failure limit analysis is 20-Apr-2016. Until the bulkhead failure limit analysis is complete there is an associated risk to the project. The EC revision will be approved and released per the Outage Milestone Recovery Plan.</p>															
14233	73380 - ESC Pressure Pulse Testing - Lack of Testing	<p>Event: Pressure pulses in ESC system above the design set point of the STOP RD, potential to be different in each unit.</p> <p>Cause: Original design of piping and check valves as measured on Unit 3 ESC</p> <p>Impact: Lack of testing could result in ineffective design solution in that it does not adequately resolve the pressure pulse issue resulting in failure of the STOP rupture disc, or STOP would not be installed or will be isolated, leading to ineffective STOP installation.</p> <p>Risk for requiring EC revision to support testing results different than expected or with lower probability not being able to execution modification due to proximity to setback.</p>		Active	Colin Barfoot		11-May-16	Mitigate	15-Apr-16	2	2	2	4	2	1	2	4
There are no Not Started, In Progress Actions associated with the risk.																	
14237	73380 - ESC Pressure Pulse Testing - Hydraulic Assessment/Analysis for Validation	<p>Event: New nozzle check valves selected as design solution to mitigate or eliminate ESC piping pressure pulse do not have detailed supporting performance analysis</p> <p>Cause: The Conceptual Design Report, NK38-REP-34110-10034, recommended replacing the current End Shield Cooling pump discharge check valves with nozzle check valves, and perform a hydraulic analysis/assessment (or testing by valve vendor) to validate the effectiveness of the nozzle check valves to resolve the water hammer concern. OPG decided not to perform the hydraulic analysis</p> <p>Impact: Risk is that the valves arrive with no assessment and will not perform at the desired level of effectiveness in resolving the pressure pulse.</p>	3	Active	Colin Barfoot		27-Apr-16	Accept	11-Jul-16	2	2	2	4	2	2	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6832	In Progress	10-73380- ESC Nozzle check valves dynamic characteristic curves to be obtained	Action to resolve the performance characteristics meet the requirements for OPG DNGS ESC discharge piping to be effective in mitigating or preventing pressure pulses on pump shutdown or duty swap. Implement by obtaining representative dynamic characteristic curves and performance results to demonstrate acceptable valve closure times.	Raza Zaidi	Sean Bagshaw	13-May-16	initial curves received , in review - do not cover full expected range of operation.							
14230	73380 - Breach of Containment if residual pressure pulse causes leak in 34110-RD1 BDBE Rupture Disk	<p>Event: A leaking rupture disk would be a failure of the primary containment boundary (closed loop ESC system).</p> <p>Cause: Pressure pulse from ESC system pumps and check valves.</p> <p>Impact: If we take the parallel to a leaking coil on vault cooling, the vault cooling OM says to isolate the leaking coil, but we cannot isolate the leaking rupture disk this would lead to a unit shutdown.</p>	3	Active	Dragan Popovic	Colin Barfoot	11-May-16	Mitigate	15-Jul-16	1	1	3	3	1	1	3	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6382	In Progress	Assess potential breach of containment and impact on monitoring design	Refurbishment Nuclear Safety assessed scope of work necessary to mitigate assessment of breach of containment being declared. Project initiated design agency scope to perform calculations and assessment prior to AFS. Outcome will Identify any procedure changes or design inputs for BDB RD monitoring.	Dragan Popovic	Colin Barfoot	30-Jun-16	analysis completed,a revision to NK38-REP-34110-10040 R000 (Safety and Operational Assessment Summary Report For Increased STOP Rupture Disc Setpoint will be required prior to AFS							
Project: Pre-requisite Projects - 73370																	
	Vendor core team charges/ supply chain charges/OSS charges	As per the current directive from the NR organization, The vendor core team charges/ Supply chain charges/OSS charges are not charged to PSVS project. But if the decision is made in future to charge core team cost to project	3	Active	Bill Devlin	Vijay Pandya	09-May-16	Monitor	30-Jun-16	2	1	1	2	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

<a href="#">12332</a>			<a href="#">3212</a>	Not Started	Increase in Project cost due to core team/SC charges	As per the current directive from the NR organization, The vendor core team charges/ Supply chain charges/OSS charges are not charged to PSVS project. But if the decision is made in future to charge core team cost to project	Vijay Pandya		28-Dec-16	A decision was made by the refurbishment organization that the DTL support will be provided by OSS contractor instead of OPG resources. This will have an impact on project cost if refurb do not transfer funds.										
Project: Pre-requisite Projects - 73472																				
<a href="#">12335</a>	73472 D2O Islanding - Header Outage Required to Perform Installation	D2O Transfer Header Outages is required for field installation. Conflicts between the required outage and other station work may cause installation to be delayed. This will delay the schedule, increasing cost and creating schedule rework.	3	Active	Mike Nairne	Simion Deju	21-Apr-16	Mitigate	26-Mar-16	3	1	3	9	1	1	1	1			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			<a href="#">3051</a>	In Progress	Schedule Integration	Project teamto engage Operations,Reactor Safety and Work Control to determine requirements for a Header Outage (max duration, pre-reqs, restrictions, etc.). Project Team to determine the number of Header Outages required to perform the installation and schedule them accordingly on the station IPG schedule.	Ken Verwoert		30-Nov-15	Adjusted due date from end of T-10 to end of T-21 for the most recent proposed installation schedule. Header outages determined and will be scheduled based on design and material readiness. Latest material delivery TCD's will require PHT header outage after 2015 VBO, tentatively 2016WW02. Due date adjusted to T-21 for 16W02. June 2/15: Project presenting bi-weekly at Darlington Senior Work Management. Moderator header work is not on IPG schedule at T-10 for a pre-VBO 2015 installation due to material and work preparation readiness. Aug. 31/15: Moderator header work rescheduled to start 2016WW01 but being challenged to pull ahead for a 2015 completion. Effort ongoing to complete work planning to allow scope injection.										
<a href="#">12393</a>	73472 D2O Islanding - Accessibility Issues During Installation Phase	Locations within the Darlington station where the modification is taking place are typically accessible to workers during normal unit operation. These locations have the potential to become inaccessible for periods of time due to elevated radiological fields and/or surface contamination, as a result of changing unit operating conditions. Unit outages may be required to perform a portion of the installation.	3	Active	Mike Nairne	Simion Deju	21-Apr-16	Accept	31-Mar-16	3	2	3	9	3	2	3	9			
			There are no Not Started, In Progress Actions associated with the risk.																	
<a href="#">12426</a>	73472 D2O Islanding - Permitry	Potential for delays due to permitry requirements. Permit application to start installation may be delayed due to station resource, delay in draining headers or system alignment issues.	3	Active	Mike Nairne	Simion Deju	21-Apr-16	Mitigate	31-May-16	3	1	3	9	2	1	2	4			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			<a href="#">6154</a>	In Progress	73472 D2O Islanding - Minimize permitry delays	Regular communication being held with Ops Assessor to ensure permitry requirements incorporated into tasks and schedule. PC1s submitted. Workplan mark-up in progress to show interaction with JV/Bellows project and effect on permit.	Bill Devlin	Ken Verwoert	18-Jan-16											
<a href="#">14067</a>	73472 D2O Islanding - Interaction with Bellows Project	Potential for delays due to shared permitry requirements with the Bellows installation project during execution. Bellows Installation Project - MEC 118769, NR TS810-3 Station Work Control and Operations have bundled both projects together due to common header drain requirements. The need to avoid a breach of containment during execution of both projects on common lines may introduce delays to execution. This risk also includes issues discovery issues and delays during installation due to the fact that these jobs were designed, assessed and installed by seperate vendors and only looked at for integration roughlyly 2 months before the installation.	3	Active	Mike Nairne	Simion Deju	21-Apr-16	Mitigate	31-May-16	3	1	3	9	2	1	2	4			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			<a href="#">6154</a>	In Progress	73472 D2O Islanding - Minimize permitry delays	Regular communication being held with Ops Assessor to ensure permitry requirements incorporated into tasks and schedule. PC1s submitted. Workplan mark-up in progress to show interaction with JV/Bellows project and effect on permit.	Bill Devlin	Ken Verwoert	18-Jan-16											

12392	73472 D2O Islanding - Discovery work during Installation Phase	Issues discovered during installation may result in a requirement for a design change and/or additional materials. Discovery work has the potential to add additional cost to the project and delay the installation and commissioning schedule	3	Active	Mike Nairne	Simion Deju	21-Apr-16	Mitigate	01-Apr-16	4	1	1	4	4	1	1	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			3272	In Progress	Discovery work during installation	Project Manager to ensure detailed walkdowns are held with the design and construction team prior to the start of installation. Issues related to installation and commissioning raised during COMS, challenge meetings, installation readiness meetings, etc., shall be dispositioned by the design team in order to anticipate and avoid potential discovery issues in the field.	Ken Verwoert	Ken Verwoert	15-Nov-15	June 2/15: Additional walkdowns organized to identify issues related to header draining strategy - planned for June 3. Aug.31/15: Additional walkdowns held in July and August to verify dimensions.							
13405	73472 D2O Islanding - Material Availability	Potential for delays due to material availability. A delay in material delivery will delay pre-fabrication activities, challenging readiness for installation of moderator header work prior to VBO 2015.	3	Active	Mike Nairne	Simion Deju	21-Apr-16	Mitigate	31-May-16	1	1	3	3	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5116	In Progress	73472 D2O Islanding - Track Material availability	Track material availability including purchase order status and material delivery estimates. Tracking to correlate material availability to EC for purposes of determining material status for each EC.	Bill Devlin		01-Dec-15	Project status meeting June 2 - requested an updated, consolidated list of outstanding materials. Directed contractor to enter MR's for materials to be procured through OPG that were at risk of late delivery through RCMT. June 16 - requested updated list that includes purchase order information for all materials - previous list did not have information for several materials July 20 - receiving weekly updated material lists from RCMT and discussion at daily conference call. All material for modification on track for delivery by July 31 with the exception of one pipe clamp being sourced from NLI - quote due Wed. July 22. Material for T-Alt ordered July 7 with latest delivery August 18. August 31 - all modification material on hand with exception of pipe clamp - engineering decision on clamp due Wed. Sept. 2. T-Alt material still outstanding and being followed up by Supply Chain. Sept. 18 - Alternate pipe clamp to be procured to support modification. T-Alt material being tracked by project and Supply Chain - one T-Alt part to be procured through RCMT							
Project: Pre-requisite Projects - 73471																	
14131	10-73471 - Cannot follow MA22 milestone due to late PO and aggressive schedule.	The current project AFS date was 30 June 2016. The AFS date is revised due to D1641 outage and frequency of the SRSTs. SRSTs need to be completed for commission of the system. This may have impact on the cost. New AFS date as agreed by OPG is October 2016.	3	Active	Jacquie Ciccarelli	Vijay Pandya	09-May-16	Mitigate	30-Jun-16	5	1	4	20	3	1	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
14132	10-73471- Assessing and procurement delay	This modification involves installation of the pressure boundary material. This requires extensive review by TSSA. Due to many parallel projects going on in the field, which can delay the approval of CWP/ITPs.	3	Active	Jacquie Ciccarelli	Vijay Pandya	09-May-16	Mitigate	31-Jul-16	5	1	4	20	3	1	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
13404	10-73471 - CLRTS software issue with new PACE 1000 pressure transmitters.	The existing DPI 145 pressure transmitters are obsolete and Existing MASSLEAK software is upgraded to suite new PACE 1000 pressure transmitters. This is not field tested yet at Darlington. The risk is if the software will not respond as per design during commissioning,it will delay the schedule.	3	Active	Bill Devlin	Vijay Pandya	09-May-16	Monitor	30-Sep-16	2	1	3	6	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
144	10-73471 - NPC Islanding- EFADS Condensate tank for U3 lead time is beyond	It was identified during procurement process that the lead time for the condensate tank is 32 weeks. This is beyond the execution date ( window start 7 july ). This condensate tank is not available in the OPG store also.	3	Active	Courtney Brisebois	Vijay Pandya	09-May-16	Mitigate	31-Aug-16	3	1	2	6	2	1	2	4
			There are no Not Started, In Progress Actions associated with the risk.														

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<a href="#">2011</a>			<a href="#">6384</a>	In Progress	Monitor SATM permits for availability	All MTLs to monitor SATM permits for each project to check for availability and interferences.	Andy Ireland	Carrie Smith	30-May-16								
<a href="#">13712</a>	Engineering rework during construction phase for Contaminated and Non-Contaminated shops [Window 512, 509]	EVENT: Engineering design rework might be needed for Contaminated and Non-Contaminated shops. CAUSE: Procured machines/equipment are different than originally designed. IMPACT: Additional costs and schedule delay to project.		Active	Andy Ireland	Nunzio Mastrocola	11-Apr-16	Monitor	12-Aug-16	1	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Refurbishment Support Facilities - 10000																	
<a href="#">14457</a>	Delay to Commissioning of the Portable Radiation Instrument Calibration & Maintenance Laboratory	Event: Refurbishment Milestone to commission the Portable Radiation Instrument Laboratory, located at P58 (1549 Victoria St. E., Whitby) is being tracked under A/T# 28182282-05 and is due 15-Aug-2016. Facilities Projects is projecting that the facility will not be available until December 2016 at the earliest. Cause: Facilities could not proceed with project execution until RQE funding was approved in November 2015. Impact: Minimal space to store and perform the calibration, maintenance, and acceptance testing of portable radiation instruments for the Refurbishment project. Additionally, need to continue to use the facility while expansion construction activities are on-going.	3	Active	Johnathon Hash	Joe Zic		Mitigate	06-Jan-17	3	3	2	9	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Retube and Feeder Replacement -																	
<a href="#">13557</a>	Damaged Airlock Vertical Striker Plate [Potential Window 160-188]	Execution Phase: Event: the Vertical Striker Plate (sides and top) may be damaged in the maneuvering of the transportation vehicle with Cause: Due to frequent movement of material / equipment / tools transitioned in or out of the Airlock #1, Impact: negative impacts on schedule and cost.	1	Active	Roy Brown	Richard Pettet	27-Apr-16	Mitigate	15-Oct-16	5	3	5	25	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5412</a>	Not Started	Install barriers around striker plates of the Airlock #1	Install barriers around striker plates of the Airlock #1 to eliminate damages. 03FEB2016: JEFF P. Find out current status from JV if there is a plan to install the barriers and that if this is included in the Class II estimate.	Jeffrey Palmateer	Jeffrey Palmateer	29-Feb-16	It is estimated \$100K as cost to acquire barriers and install the barriers around striker plactes of Airlock #1.							
<a href="#">14161</a>	Manufacturing delay possible for Feeder Flow Element and Pressure Breakdown Orifice (Inconel-690 materials), necessary for the Upper Feeder Installation [Window 76]	[Execution Phase] Event: The feeder flow elements (FEs) and pressure breakdown orifices (PBOs) are to be manufactured and delivered to the feeder fabricator and then need to be welded to the upper feeder assemblies prior to shipping them to site for installation. The current start date for upper feeder installation is October 2017 (feeders will need to be on site before then). Therefore, the manufacturing of feeder flow elements and PBOs could delay site installation of feeders if not manufactured in a timely manner. Cause: There is a high likelihood that FE's and PBO's will be received late due to the lead time for Inconel-690 material and for the fabrication of the sub-assemblies. Impact: Feeder assemblies will not be available intime for schedule site execution date. [JV Risk 8.131 / 8.134]	4	Active	Andrew Cerilli	Cole Stark	19-Apr-16	Transfer	01-May-17	5	2	5	25	5	2	5	25
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">6882</a>	In Progress	oversight of risk transfered to JV	this action is in place to ensure risk 14161 which is transfered to the Contractor and is being mitigated by the vendor has an action to avoid triggering "Risk without mitigation action" metric. OPG mitigation is to perform oversight and it is not the practice to input RMO actions to document oversight activities.	Andrew Cerilli		31-Jan-18	this action will not be stasured, it is only in place to allow the transfered risk to not trip "risk without action" metric. Action is to perform oversight which is managed in oversight portion of RMO.							
<a href="#">14115</a>	Feeder fabrication schedule delay as a result of flow element (I690) weldability challenges. [Window 76]	[Execution Phase] Event: There is a risk of delays to feeder fabrication schedule. Cause: Flow Element and Pressure Breakdown Orifices material has been changed to Inconel 690 from Inconel 600 per DRAS 584. Challenges associated with dissimilar metal welding procedures development and qualification for Inconel 690 using filler metal 52M are expected. Impact: Delays to the feeder fabrication schedule will further challenge the availability of feeder pipes for the start of the Upper Feeder Install series for DNGS Unit 2 refurbishment. [JV Risk 8.124/8.135]	2	Active	Andrew Cerilli	Andre Sidiropoulos	19-Apr-16	Transfer	01-May-17	4	1	5	20	4	1	5	20
			There are no Not Started, In Progress Actions associated with the risk.														
	ILW Transfer Flask may not be delivered on time [Window 164]	[Execution Phase] Event: Delays to ordering, schedule compression from communication errors surrounding need by date and production ramp up concerns.	3	Active	Andrew Cerilli	Cole Stark	19-Apr-16	Monitor	02-May-16	4	3	5	20	4	3	5	20
			There are no Not Started, In Progress Actions associated with the risk.														

14253		Cause: There is a risk that Transfer Flask cannot be manufactured and/or delivered on-time, due to delays in placing the order, schedule compression due to misunderstanding of need by date, and potential production ramp-up risks based on OPEX from previous similar fabrications. IMPACT: Transfer Flask will not be delivered on time to meet Window (End fitting removal) of Unit 2 Level 1 outage															
13555	Extra Bellows Need Replacement - all units	[Execution Phase] Event: Not enough spare bellows for all 4 units Cause: During bellows inspection it is possible to find legacy damage to bellows or during construction bellows may be damaged Impact: If bellow damages require replacement above the number of spares planned, there will be a critical path delay and project costs incurred.	1	Active	Andrew Cerilli	Cole Stark	18-Apr-16	Mitigate	01-Jan-26	4	2	4	16	3	2	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6415	In Progress	Convert a Legacy Annulus Bellows Spare to the RFR Design - Prototype Effort	Have a vender convert one spare bellows to the rfr design. This action requires review of deliverables, attendance at meetings and oversight of the vendor as required.	Cole Stark		01-Jun-16								
12322	End Fitting Waste Processing - First Of A Kind (FOAK) risk [Window 184]	Execution Phase Risk: EVENT: As a result of the first of a kind nature of the End Fitting waste processing with no existing operating experience, the risk is that the Waste Processing becomes the critical path, with negative impacts on the schedule. CAUSE and IMPACT:This may occur due to two scenarios: 1) (primary risk) Equipment Reliability - there is more downtime of the tooling system than planned. Due to the radiation hazards, equipment failures may be difficult to troubleshoot and concerns regarding safety may lead to significant delays during execution. Design Requirements call for close to 100% equipment availability, which may be difficult to demontrate in test program. 2) (secondary risk) EF Waste Processing Rate - The End Fitting Removal from the Vault may be faster than the End Fitting Waste Processing in Retube Waste Processing Building can handle. This would lead to a need for extra EF flasks to continue reactor face work, and might lead to a delay starting the next stream of waste removal to clear the backlog of EF waste.	3	Active	Michael Hersch	Sean Carpenay	12-May-16	Mitigate	31-Jul-16	3	1	5	15	2	1	5	10
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2988	In Progress	Initiating contingency plans for Tooling Systems in End Fitting Waste Processing	Initiating contingency plans with contractor on unplanned maintenance of the tooling systems in End Fitting Waste Processing.	Michael Hersch	Sean Carpenay	31-Aug-16	2015/04/21: No Contingency Plan initiated. Operating Manual (OM) does contain a contingency section, but we consider it weak in content. To truly have a contingency plan, these procedures must be vetted during testing at ATS. Testing program under evaluation. 2016/01/12: Proof of Concept testing started week of Jan 11, 2016. TCD of FAT testing complete is March 2016. Any failure modes identified during POC and FAT testing will require a troubleshooting/contingency plan as part of the OM for final procedures milestone acceptance. 2016/04/04: FAT testing is currently in progress. The Waste Tooling System will include a Post FAT and Stand-by Plan to further test the contingencies of the EF Station. Thus, the due date has been changed to the end of August to accommodate the Stand-by Plan completion.							
13326	Excusable Delays [Windows All]	Execution Phase: Due to conditions beyond the control of JV and OPG RFR, 5.2 (a) Excusable Delays Section of EPC Agreement explains the condition and the contract terms of excusable delays, which have impacts on Execution phase Schedule. This risk concentrates on delays of more than 3 days. The examples include, but not limited to: - Radiation conditions (tritium, alpha, debris, high activation product concentration, high radioactive debris/particles) higher than expectations causing delays in cleanup (> 3days);- Fueling machine stops unexpectedly (> 3days) below the bulkhead of the Unit being refurbished with Labour Force in the vault working on critical path;- Unplanned Fuel Handling activities affecting duct access (> 3days) applicable to critical path refurbishment work in the duct;- Required upgrades/repairs/maintenance to OPG existing facilities (> 3days);- Unexpected operating plant transients with impacts > 3days on critical path;- Delay in completion of work required to be completed by OPG (or its vendors) (> 3days);- Reactor not defueled on time as scheduled by OPG (> 3days);- Delay in Breaker Open milestone (> 3days);- Loss of station power (OPG supply) to run JV equipment / tools (> 3days)- D2O spills (> 3days)- Activities in operating units (including testing and Safety Related System Test of adjacent operating units) causing interruptions in refurbishment work (> 3days)- Vault Equipment Airlock Malfunction causing interruptions in transitions and material movement (> 3days)- CNSC work stoppage (> 3days)- MOL work stoppage not due to JV's negligent work (> 3days) PCD according to 5.2 (a) Excusable Delays (> 3 days)	1	Active	Roy Brown	Cameron Macleod	11-Mar-16	Monitor	01-Jan-26	3	1	5	15	3	1	5	15
			There are no Not Started, In Progress Actions associated with the risk.														

<a href="#">13556</a>	Reactor Core Components demand more RWC/DSO [Window 114]	[Definition Phase] Event: As results of characteristics of irradiated reactor core components, the risk of more RWC/DSO needed. Cause: (1) the lid not being able to be closed due to pile height of wastes inside RWC/DSO during waste reduction being too high , and (2) excessive waste emissions from waste inside RWC/DSO may occur with negative impacts on schedule. (OPEX from Bruce and Wolsong) (3) OPG SOW requires PT cut to leave a stub on endfitting of 6" or less. JV current plan is to leave an 8" stub which will result in more pressure tube material in the end fitting RWC. SCR-N-2015-08429 was raised to document the non-conformance with the SOW. Impact: Additional funding required for more RWC/DSOs. [JV Risk 8.127]	1	Active	Andrew Cerilli	Cole Stark	05-Apr-16	Transfer	15-Oct-16	5	3	1	15	5	3	1	15
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">13860</a>	Owner Specified Material (OSM) pricing from Unit-to-Unit Procurement [No Window Related]	[EXECUTION PHASE] EVENT: There is a risk of cost escalation of the OSM pricing. CAUSE: Due to Unit-to-Unit Procurement, vendor price increases and foreign exchange. IMPACT: Change to budget allocation.	1	Active	Andrew Cerilli	Bill Donovan	28-Apr-16	Monitor	30-Dec-16	5	3	1	15	5	3	1	15
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">14164</a>	There is a risk that Liner Spacers and Liner Latch Assemblies will not be available in time for Fuel Channel installation [Window 119]	[Execution Phase] Event: There is a risk that Fuel Channel Liner Spacers and Liner Latch Assemblies manufacturing will be delayed beyond the need by date for execution Cause: The delay is due to time lost through the purchasing and document review/acceptance phase of work (cannot be recovered), and for a longer than expected manufacturing process as proposed by the vendor. Impact: Liner spacer and latch assemblies are required on site prior to the fuel channel installation series which is scheduled for August 2018. [JV Risk 8.133]	3	Active	Andrew Cerilli	Andre Sidiropoulos	19-Apr-16	Transfer	03-Jun-16	3	1	5	15	3	1	5	15
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">13338</a>	Not Enough commissioning / training Time for Volume Reduction System in Retube Waste Processing Building (RWPB) [Window 130]	Execution Phase: Event: Due to RWPB construction being late (potential), the risk of not having enough commissioning / training time for Volume Reduction System . Cause: RWPB construction schedule slippage. Impact: Potential for negative impacts on Execution Phase schedule	2	Active	Roy Brown	Jeffrey Palmateer	27-Apr-16	Mitigate	31-Dec-15	3	1	4	12	2	1	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5430</a>	In Progress	Extra testing to be completed at Vendor Location	27APR2016 (J. Girodat) - Post FAT testing in progress. Planning on standby plan which is 8 weeks of testing. Issues with contingency shear to recover the PT with the RAM. A new process has been written to recover PT. Extra cycles are being done to prove more reliability. EF severing is to begin 27apr2016 and will do 3 cycles and continue post FAT cycles. Plan B of full cutting without tap breaking will be executed as it is much simpler than the full cut process. PCD is to be signed (Perrick L.) and standby plan will then be released. Additional 4 weeks on top of 8 weeks of testing, J.Palmateer: higher level of oversight at the vendor location to monitor the testing and mitigate any issues during commissioning. Standby plan is to be approved so that OPG can be at vendor site. Cam Macleod is the standby plan approval efforts. Extra testing to be completed at Vendor location	Jeffrey Palmateer	Jeff Girodat	15-Oct-16	Mitigatin action estimate: \$1.5M							
<a href="#">13427</a>	Extra Duration Caused By 3% Rework [Potential Window 160-188]	[Execution Phase] Event: Risk of Rework to correct work, Goods or OSM that is not Defective exists Cause: Due to the size and nature of the project, Impact: Negative impacts to Schedule, notwithstanding the exercise of Prudent Practices.	1	Active	Roy Brown	Jeffrey Palmateer	22-Mar-16	Accept	01-Jan-26	3	1	4	12	3	1	4	12
			There are no Not Started, In Progress Actions associated with the risk.														
	More Expensive Pressure Tubes for subsequent units [No Window Related]	[Execution Phase]: Event: There is a risk that if only one brand of pressure tubes (PT) are used in all four units, then the cost of 3 more units of PTs will be higher than the cost estimate used in the Class 2 estimate.	1	Active	Andrew Cerilli	Bill Donovan	28-Apr-16	Monitor	01-Jan-18	4	3	1	12	4	3	1	12
			There are no Not Started, In Progress Actions associated with the risk.														



ONTARIOPOWER  
GENERATION

Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

13564		Cause: Caused by using the lower priced of the two supplier's single unit bid cost (2013) as the expected cost for subsequent units. Impact: This would result in a need for additional approved funding/budget if only the more expensive supplier's PTs are installed in subsequent reactor units.																
14425	Failure to Upgrade Unqualified Source Material for I690 Flow Elements / Pressure Breakdown Orifices	Event: There is a risk that the supplier of Flow Elements (FE) and Pressure Breakdown Orifices (PBO) may fail to upgrade the unqualified source I690 BAR stock they have purchased if due to its quality issues are revealed during the upgrading process. Cause: The supplier of FE and PBO's have purchased unqualified source I690 BAR stock material because nuclear grade I690 is not a readily available product on the market. The supplier will be upgrading unqualified source I690 BAR stock material in parallel with machining activities in support of schedule recovery efforts. Impact: Should the supplier find that the unqualified source material cannot meet the ASME requirements, rework would be required, beginning with ordering new I690 BAR or pipe stock. This would have significant schedule implications.	4	Active	Andrew Cerilli		03-May-16	Mitigate	31-May-16	2	1	5	10	2	1	3	6	
			There are no Not Started, In Progress Actions associated with the risk.															
13330	RTP first-of-a-kind in Darlington Vault [Window 8, 16]	Execution Phase Risk. Event/Cause/Impact: As results of Retube Tool Platform (RTP) being the first-of-a-kind platform installed in the Darlington vault with various constraints, the risk of more downtime of the installation than planned may occur in Unit 2 with negative impacts on Execution Phase schedule.	1	Active	Michael Hersch	Sean Carpenay	12-May-16	Monitor	01-Jan-26	3	1	3	9	3	1	3	9	
			There are no Not Started, In Progress Actions associated with the risk.															
11476	Insufficient Tooling Intellectual Property Escrow [Potential Window 160-188]	Execution Phase: As a result of Incomplete Engineering Package filing and insufficient documentation of software tools in Intellectual Property (IP)Escrow, combined with a contractor default, the risk of inability to tackle a technical issue may occur during the Definition / Execution phases, which would lead to negative effects on * RFR schedule * RFR cost	2	Active	Michael Hersch	Kevin Hill	23-Mar-16	Mitigate	15-Jun-16	2	4	3	8	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			2295	In Progress	Oversight Plan on IP Escrow	Oversight Plan - Monitor and perform quartely review of IP Escrow as per PMP Contract Management Plan Section.	Michael Hersch		31-Dec-15	InitiateOPG Deep Dive completed by end of 2014 and yielded unsatisfactory results (not enough contents on Escrow). As a result, additional OPG Deep Dive will be performed - TCD end of April, 2015. 6 months path forward will be issued in July 2015.								
			2822	In Progress	Deep Dive on IP Escrow	Perform Deep Dive on IP Escrow	Michael Hersch		31-Dec-15	Monthly Escrow Deposit Meetings organized with the 1st meeting held on June 30, 2015.								
13327	Above and Beyond Assumed Escalation Cost [Potential Window 160-188]	[Execution Phase] Event: Due to some costs that are uncontrollable by OPG and JV, the risk of higher costs flown through JV to OPG may occur with negative impacts to the Execution Phase cost. The examples of cost above and beyond assumed escalation cost include the following, but not limited to: Cause/Impact: - Amendment to labour agreements such as Nuclear Project Agreements (NPA);- One or more unions not signing the labour agreements such as NPA;- Amendment to travel and boarding provisions;- Inadequate LOA allowances due to higher than expected out-of-province / international labour forces;- Higher than expected commodity pricing such as Fuel Channel Closure Plug costs	1	Active	Roy Brown	Jeffrey Palmateer	22-Mar-16	Monitor	01-Jan-26	2	4	1	8	2	4	1	8	
			There are no Not Started, In Progress Actions associated with the risk.															
	Stop Work Order due to Safety Events [Potential Window 160-188]	Execution Phase: Event:: OPG stopping the work order(s) may occur Cause: Due to safety events or near-misses (specifically not related to JV's neqliqent work)	1	Active	Roy Brown	Jeffrey Palmateer	29-Mar-16	Mitigate	01-Jan-26	4	1	2	8	4	1	2	8	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								

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13333		Impact: Negative impacts on Execution Phase schedule.																		
			5408	In Progress	Reinforce high safety culture	Reinforce high safety culture in the project team to eliminate safety events or near-misses to avoid impacts of Stop Work Orders.	Jeffrey Palmateer		01-Jan-26	2015/07/13: No mitigation cost as this shall be part of normal training. To ensure that there is a strong safety culture within the JV Project Team there are numerous interactions to ensure there is strong communications, interactions such as; There is a scheduled weekly mock-up walk down with a quorum of the both RFR Construction Mangers (JV & OPG) with the Training Area Supervisor and the Safety Representatives Weekly OPG/JV day meeting where safety events or issues are dicussed and tracked SCR's are entered for significant events or occurances; list can be provided if required										
13571	Quality issues of JV work causing extra rework [Window 23]	Execution Phase Event: Extra rework (including higher welding failures (Feeders not meeting tolerance, feeder over bend, welding procedures and human performance involved.), work in bellow cut, feeder overbent, feeder not meeting tolerances, CT install, PT retraction, CT head) Cause: Quality issues of JV work Impact: May occur with negative impacts on schedule.	1	Active	Roy Brown	Tara Rehsi	28-Apr-16	Mitigate	15-Oct-16	2	1	4	8	1	1	4	4			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			5428	In Progress	Additional qualification requirement for vault workers	28 April 2016: The main focus of the mobilization plan (standby plan) is to rehearse retubing activities. JV is executing the standby plan. Feb 2016: Additional qualification requirement for vault workers to improve quality of vault workers to avoid reworks. mobilization plan (standby plan) approved for mitigation that will support and establish training requirements	Jeffrey Palmateer	Tara Rehsi	15-Oct-16	\$1M budget on additional qualification requirement on vault workers.										
13892	End Fittings will not be available in time to support the scheduled site execution date [Window 168]	[Execution Phase] EVENT: There is a risk that End Fittings will not be available in time to support fuel channel installation (execution window 119).  CAUSE: Caused by various issues with the overall procurement steps and strategies as well as complications with individual components.  IMPACT: This would result in a miss of the Execution Date. Therefore reducing the amount of available time for the JV to unpack, inspect and assemble sub-assemblies in preparation for the fuel channel install series. [JV Risk 8.118]		Active	Andrew Cerilli	Andre Sidiropoulos	08-Apr-16	Transfer	02-May-16	2	1	4	8	2	1	4	8			
			There are no Not Started, In Progress Actions associated with the risk.																	
	Waste - Insufficient Number of Retube Waste Containers [Window 117]	Definition Phase: As a result of many risks, such as the set listed below,the risk that a larger number of Retube Waste Containers needed than planned may occur during the Execution phase, which would lead to negative effects on both schedule and cost. Examples of risk requiring larger number	3	Active	Michael Hersch	Yung Cheung	23-Mar-16	Mitigate	31-Dec-17	3	2	1	6	1	1	1	1			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										

11582		of Retube Waste Containers are: 1) Inefficient segregation practices are encountered. 2) Container may not be optimized for, or compatible with, the volume reduction process. 3) Latest discovery of higher than anticipated level of Cesium-137 in pressure tubes which may trigger need of extra RWCs.	<a href="#">3331</a>	In Progress	Review number of containers used during Execution Phase	27APR2016 - JV has completed the technical evaluation on the bids for additional RWCs. A recommendation for purchase is to be provided in 2 weeks time. once that is approved a PO will be out. To ensure sufficient containers are available for the remaining reactor units, review the number of containers used during the Execution phase for the first refurbishing unit. The current strategy is to increase the contingency of containers for the first reactor unit in addition to starting early production for the second reactor unit. At the completion of the first reactor unit the actual number of containers consumed will be the baseline for the following three units and this strategy eliminates the risk of insufficient containers being available for the first unit. [M Carter May 26,2015]  RAP for additional 11 RWCs sent to OPG for acceptance on Sept. 1, 2015. [ M Carter Sept 9, 2015] EQR for second set of containers to be purchased from Alternate Supplier issued [ M Carter Nov 10, 2015]	Michael Hersch	Yung Cheung	31-Dec-17	The current strategy is to increase the contingency of containers for the first reactor unit in addition to starting early production for the second reactor unit. At the completion of the first reactor unit the actual number of containers consumed will be the baseline for the following three units and this strategy eliminates the risk of insufficient containers being available for the first unit. [M Carter May 26,2015] The additional bids for the additional RWC/DSOs are currently being reviewed. The recommendation for purchase should be going to OPG for approval in the next few weeks. [Y Cheung April 25, 2016]  RAP for additional 11 RWCs sent to OPG for acceptance on Sept. 1, 2015. [ M Carter Sept 9, 2015] EQR for second set of containers to be purchased from Alternate Supplier issued [ M Carter Nov 10, 2015]									
			<a href="#">3662</a>	In Progress	Review Canadian Nuclear Labs (CNL) Report on D1321 SFCR Channel M09 Pressure Tube (PT) Gamma Spectroscopy	The latest results from CNL has confirmed values of Cs-137 on the PT (base metal plus magnetite layer) are about 2.0 to 3.0 higher than Cs-137 values found on the end fittings (from the same channel) and values found on the steam generator tubes (from oxiprobe analysis). To address this concern, OPG to assess what are the key impacts of this finding, develop strategies to address the impacts, and execute the strategies.	Michael Hersch	Jeff Johansson	30-Sep-15	This action is assigned to Jeff Johansson. Three sub-actions are identified. -OPG (Jeff J)set-up a meeting with key stakeholders from RFR, NWED and RP to review and discuss the results and assess what the key impacts are of this finding (meeting held on 11Feb2015). Subsequent meetings may be required. -Upon agreement on the impacts, a strategy will be developed to address the impacts to ensure that any risks associated with this finding is minimized or mitigated (TCD: TBD). -Adopt and execute the above developed strategy to close this risk (TCD: TBD after strategy is developed). 11-Mar-15: On target to complete at end of March 2015. Jeff J 2015-04-01: Draft report received and going thru the disposition process. Final report to be issued in April. Due Date: moved to end of April 2015. 2015-04-27: Pending JV response. 2015-7-2: Report submission delayed until end of August 2015. TCD for this risk revised to September 30, 2015.									
13329	Claims from Retube and Feeder Replacement (RFR) Vendor Not already Covered in the Contract [Potential Window 160-188]	Execution Phase: As a result of OPG not meeting its obligations, there are risks of the RFR vendor making claims for additional costs, cost claim from schedule delay not covered in the Contract, in the Execution Phase. Note: there is a similar risk for Definition Phase (risk #12214).	1	Active	Roy Brown	Cameron Macleod	21-Apr-16	Monitor	01-Jan-26	2	3	1	6	2	3	1	6		
			There are no Not Started, In Progress Actions associated with the risk.																
	As-found Conditions not Known [Potential Window 160-188]	[Execution Phase] Event: Risk of no evidence to support or deny JV's claims Cause: As found vault conditions (discovery work)	1	Active	Roy Brown	Jeffrey Palmateer	29-Mar-16	Mitigate	15-Oct-16	2	3	1	6	2	2	1	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									

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13562		Impact: Negative impacts on Cost and Schedule	5421		In Progress	Phased turnover of Operations to Construction	As components are accessible in phased turnover, OPG to do inspections with formal report generated from these inspections to document the findings and give the formal report to contractor to avoid uncertainty.	Ken Brown	Jeffrey Palmateer	15-Oct-16	No incremental costs. 28April2016: Action delegation requested from Ken Brown and Jeff P.									
			5422		In Progress	Dedicated OPG oversight team to document potential JV claims in real time	Dedicated OPG oversight team members to document the potential JV claims in real time. Two FTEs are deployed as the dedicated resources for the entire project duration.	Ken Brown	Jeffrey Palmateer	15-Oct-16	28April2016: Action delegation requested from Ken Brown and Jeff P. ~Two FTEs are estimated to cost \$2M incremental for the entire RFR Project for 4 Units. 1. Turnover Tasks to record the turnover conditions, including photos of components such as AGS pigtails, before JV and after JV for documenting the environment before and after to provide evidence to support or deny JV's claims in future investigation. 2. Phased turnover of operations to construction (As components are accessible, OPG to do inspections). Formal report to be generated from these inspections and given to contractor. 3. Dedicated OPG oversight team to integrate with JV As Found Team to document potential JV claims in real time (e.g. Two FTEs for entire project duration) Mitigation Cost: \$2M (incremental)									

13569	Interruption from False Alarms of Safety Events [Potential Window 160-188]	Execution Phase: Event: The risk of false alarms of Safety Events Cause: False alarms could be raised by workers based on their personal sensing (chemical smell, temperature, gamma, ozone etc.) and physical alarm malfunctioning, Impact: negative impacts on Schedule.	1	Active	Roy Brown	Jeffrey Palmateer	28-Apr-16	Monitor	01-Jan-26	2	1	3	6	2	1	3	6		
			There are no Not Started, In Progress Actions associated with the risk.																

13911	Risk of need to procure additional pressure tubes [No Window Related]	[Execution Phase] Event: An additional set of pressure tubes may need to be procured if OPG decides to install pressure tubes manufactured by only one supplier accross all 4 units. This would potentially bring the total number of reactor sets worth of PTs to 5. Cause: OPG may decide that all pressure tubes installed in Darlington Refurbishment must come from one vendor. For the first unit, RFR scope include procurement of two full reactor quantities of pressure tubes from two separate vendors as a commercial risk mitigation strategy. The current project estimate includes 2 additional reactor quantities of pressure tubes (for a total of four reactor quantities). Impact: the pressure tubes from the vendor not installed in Unit 2 will not be useable by Refurbishment, and an additional reactor quantity of pressure tubes will need to be procured.	3	Active	Andrew Cerilli	Andre Sidiropoulos	05-Apr-16	Mitigate	30-Apr-16	2	3	1	6	2	3	1	6		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6408	In Progress	Determine which Supplier's Pressure Tubes will be installed in Unit 2	The RFR project, in conjunction with the Joint Venture and NR Components engineering, need to determine which Supplier's pressure tubes will be installed during Unit 2 retube.	Andrew Cerilli		30-Apr-16										

	WTS - Retube Waste Processing Building Too Humid for Tooling Electrical	[Execution Phase] Event:	1	Active	Michael Hersch	Sean Carpenay	12-May-16	Monitor	01-Dec-17	3	1	2	6	3	1	2	6		
			There are no Not Started, In Progress Actions associated with the risk.																

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<a href="#">14015</a>	Components	There is a risks that electrical components in the WTS may fail due to high humidity in the RWPB. Cause: The waste tooling system contains electrical components that have a maximum humidity rating of 80%. This is not in compliance with the OPG Tooling Design requirements of 95%. There is a residual risk to OPG of delay due to a JV response to procure more spares of sensitive electrical components affected by the 95% humidity. The RWPB Tech Spec for active ventilation, NK38-TS-73600-10003 R00 has a max humidity requirement of 80% however there is a risk that with the number of overhead door openings for truck entry and exiting that this may not be maintained in the cases where outside humidity is high. Impact: Potential critical path delays due to frequent component replacements and/or insufficient spares if rapid/common mode component failure on high humidity days.															
<a href="#">14016</a>	Toolset Modification due to Station Status Documents for Units 1, 3 & 4	[Execution] Event: There is a risk that Station Status Documents (SSD) for units 1,3,4 will reveal anomalies that challenge tooling design or MOD packages. Preparation of SSDs for future units have not yet been started. Cause: The station status documents were generated for Unit 2 only. Upon review of the station status documents, there were anomalies identified that challenged the tooling design which had to be accounted for. The station status documents for Units 1,3,4 are not initiated so any anomalies in those units are not considered in the current design of the toolset. Impact: Modifications to the toolset or MOD packages may be required. The cost of completion of the station status documents for Units 1,3,4 are considered in the class II estimate. However, the cost of any modifications to the tooling or MODs is unknown.	3	Active	Michael Hersch		04-Apr-16	Monitor	01-Jan-19	3	2	2	6	3	2	2	6
There are no Not Started, In Progress Actions associated with the risk.																	
<a href="#">11106</a>	RWC/DSO may not be delivered on-time [Window 114]	[Execution Phase] Event: RWC's will not be delivered on time to meet Window 114 (End fitting removal) of Unit 2 Level 1 outage Cause: There is a risk that retube waste containers cannot be manufactured and/or delivered on-time, due to delays in placing the order, schedule compression due to misunderstanding of need by date, and potential production ramp-up risks based on OPEX from previous similar fabrications. IMPACT: Critical path delays.	3	Active	Andrew Cerilli	Cole Stark	05-Apr-16	Monitor	30-Apr-16	1	3	4	4	1	3	4	4
There are no Not Started, In Progress Actions associated with the risk.																	
<a href="#">11150</a>	Risk of Vendor Default/Business Continuity [Potential Window 160-188]	Definition Phase / Execution Phase: Due to vendor default. the vendor is unable to meet the contractual obligation it may have negative impacts on cost and schedule to re-organize the teams to continue RFR project.	3	Active	Roy Brown	Cameron Macleod	21-Apr-16	Monitor	01-Jan-26	1	2	4	4	1	2	4	4
There are no Not Started, In Progress Actions associated with the risk.																	
<a href="#">12214</a>	Claims from Retube and Feeder Replacement (RFR) Engineering, Procurement and Construction (EPC) Vendor [Potential Window 160-188]	Definition Phase: As a result of OPG not meeting its obligations (for instance: Contractor's Access to Site for Retube Waste Processing Building (RWPB), there are risks of the RFR EPC vendor making claims for additional cost and schedule in the Definition Phase, per article 4 of the Agreement. Note: It will be raised as another risk (#13329) for the Execution Phase.	3	Active	Roy Brown	Cameron Macleod	21-Apr-16	Mitigate	16-Oct-16	1	3	4	4	1	2	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">2628</a>	In Progress	Engage OPG commercial lead with OPG counterparties on Claims	Engage OPG commercial lead with OPG counterparties on Claims due to OPG not meeting obligations.	Cameron Macleod	Isaac Smith	16-Oct-16	OPG commercial lead with OPG project team on potential Claims due to OPG not meeting obligations. Commercial lead attends regular project management meetings internally and with Contractor where such items could arise.							
	Concealed Conditions [Potential Window 160-188]	Execution Phase: Due to uncontrolled and unknown conditions inside the vault, especially, those inside the reactor, 4.8 Concealed Conditions Section of the EPC Agreement explains the condition and the contract terms of concealed condition. which can have cost and schedule impacts on	1	Active	Roy Brown	Jeffrey Palmateer	29-Mar-16	Accept	01-Jan-26	1	3	4	4	1	3	4	4
			There are no Not Started, In Progress Actions associated with the risk.														

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13325		<p>Execution Phase.</p> <p>The examples of Concealed Conditions include, but not limited to:- CTSB Inspection Results;- Feeder nozzle found unsatisfactory;- Calandria tube contacting horizontal flux detector when they are moved;- As-built configurations vary from design and drawings, while laser scan and walk down etc. did not identify the variations and the JV had done everything possible;- Permanent bulkhead unexpected repairs identified during NDE;- Unexpected deficiencies of existing EPs in shutdown cooling rooms, after due diligence of JV exercised;- As-found "original construction" feeder flaws uncovered, after JV verification completes but could not identify those feeder flaws earlier;- Unexpected changes to containment boundary from OPG/other vendors may cause interruption to containment isolation pressure test;- Calandria Vessel discovery work requiring new tool and new method to remove the discovery materials;- PT factures longitudinally, resulting in jagged end on the PT</p>															
13442	Not able to dry PHT System with Bulk Dry Proposal [Window 29]	<p>Exectuion Phase Risk.</p> <p>Event:</p> <p>The joint venture has decided to go with a bulk dry strategy that would use the PHT Vacuum Dry tooling to remove all of the water in the PHT system from the Very Low Level Drain State (VLLDS). The risk is the residual risk that the Channel Drain Tool is required during execution as contingency. Channel Drain Tool has been procured and accepted by OPG as a contingency. The original plan to create a tie-in point (MOD) to interface with the channel drain tool with D2O collection has been cancelled. This CWP instructions on how to implement the channel drain tool were cancelled. JV and OPG SMEs reviewed the risk of requiring CDT if Bulk PHT failed to remove all water in Jan 2016 after sucessful completion of FAT testing of the system at TKMS in Oct 2015. This review determined the likelihood of the risk occuring was sufficently low that the CWP were not required. This decision was documented in the JV risk register and was part of the evidence package for OPG acceptance of the CDT final design.</p> <p>Cause and Impact:</p> <p>If the bulk dry process is not successful at Darlington, it will not be easy to revert back to a Channel by channel drain process as there will be no D2O transfer system tie-in and two major parts of the tool are not being delivered. The risk would result in having to drain and drum each fuel channel, with significant impact on critical path and increased radiation exposure to workers.</p> <p>The bulk dry strategy has not been successful during any other refurbishment project (OPEX). PT. Lepreau, Wolsong and G2 all used a channel drain prior to vacuum dry. Bulk dry was attempted during the Pickering Safe Storage project, however, there were a number of issues that arose during that operation which slowed down the process.</p>	2	Active	Michael Hersch	Sean Carpenay	12-May-16	Monitor	15-Oct-16	1	1	4	4	1	1	4	4
			There are no Not Started, In Progress Actions associated with the risk.														
13527	New Annulus Spacer design may not be used for Darlington [No Window Related]	<p>[Definition Phase]</p> <p>Event</p> <p>The new annulus spacer design is not accepted for use for Darlington.</p> <p>Cause</p> <p>In the event that the interm results of the irradiation testing does not provide assurance of the analysis model used by Candu Energy, the Chief Nuclear Engineer has the authority to request the project to use the original spacer design and material (Inconel).</p> <p>Impact</p> <p>The impact this risk is mainly financial as the RFR project will have to purchase a new set of Inconel spacers, and will need to update design registration and analysis documentation.</p>	2	Active	Andrew Cerilli	Geoff Colling	19-Apr-16	Mitigate	01-Jun-16	2	2	1	4	1	2	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6409	In Progress	Obtain Acceptance of New Annulus Spacer Design for use at Darlington NGS	NR Components engineering, with the support of the RFR project, must obtain the final approvals to install the new Annulus Spacer Design at Darlington NGS.	Thomas Lau		20-May-16	The process to obtain approval has been mapped: a) CEI to review CNL relaxation data and analysis whether the CEI model and qualification program is bounding b) AMEC to assess incremental risk based on the higher relaxation rate c) Cold body review (KT process is suggested) of available information for recommendation to CNE d) EDM							
	Significant Radiation Exposure without Optimal Shielding in Pre-	<p>[Execution Phase]</p> <p>Event: Risk of radiation exposure may be significant</p> <p>Cause: Due to higher than estimated dose rate and collective dose accumulation of the work group</p>	1	Active	Johnathon Hash	Kwok Tsang	11-May-16	Mitigate	14-Oct-16	2	2	2	4	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

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13563	Requirement Tasks [Window 8, 16]	during the Pre-Requirement period and lack of shielding Strategy dedicated for that period. Impact: Negative impacts on Cost and Schedule.																	
			5423	In Progress	Shielding strategy to minimize exposure	Use Shielding strategy dedicated to the Pre-Requirement period to contain radiation to lower dose exposures.	Jeffrey Palmateer	Johnathon Hash	01-Aug-16	DUE DATE CHANGED TO 1 AUG 2016. OPG Project team with JV and OPG RP are working on a shielding and Radiation protection strategy. ** OWNERSHIP TO BE TRANSFERRED TO RP ** No incremental costs expected. This was a strong focus area post CL-III estimate submission. The dose calculations and totals that had been provided as the basis (no-basis) were as noted by OPG as a sign-off of the submission. There were many challenge meetings to review the calculations with a SME hit team in support of the CL-II submission; the dose became more reasonable and was accepted as the basis with new shielding strategies in place such as rada-shielding. However there are many actions and options being progressed to progress the dose mitigation. RWPB waste process from removal phase will be a major focus.									
13568	Non EF Waste Processing not Meeting Demand [Window 115, 116, 117]	Execution Phase Risk: Event: There is a risk of Waste Processing (excluding EF waste processing, which is covered by risk #12322) becoming the Critical Path and interrupting the reactor face work with negative impact on Schedule due to lower than expectation performance. Cause & Impact: Expected cause is Equipment Reliability - there is more downtime of the tooling system than planned. Due to the radiation hazards, equipment failures may be difficult to troubleshoot and concerns regarding safety may lead to significant delays during execution. Design Requirements call for close to 100% equipment availability, which may be difficult to demontrate in test program.	2	Active	Michael Hersch	Sean Carpenay	12-May-16	Monitor	01-Oct-17	1	1	4	4	1	1	4	4		
	There are no Not Started, In Progress Actions associated with the risk.																		
13744	Risk of Damage During Transportation and Handling of Fuel Channels and Feeders During Baseline Inspections [Window 71, 76, 83, 118, 119]	Event: Baseline inspections are required for the fuel channels and feeders in order to support future inspections, analysis and life cycle management. Cause: During these inspections, the FCs and feeders may be transported and handled by groups (i.e. IMS) other than the vendor. With this transfer of responsibility over the materials, there is associated risk that the materials may be damaged. Impact: These materials are pressure boundary items and any damage to them would require dispositioning or replacement. This risk is relevant during the execution phase, specifically between manufacturing of the PTs and Feeders and their installation.		Active	Paul Ross	Brian Barclay	02-Mar-16	Monitor	31-Dec-16	2	1	2	4	2	1	2	4		
	There are no Not Started, In Progress Actions associated with the risk.																		
	Large Number of Flow Restricting Orifice Bung (FROB's) and Dummv Fuel	Execution Phase: There is a risk that the number of number of fuel channels with DB's could change from the Class 2 Estimate (124 channels with DB based on all channels less than 2 bundle flow defuelling criteria). The actual number of channels with DB will be determined by TUF just before	2	Active	Michael Hersch	Martin Geary	10-May-16	Monitor	01-Jan-17	1	1	2	2	1	1	2	2		
	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											



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11743	Bundles [Window 115]	<p>defuel. If TUF requires more or less DB than the class 2 estimate, then this would impact the Joint Venture schedule duration.</p> <p>If a channel has DB, then it has 11 DB and no FROB. 2 DB are manually removed from each applicable channel. This risk impacts the execution time for the manual removals. 9 DB are removed with the PT and disposed in the WTS. This isn't expected to change the series duration. Non-DB channels have 1 FROB and no DB.</p>															
	3513	In Progress	Finalise Number of Channels for Dummy Fuel Bundles	To obtain the date from Fuel Handling project when they will finalize the number of channels for Dummy Fuel Bundles (DB's). Expect final number to be determined very close to the actual date of defuel with F/M (~Oct 2016). This would give at least some notice to JV as DB are manually removed just prior to PT cut (ie ~150 days).	Michael Hersch	Martin Geary	31-Oct-16	Worst case and best case submitted. RFR team initiating face to face meeting to expedite the final number. Date moved to confirm the number of Dummies and FROBs.									
Tara R 2014/04/21: Due date set to June 2016 Tara R 2015/07/02: Correct Due date. Marty G 2016/03/22: Conversations with Larry Nichols ip to determine more detailed timing when we will be able to know the final numbers. Marty G 2016/05/02: Final numbers will not be determined until analyzed by TUF just before execution.																	
13336	Calandria TubeSheet Bore (CTSB) Needs to be Milled [Window 167]	<p>Execution Phase: Event: Calandria Tube Sheet Bore needs to be milledCause: If CTSB is gouged or scratched during the CT Removal, Impact: Negative impacts on Execution schedule.</p>	1	Active	Michael Hersch	Martin Geary	10-May-16	Monitor	22-Mar-16	1	1	2	2	1	1	2	2
	There are no Not Started, In Progress Actions associated with the risk.																
13560	Unforeseen Challenges / Complications in installing re-designed components [Window 17, 119]	<p>Execution Phase: Event: Unforeseen challenges / complications in installation of re-designed items may occur Cause: Due to re-design of components such as End Fitting Closure Plugs and Garter Spring Spacers, Impact: Negative impacts on Execution Phase cost and schedule.</p>		Active	Roy Brown	Jeffrey Palmateer	01-Mar-16	Mitigate	15-Oct-16	1	1	2	2	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5416	In Progress	Qualification test of re-designed components with applicable RFR Tooling used to install them	Qualification test of re-designed components such as End Fitting Closure Plugs and Garter Spring Spacers with the applicable RFR Tooling to be used in the Execution Phase to install them to prove that the re-designed components work with the applicable Tooling as expected.	Michael Hersch	Jeffrey Palmateer	15-Oct-16	28April2016: PCD is in the final stages of commercial review and approval. It was submitted before and an updated was required for re-issue. Feb 2016: Cost of actions - no incremental costs. PCD has been issued, money is allocated to the spacer as per RFR tooling.							
Project: Retube and Feeder Replacement - TL																	
1	Tool change control and management [Potential Window 160-188]	<p>Execution Phase Risk. Event/Cause/Impact: As a result of the Lack of Change Control on Tooling leading to Unapproved Design Changes to tooling, the risk of unexpected damage to the reactor or failure to perform may occur in the Execution Phase, which would lead to negative effects on * RFR schedule * RFR cost.</p>	3	Active	Michael Hersch	David Kurpjuweit	15-Mar-16	Mitigate	30-Sep-16	4	1	3	12	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2291	In Progress	Tool Management Plan contents	Ensure the following material is included in Tool Management Plan: roles and responsibilities (addressed 20150421), contingency planning (addressed 20150421), limits of authority, physical/security controls	Michael Hersch		30-Jun-16	Latest draft under review, comment due March 5. Tara R April 21, 2015: Comments and Disposition underway. Due date set to June 2016.							
			2293	In Progress	Review of Tool Management Plan on Procedural Control	Conduct a review to ensure adequate procedural controls are in place with the JV	Michael Hersch		30-Jun-16	Tara R 2014/04/21: Due date set to June 2016							
			2294	In Progress	Checklist as part of Detail Engineering on Tooling	As per Tooling Quality Design Plan, populate the Checklist as part of the Detail Engineering.	Michael Hersch		30-Jun-16	Tara R 2014/04/21: Due date set to June 2016							



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14319	(possible similar risks to EF/CT/CTI) [Window 114, 115, 116, 117]	WTS and RWPB, with negative impacts on the schedule and worker dose due to need to cleanup. This residual risks remains despite best practices in RFR WTS design and procedures. CAUSE: This risk is postulated to occur by loose contamination being spread from the PT chute that links the VRS press to the RWC debris cover. There is a 'O-ring' like barrier that seals the connection between the chute and RWC debris cover during PT crushing, however when the chute is retracted, it is speculated that some of the fine particles in the chute would become loose and spread beyond this ring. By design, it is expected that the 'dirty' pins on the WTS lidding station will become contaminated over time as they lift the debris cover. there are seperate 'clean' pins for lidding the RWC lids. However, it is speculated that the partly contaminated debris cover will be lifted over clean RWC lids and transfer some of this loose contamination to the clean lids, therefore requiring cleanup. Note that this lidding station is contained inside a large concrete bunker so direct beams are not a concern. IMPACT: Based on OPEX with a similar WTS VRS press used at Lepreau Refurbishment - when PTs were crushed, the loose containnation led to high dose rates in the vault that required significant cleanup. For RFR, the negative impact would be on the schedule for PT removal and worker dose due to need to cleanup loose contamination.															
	Project: Retube and Feeder Replacement - 10000																
13266	Waste - ILW containers for non-standard waste streams [No Window Related]	Definition Phase: There may be a requirement for ILW containers to be designed for some ILW that are not the standard waste stream. Examples of such waste stream include the primary VRS press, chute and primary HEPA filter. This is identified in the JV document, "RFR Waste Forecast Quarterly Update Report" (509407-0000-00000-40RA-0094) and the Radioactive Waste Notifications (RWN) for the waste streams of interest.	3	Active	Cameron Webb	Yung Cheung	29-Mar-16	Mitigate	31-Mar-16	3	3	2	9	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5929	In Progress	The plan for the VRS press and chute	The plan for the press and chute is: 1: Decontaminate in the WTS using CO2 blasting 2: Debris from CO2 blasting will go into a RWC/DSO assembly 3: Following decontamination, the press will be removed and placed in a "strong box". This "strong box" will either be stored on-site or off-site for approximately 10-15 years (after storage period, the press will be size reduced), or will be shipped to a decontamination facility for further decontamination and size reduction. For this plan to be viable, the following concerns will need to be addressed: 1: Impact of decontamination debris in the RWC/DSO assembly (long term storage) 2: Potential and impact of condensation build up during decontamination. There should be no water in the retube waste container. 3: Need specification of the proposed "strong box". At a minimum, this will still need to meet Minstry of Transportation requirements (tie-downs) for on-site transfer. 4: To confirm that the EA and licence of the RWSB can accept the new waste stream.	Cameron Webb	Yung Cheung	03-Jun-16	05 May 16 - The CWP will be updated to include steps to ensure there will no water in the RWC from in-situ decontamination. The "strong box" will be developed once the RWN has been processed. The TCD for the approval of the RWN is May 13, 2016. The steps associated with the assessments (EA) will be identified in the completed RWN. 28 Jan 16- On Track							
			5930	In Progress	The plan for primary HEPA filters and Misc ILW	The plan for the primary HEPA filters and misc ILW is to place the waste items in the RWC/DSO assembly. For this to work, an interface for the RWC/DSO assembly to allow the waste to be safely placed in the waste container will need to be designed. The concerns associated with this plan are: 1: Safety assessment may need to be revised to assess the impact of the proposed waste streams 2: Long term safety: filters will contain fine zirconium dust, so there is a higher chance for a fire to occur in the RWC/DSO assemby during storage. 3: Need to confirm if the waste should go into the RWC/DSO assembly or the Darlington in-station flask.	Cameron Webb	Yung Cheung	30-Jun-16	05 May 16 - The primary HEPA filters and VFF (Vacuum Filter Flask) filters will be going into the RWC. The types of assessments that need to be performed to demonstrate that there are no additional risks to the RWSB with this new waste stream have been identified. These assessments will identified in the RWSB New Waste Form process. The JV has a preliminary interface design, which has been reviewed by OPG. The JV will submit a cost estimate for this the interface (design and fabrication) for OPG to review and accept. 28 Jan 16- On Track.							
Restriction for Craft to Enter the Vault Potential Window			1	Active	Roy Brown	Kwok Tsang	29-Mar-16	Monitor	01-Jan-26	3	1	3	9	3	1	3	9
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13426	the vault [Potential window 160-188]	Event: Imposing restriction on crant to enter the vault may occur Cause: Due to radiological condition (contamination level too high, loss of component, or spikes of radioactivity) Impact: Results in productivity losses and impacting schedule.	There are no Not Started, In Progress Actions associated with the risk.														
11584	Waste - Inefficient Waste planning and practices [Window 117]	Definition Phase: Unplanned waste combined with inefficient practices could lead to negative impact on both schedule and cost. 1) Activity of the waste targeted for the containers are higher than assumed preventing the containers from being filled to capacity. 2) The process of loading Intermediate Level Waste into the containers impacts the packing factor.	3	Active	Cameron Webb	Yung Cheung	29-Mar-16	Mitigate	16-Oct-16	2	1	1	2	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			3175	In Progress	Provide Constant Oversight on Waste Strategy	OPG to provide constant oversight on Joint Venture Retube and Feeder Replacement Waste Plan and Refurb. Waste Plan.	Cameron Webb	Yung Cheung	29-Apr-16	Scroll down for latest updates. 29-Oct-14: Verify that the OPG Refurbishment Integrated Waste Management Plan is aligned with the SLN-Aecon Joint Venture Waste Plans and the latest Waste Quarterly Update Report. Furthermore, the aforementioned documents must ensure that RFR waste is suitably packaged and the intent of the Nuclear Waste Management waste acceptance criteria is met. This will help to ensure seamless turnovers between the Retube and Feeder Replacement Project and the Nuclear Waste Management Division. 17-Nov-14: Joe Burnham noted that as per RFR Waste Forecast Quarterly Update Report, all other items that have not been approved to be loaded into RWC (and that consists of fuel channel components that were originally known to have to be disposed of) do not have a container identified for use. The new Waste Forecast Update may have more information on this. 13-Mar-15: Waste Forecast report to be updated at the end of March 2015. 24-Apr-15: Even though RWNs are only required to be submitted one month prior to shipment, high priority RWNs are being pushed to identify risks and drive engineering of the containers. 6-May-15: High priority RWNs will be submitted on 8-May-15. OPG to review and then forward to Waste Acceptance Coordinator. 29-May-15: All high priority RWNs have been submitted except one, the VRS primary HEPA filters. Submission of this RWN is tracked by Action # 3153. 11-Jun-15: All high priority RWNs are submitted. VRS Chute RWN (non high priority) is in progress. 25-Jun-15: WWMF reviewed RWNs and have no comments. WWMF new waste coordinator to circulate to skateholders for their review. 20-Jul-15: Beginning to receive comments back from stakeholders on the RWNs. 10-Aug-15: New waste form has been initiated. Waiting for JV to provide additional information so that new waste review can be initiated. 17-Aug-15: A schedule is to be developed that shows the timeline for procurement of containers. 18-Sep-15: JV is working on outstanding R							
Project: Retube and Feeder Replacement - 73118																	
	RWPB - Retube Waste Processing Building Execution Readiness [No	[Definition Phase] Event: The results of the NSA may deem the RWPB to be a full safety-related structure. Cause: Scope definition incurred a late NSA of the RWPB	3	Active	John Hamilton	Khai Ngo	12-May-16	Mitigate	30-Jun-16	3	3	4	12	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							



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12341	Window Related]	Impact: This could incur rework to the superstructure design, impacting cost and schedule of the Definition Phase.													25-Sep-14: This task is already included in Joint Venture schedule with the due date of 27MAR2015. 12-Dec-14: Note: To minimize scheduling impact, Joint Venture is adopting the strategy of issuing intermediate memos along the way, and a final report at the end. On 11-Dec-14, a conference call was held with JV (including CANDU Energy), and a Level 3 schedule for the Safety Assessment is to be provided to OPG by early January 2015, so that tracking of this report can be closely monitored. Building classification memo has been issued in DRAFT form. OPG to ensure that RWPB collapse scenario is considered in the NSA. A meeting was held on 11Feb2015 to discuss the plan for NSA. It has been confirmed that RWPB collapse scenario is included. JV to document in Design Plan the approach they are pursuing for the NSA. 13-Mar-15: NSA in progress. Preliminary results are available. 24-Apr-15: Date set for submission of NSA to CNSC is 24-Jun-15. NSA is on track, and not at risk. Review in progress. OPG has provided comments on one file today, with the rest planned for tomorrow. 6-May-15: Meeting will be held today to resolve comments and dispositions on Methods and Assumptions, then Analysis Plan can be accepted by Gerry Martin. Analysis on-going and on track. 29-May-15: Analysis plan on track to be formally accepted by OPG on 3-Jun-15 and the analysis itself on 23-Jun-15. Date set for submission to CNSC is 20-Jul-15. 2-Jun-15: Action assigned to Kwok Tsang. Analysis plan to be formally accepted by OPG on 5-Jun-15, and preliminary report ready by 24-Jun-15. 11-Jun-15: OPG received analysis plan (38RF-03600-PLA-001 R00) and a meeting was held on 10-Jun-15 to discuss the preliminary results. 25-Jun-15: OPG to discuss strategy for discussion with CNSC. Preliminary report expected 30-Jun-15. 20-Jul-15: Preliminary NSA report received on 30-Jun-15. OPG review in progress (TCD: 21-Jul-15). 10-Aug-15: OPG completed review on time (21-Jul-15). Proposed dispositions were provide											
	RWPB Procurement - Structural Steel Late Deliverv [No Window	[Definition Phase] Event: Late delivery of Structural Steel Cause: NSA requirement date drove the steel tech specs late in the schedule	2	Active	John Hamilton	Peter Kempton	12-May-16	Mitigate	30-Sep-16	3	1	4	12	2	1	3	6									
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments																

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13981	Related]	Impact: Delay in construction may occur with impacts on delay in Construction schedule thereby impacting Availability Date																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

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13991		Impact: Potential impact on critical path.																
	6198	In Progress	Track Rework	Track rework and develop mechanism to minimize construction and engineering rework.	John Hamilton	Adam Coyle	14-Apr-17	12-Jan-16: No rework tracked so far. Will develop mechanism to track rework. Engineering rework is defined as revised design post DEC approval. Construction rework is defined as re-installation or re-fabrication. 29-Jan-16: Rework means that work that is required to correct original work (or rework) that is not defective. To proactively minimize pilecap pour rework, they are now scheduled to the weekends, as any delay at the Sally Port during the weekdays will incur rework to this task. 19-Feb-16: To minimize potential rework/delay, the first pilecap zone pour will use 3 pump trucks, 1 station outside the PA incase one of the other 2 inside the PA fails. 22-Mar-16: Update to Critical Path: Zone 1 pour was executed per logistics plan and executed in 2 hours less than planned. The next 10 pours will be planned and executed in the same manner. 13-Apr-16: Zones 3 and 2 poured within allocated time. No rework. 12-May-16: Zone 4 and 5 poured within allocated time. No rework.										
13980	RWPB Engineering - Delay or Schedule inaccuracy impacting Critical Path [No Window Related]	[Definition Phase] Event: delay to Engineering or inaccurate schedule estimate Cause: Inefficient Engineering hand-offs and/or P6 misalignment to need dates Impact: Negative impact to Construction schedule.	3	Active	John Hamilton	Peter Kempton	12-May-16	Monitor	30-Dec-16	2	1	3	6	2	1	3	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			6199	In Progress	Meet Regular to Identify Delays or Schedule Inaccuracy	Hold regular engineering and construction schedule meetings to identify delay and schedule risks and mitigate as required.	John Hamilton	Peter Kempton	30-Dec-16	12-Jan-16: Meeting held as planned. Report weekly to senior team to ensure full transparency. JV construction/engineering team will be at site to expedite resolution of issues. 01-Feb-16: A 4-week look ahead process is developed for JV to explain weekly the status of all work that is completed as planned, not-completed when it should have been, and the tasks for the next four weeks. Meeting are held weekly on Wednesday with OPG and JV, both construction and engineering teams. 19-Feb-16: Binder Review, Pre-DCAVR/DCAVR dates are tracked daily and discuss weekly with OPG/JV to identify any delays and determine mitigating/recovery actions as required. 22-Mar-16: Engineering is tracking on schedule to the milestone dates. 13-Apr-16: Engineering is tracking on schedule to the milestone dates. 12-May-16: Engineering is still tracking on schedule to the milestone dates.								

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1241	Requirements [No Window Related]	Cause: insufficient planning, review and approval of construction strategy Impact: schedule delay and/or additional cost during the Definition Phase.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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13987		Impact: inaccurate reporting may incur additional costs.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									

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Process Owner: R. Smith  
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14319	(possible similar risks to EF/CT/CTI) [Window 114, 115, 116, 117]	WTS and RWPB, with negative impacts on the schedule and worker dose due to need to cleanup. This residual risks remains despite best practices in RFR WTS design and procedures. CAUSE: This risk is postulated to occur by loose contamination being spread from the PT chute that links the VRS press to the RWC debris cover. There is a 'O-ring' like barrier that seals the connection between the chute and RWC debris cover during PT crushing, however when the chute is retracted, it is speculated that some of the fine particles in the chute would become loose and spread beyond this ring. By design, it is expected that the 'dirty' pins on the WTS lidding station will become contaminated over time as they lift the debris cover. there are seperate 'clean' pins for lidding the RWC lids. However, it is speculated that the partly contaminated debris cover will be lifted over clean RWC lids and transfer some of this loose contamination to the clean lids, therefore requiring cleanup. Note that this lidding station is contained inside a large concrete bunker so direct beams are not a concern. IMPACT: Based on OPEX with a similar WTS VRS press used at Lepreau Refurbishment - when PTs were crushed, the loose containmation led to high dose rates in the vault that required significant cleanup. For RFR, the negative impact would be on the schedule for PT removal and worker dose due to need to cleanup loose contamination.															
12428	OPG Foreign Material Exclusion (FME) Events Concealed [Window 42, 111, 114, 115, 116, 117]	Execution Phase: Events: FME items sitting inside Concealed Areas that cannot be discovered/identified in Walkdowns may occur during RFR work in Execution Phase Cause: As a result of historical FME events, Impact: Additional inspection / repair activities with negative impacts to * RFR cost * RFR schedule SCR; N-2015-19073 - RFR – Lack of FME Program was filed to identify the lack of FME currently in place as practice. For trending; N-2015-22746 - RFR Tooling shipped to DEC from manufacture with visable Foreign Material JV will issue REV-0 of the FME plan as per the meeting on Nov 4th with planning manager - Sebastian Wojewoda. Follow-up by Gerard Edison with JV SME indicated that incororpoation of comments have been completed and issue date TBD by JV. The JV will require an approved FME plan for the standby plan that has been approved and issued.	3	Active	Roy Brown	Jeffrey Palmateer	29-Mar-16	Accept	01-Jan-26	1	2	2	2	1	2	2	2
There are no Not Started, In Progress Actions associated with the risk.																	
Project: Retube and Feeder Replacement - PN																	
14117	Condensate Line Relocation (DEC123638)- Material Delivery Dates Present Risk to Outage Pre-Requisite Execution [Window 130]	[Definition Phase] Event This item documents the risk associated with delayed delivery of material for the Condensate Line Relocation Modification (DEC123638). Installation of this DEC requires a TRF Outage and as such must be coordinated with the station outage schedule. Currently, POs are just being let for the majority of the material required to complete this modification and the JV Procurement Schedule has delivery dates for this material that do not meet the needs of the Project Schedule (see specific details provided in the Comments). Cause Significant delays have been experienced in the Procurement Process. There are many reasons for these delays, however, the main cause of the delays seen related to materials required for this Modification is [REDACTED] [REDACTED].Impact Lack of Material availability and delays in the installation of DEC123638 may result in a TRF Forced Outage to complete the work at a later date following the TRF Planned Outage and prior to Breaker Open. This could have significant financial impacts to OPG.	4	Active	Andrew Cerilli	Ian Wilcox	09-May-16	Monitor	13-Apr-16	1	2	1	2	1	2	1	2
There are no Not Started, In Progress Actions associated with the risk.																	
Project: Retube and Feeder Replacement - WM																	
	RFR Schedule assumptions for reduced RPPE [Window 23. 24. 25. 29]	[Execution Phase] Event: The project schedule currently recognizes a large portion of work that requires the use of plastic suits. The transition from plactic suits to reduced required RPPE is a process that will require	2	Active	Johnathon Hash	Ian Edwards	25-Jan-16	Mitigate	03-Oct-16	2	2	3	6	2	2	2	4
There are no Not Started, In Progress Actions associated with the risk.																	



Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

14136		sustained samples which demonstrate the requirements and risk for palstic suits is no longer necessary. Cause: At present this could take between three and five days of continued monitoring and surveys. Impact: The schedule and the assumptions made from the project need to be aware and reflect these requirements to ensure a smooth transition with minimal delays is achievable.															
Project: Retube and Feeder Replacement - WA																	
14319	Spread of Contamination during RFR Waste Processing of crushed PT (possible similar risks to EF/CT/CTI) [Window 114, 115, 116, 117]	Execution Phase Risk: EVENT: There is a residual risks that that there will be spread of loose contamination in the RFR WTS and RWPB, with negative impacts on the schedule and worker dose due to need to cleanup. This residual risks remains despite best practices in RFR WTS design and procedures. CAUSE: This risk is postulated to occur by loose contamination being spread from the PT chute that links the VRS press to the RWC debris cover. There is a 'O-ring' like barrier that seals the connection between the chute and RWC debris cover during PT crushing, however when the chute is retracted, it is speculated that some of the fine particles in the chute would become loose and spread beyond this ring. By design, it is expected that the 'dirty' pins on the WTS lidding station will become contaminated over time as they lift the debris cover. there are seperate 'clean' pins for lidding the RWC lids. However, it is speculated that the partly contaminated debris cover will be lifted over clean RWC lids and transfer some of this loose contamination to the clean lids, therefore requiring cleanup. Note that this lidding station is contained inside a large concrete bunker so direct beams are not a concern. IMPACT: Based on OPEX with a similar WTS VRS press used at Lepreau Refurbishment - when PTs were crushed, the loose containmation led to high dose rates in the vault that required significant cleanup. For RFR, the negative impact would be on the schedule for PT removal and worker dose due to need to cleanup loose contamination.	3	Active	Michael Hersch	Sean Carpenay	04-Apr-16	Monitor	01-Feb-18	2	1	2	4	2	1	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Security - Project - 25918																	
13241	10-25918 Troubleshooting software configuration and setting - Delays	There is a risk that multiple iteration of software configuration and setting change might be required during installation (Based on OPEX from PNG Sally Port project).		Active	Francis Davis	Getuta Butoi	09-May-16	Monitor	31-May-16	4	2	5	20	2	1	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5658	In Progress	10-25918 DN Sally Port - Review and apply lesson learnt	Review and apply lesson learnt from Pickering Sally Port project to avoid repeating the same issues. OPEX for RPO Project will also be incorporated in this project.	Scott Ritzie	Getuta Butoi	11-Jul-16								
			5659	In Progress	10-25918 DN Sally Port - Site Acceptance Testing	A more rigorous Site Acceptance Testing (SAT) will be planned and executed to detect software bugs prior to live system installation.	Scott Ritzie	Getuta Butoi	11-Jul-16								
			5660	In Progress	10-25918 DN Sally Port - SAT Work Plan will be reviewed by Security and SRE	Software installation and SAT Work Plan will be reviewed by Security and SRE.	Scott Ritzie	Getuta Butoi	11-Jul-16								
13237	10-25918 Unknown buried Service Relocation & Void - Delays	There is a risk of hitting unknown burried service during construction. Initial scan revealed multiple buried services (electrical, drainage) in Sally Port.		Active	Francis Davis	Getuta Butoi	09-May-16	Mitigate	30-Jun-16	4	2	3	12	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4377	In Progress	10-25918 DN Sally Port - Scan a larger area coverage for buried service	A more detailed and larger area coverage scan will be conducted by EMSMA vendor to discover all buried service.	Scott Ritzie	Getuta Butoi	31-May-16								
			4378	In Progress	10-25918 DN Sally Port - Day lighting the buried services	Day lighting the buried services will be performed prior to construction starts.	Scott Ritzie	Getuta Butoi	31-May-16								
	10-25918 Delay in Material Delivery	There is a risk that delay in material/parts delivery will affect downstream installation and commissioning activities. Some security devices are proprietary and can only be supplied by one vendor. Some securitv devices have lead time between 12 to 16 weeks.		Active	Francis Davis	Getuta Butoi	09-May-16	Mitigate	11-Jul-16	3	1	4	12	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

<a href="#">13238</a>			<a href="#">4379</a>	In Progress	10-25918 DN Sally Port - Engage and communicate with supplier for material procurement	Material procurement is an activity on project schedule and will be tracked by Project during regular project meeting. Long lead time parts will be ordered in advance. Engage and communicate with supplier to expedite the process.Monitor the status of the material delivery.	Scott Ritzie	Getuta Butoi	30-May-16	Monitor the status of the material delivery. Apr 18, 2016: Civil: 100% Electric: 85% I & C: 60%							
<a href="#">13239</a>	10-25918 Internal Resource Conflict - Delays	There is a risk that internal resource to support this project (e.g. FE, CM, Site Security, RP, Project Design etc) may be affected by station priorities.		Active	Francis Davis	Getuta Butoi	09-May-16	Mitigate	15-Jun-16	4	2	3	12	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">4380</a>	In Progress	10-25918 DN Sally Port - Use IPG Process to schedule the work	Station resource will be scheduled through DNG Work Control's IPG process as early as possible.	Scott Ritzie	Getuta Butoi	15-May-16	Due date updated to Mar 15/2016 as the approved schedule start of installation was agreed for Mar 4/ 2016. ES Fox/Projects are working with IPG organization on scheduling the work.  Apr 18, 2016: Due date updated to May 15/2016. ES Fox/Projects are working with IPG organization on scheduling the work and injecting the WO in the schedule.							
			<a href="#">4381</a>	In Progress	10-25918 DN Sally Port - Station resource will be tracked in regular project meetings	Station resource will be tracked in regular project meeting. Specific contingency will be allocated for overtime.	Scott Ritzie	Getuta Butoi	31-May-16								
<a href="#">13868</a>	10-25918 High traffic through Sally Port - Delays	There is a risk that due to many construction activities on Darlington site, a high amount of truck traffic will travel through Sally Port daily causing construction activities for the project to be impacted and resulting in project delays. Multiple new building projects inside DNG's protected area have the same construction period as this project.	3	Active	Francis Davis	Getuta Butoi	09-May-16	Mitigate	11-Jul-16	5	1	2	10	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5651</a>	In Progress	10-25918 DN Sally Port - Site survey and planning	Site survey, planning and construction island will be conducted and setup by ESMSA vendor such that Sally Port will remain open and stay operational during construction period;	Scott Ritzie	Getuta Butoi	11-Jul-16								
			<a href="#">5652</a>	In Progress	10-25918 DN Sally Port - Road layout verified frequently	Road layout during construction period will be tested in advance to ensure adequate spacing for truck to pass through during construction	Scott Ritzie	Getuta Butoi	11-Jul-16								
<a href="#">13866</a>	10-25918 Main vehicle entrance to station - Delays	There is a risk that Sally Port will be required to immediate return to service due to station emergencies as Sally Port is the main access point for vehicle entering/leaving the station, resulting in project delays.	3	Active	Francis Davis	Getuta Butoi	09-May-16	Mitigate	11-Jul-16	3	1	2	6	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5644</a>	In Progress	10-25918 DN Sally Port - Station emergencies vehicle access	Work with ES MSA Contractor to minimaze exposure time and work afternoon shifts.	Scott Ritzie	Getuta Butoi	11-Jul-16								
<a href="#">13242</a>	ES MSA Contractor Performance Incentive	█ of total contract value for ES MSA Contractor performance incentive to be included as specific contingency.		Active	Francis Davis	Francis Davis	09-May-16	Accept	31-Jul-16	2	2	1	4	2	2	1	4
There are no Not Started, In Progress Actions associated with the risk.																	
Project: Security - Project - 82929																	
<a href="#">14381</a>	There is a risk that cost will increase due to the quality of estimates	A third party estimated was performed for this project, but there is a risk that the estimate may prove to be inaccurate. If this is the case, this could result in an increased project cost due to the requirement to obtain additional funding. Additionally, the cost could increase due to scope changes and schedule delays not accounted for in the estimate.	1	Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Jan-17	2	3	4	8	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">14382</a>	There is a risk that too generically defined scope will impact the cost of schedule	A change in scope could occur due to discovery work, additional ECS badging stations needed by Nuclear Refurbishment, or future extension of security systems between now and the date when the design for this project is approved. This could result in increased cost or schedule delays for the project.		Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Jan-17	2	3	4	8	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">143</a>	There is a risk that the schedule will be extended due to late desian or	There is a possibility that the design for the new system will be late which could impact the procurement of Engineering Equipment. This work will be executed during Nuclear Refurbishment which might result in resource problems. This could result in increased costs and a delayed		Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Jan-17	2	2	3	6	1	1	2	2
There are no Not Started, In Progress Actions associated with the risk.																	

14383	insufficient resources	schedule.																
14384	There is a risk that vendor and station support resources will be limited when needed	This work is being executed during Nuclear Refurbishment which could result in limited resource availability to support this project. This would be caused by late scheduling of resources or due to resources being pulled from the project to support NR. This could result in increased project costs and a delayed project schedule.		Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Jan-17	2	2	3	6	1	1	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
14386	16-82929 and 13-82930 - Risk Event 2	Details for Risk Event 2 are stored in the project files.		Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Jan-17	2	2	3	6	1	1	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
14385	16-82929 and 13-82930 - Risk Event 1	Details for Risk Event 1 are stored in the project files.		Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Dec-17	1	1	3	3	1	1	1	1	
			There are no Not Started, In Progress Actions associated with the risk.															
Project: Security - Project - 82930																		
14381	There is a risk that cost will increase due to the quality of estimates	A third party estimated was performed for this project, but there is a risk that the estimate may prove to be inaccurate. If this is the case, this could result in an increased project cost due to the requirement to obtain additional funding. Additionally, the cost could increase due to scope changes and schedule delays not accounted for in the estimate.	1	Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Jan-17	2	3	4	8	1	1	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
14382	There is a risk that too generically defined scope will impact the cost of schedule	A change in scope could occur due to discovery work, additional ECS badging stations needed by Nuclear Refurbishment, or future extension of security systems between now and the date when the design for this project is approved. This could result in increased cost or schedule delays for the project.		Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Jan-17	2	3	4	8	1	1	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
14383	There is a risk that the schedule will be extended due to late design or insufficient resources	There is a possibility that the design for the new system will be late which could impact the procurement of Engineering Equipment. This work will be executed during Nuclear Refurbishment which might result in resource problems. This could result in increased costs and a delayed schedule.		Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Jan-17	2	2	3	6	1	1	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
14384	There is a risk that vendor and station support resources will be limited when needed	This work is being executed during Nuclear Refurbishment which could result in limited resource availability to support this project. This would be caused by late scheduling of resources or due to resources being pulled from the project to support NR. This could result in increased project costs and a delayed project schedule.		Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Jan-17	2	2	3	6	1	1	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
14386	16-82929 and 13-82930 - Risk Event 2	Details for Risk Event 2 are stored in the project files.		Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Jan-17	2	2	3	6	1	1	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
14385	16-82929 and 13-82930 - Risk Event 1	Details for Risk Event 1 are stored in the project files.		Active	Francis Davis	Silviu Olariu	21-Apr-16	Monitor	31-Dec-17	1	1	3	3	1	1	1	1	
			There are no Not Started, In Progress Actions associated with the risk.															
Project: Shutdown, Layup, Services -																		
14452	Vendor Resource constraints impacting SDLU execution [No Window Related]	EVENT: Delay in all SDLU project deliverables CAUSE: Vendor does not have sufficient qualified personnel to complete SDLU project deliverables IMPACT: Impacts execution schedule of all SDLU projects		Active	Andy Ireland		06-May-16	Monitor	15-Oct-16	4	2	5	20	4	2	5	20	
			There are no Not Started, In Progress Actions associated with the risk.															
14318	Quality issues in Vendor/OPG work causing issues [No Window Related]	EVENT: Additional effort needed due to quality issues in design and field work. CAUSE: Human error and/or schedule pressure IMPACT: Additional cost and schedule delay to develop/implement solutions		Active	Andy Ireland		15-Apr-16	Monitor	31-Aug-17	3	3	4	12	3	3	4	12	
			There are no Not Started, In Progress Actions associated with the risk.															
13514	Procurement of materials is delayed [No Window Related]	EVENT: Material is ordered/delivered late. CAUSE: Delays in engineering/design/ transit or late release of procurement funds. IMPACT: Delayed Project Schedule and increased costs.		Active	Pejman Asgaripour	Andy Ireland	06-May-16	Mitigate	31-Dec-16	3	2	3	9	2	2	2	4	
			There are no Not Started, In Progress Actions associated with the risk.															
120	Additional minor mods may be required to support the layup Scope of Work and	EVENT: Additional minor mods may be required to support the layup Scope of Work. CAUSE: Detailed Design uncovering new needs as design progresses. For example, draining the deadlegs in PHT Dry Air project and Moderator Flush Tmod. IMPACT: Result in increase in scope, schedule and cost	2	Active	Andy Ireland		12-May-16	Monitor	31-May-19	4	2	1	8	4	2	1	8	
			There are no Not Started, In Progress Actions associated with the risk.															



122	services [No Window Related]																
13619	SDLU Pre-requisite projects delays [No Window Related]	EVENT: Prerequisite work required before breaker open may be delayed. CAUSE: 1) Poor quality field work due to OPG-applied schedule pressure (Some project designs are currently delayed and challenging N-PROC-MA-0022 milestones. These delays are partially caused by OPG inefficiencies in reviews and late scope identification). 2) Productivity lower than planned due to OPG coordination and planning (e.g. permitry, work authorization, RP support).IMPACT: Increased labour costs and additional trades standby costs.		Active	Andy Ireland		12-May-16	Mitigate	16-Oct-16	2	4	2	8	2	4	1	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5510	Not Started	Initiate Readiness Stakeholder meeting for Breathing Air	Stakeholder meeting to be set at T-5 to ensure Vendor has everything to start execution.	Kris Dabiran	Gaye Winters	29-Jun-16								
11824	Insufficient bulk gases for Refurb work [Window 3, 13, 38]	EVENT: Existing system supply may not have enough bulk gases to do refurbishment work, specifically the gases for SG/Conventional systems layup (Nitrogen and Helium gases). CAUSE: Amount of bulk gases required to fill the systems are unknown. IMPACT: Increased cost and schedule delays to project.		Active	Andy Ireland		13-May-16	Accept	30-Apr-17	2	1	3	6	2	1	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6752	In Progress	Assess quantity of bulk gases needed (Nitrogen/Helium)	Determine the amount of bulk gases needed for Refurbishment Layup.	Andy Ireland	Alston Castelino	31-May-16	13May2016: Assumptions used in SRE calculation should be validated. Nitrogen needed for PHT system and Helium for Moderator not taken into account.							
13608	No PMT Cost Reduction [No Window Related]	EVENT: Vendor PMT costs do not reduce if vendor workload is decreased. CAUSE: ESFox has stated that it needs to maintain PMT resources across all SDLU/RSF projects.IMPACT: PMT costs may be increased per project as the overhead for the entire team is to be maintained upon project cancellation		Active	Andy Ireland		12-May-16	Monitor	30-Jun-16	3	2	1	6	3	2	1	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5987	In Progress	Complete PMT review at ES Fox	Initiate and complete a project management review at ES Fox (by consultant)	Nunzio Mastrocola		30-Jun-16	PO issues for consultants and review underway. Report expected in spring of 2016.							
14037	Increased Vendor PMT costs [No Window Related]	EVENT: Increased vendor Project Management cost CAUSE: 1) New OPG expectations unaccounted for in initial estimates. Eg, CWP reviews/schedule coding requirements. 2) Unoptimized vendor utilization of project management resources. IMPACT: Consumption of project contingency funding		Active	Andy Ireland		12-May-16	Mitigate	30-Jun-16	3	2	2	6	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5987	In Progress	Complete PMT review at ES Fox	Initiate and complete a project management review at ES Fox (by consultant)	Nunzio Mastrocola		30-Jun-16	PO issues for consultants and review underway. Report expected in spring of 2016.							
14045	Insufficient Breathing Air for Power Track work during Refurbishment [Window 505]	EVENT: Breathing Air distribution and capacity assessment concludes that there is insufficient Breathing Air to support Refurbishment activities in the Fuelling Machine Duct CAUSE: Refurbishment requirements of 24 workers in plastic suits exceeds the maximum number of workers that have ever worked in the Fuelling Machine Duct (based on OPEX). IMPACT: Additional cost to the project to create a new modification to support this work. Delay to SDLU Breathing Air schedule		Active	Pejman Asgaripour	Andy Ireland	05-May-16	Mitigate	03-Jul-17	2	2	3	6	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6186	In Progress	Assess breathing air distribution network inside Fuelling Machine Duct	Assess whether the breathing air distribution network can support 24 people in the Fuelling Machine Duct, given that there is enough capacity.	Andy Ireland	Prasanth Gopinath	31-May-16	Draft of memo complete. Calculations show 58 psi at the furthest Breathing Air Station that the Power Track workers will use. Memo being reviewed by Design Engineering.							
14420	Wet Layup Skids not Meeting Intended Design Function [Window 37]	EVENT: Wet layup skids may not meet intended design function CAUSE: Procurement/fabrication of skids does not meet the required specifications IMPACT: Delay to project schedule and increase in project costs		Active	Jos Diening		09-May-16	Monitor	31-Aug-16	2	1	3	6	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
14421	Inflatable Bung does not provide Adequate Sealing [Window 37]	EVENT: Inflatable bung may not provide adequate sealing of nitrogen blanket CAUSE: Issues in bung design or bung fabrication IMPACT: Transfer of nitrogen beyond the intended system barriers leading to a delay in the T/G refurbishment schedule. Minimal impact to cost. Schedule delay to project.		Active	Jos Diening		13-May-16	Mitigate	17-Mar-17	2	1	3	6	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			7458	Not Started	SGECS bung - testing and spares	SDLU to engage Vendor to include procurement of additional spares, and Factory Accepted Testing in contract.	Jos Diening	Alston Castelino	19-Aug-16								
1136	Degraded condition of PHT IX columns may affect layup strategies [Window 131]	EVENT: High pressure differential across IX columns.Degraded conditions of the PHT IX columns. CAUSE: Degraded conditions of the PHT IX columns. IMPACT: Might affect unit startup schedule by prolonging purification	2	Active	Andy Ireland		13-May-16	Monitor	31-Oct-16	2	2	2	4	2	2	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
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ONTARIOPOWERGENERATION

Risk Report by Project with Associated Actions

13636	Currently no alternate cooling water design for SA compressors [Window 506]	EVENT: No cooling water available during 60 day LPSW outage. CAUSE: No alternate connection designed in SA mod or LPSW alternate cooling mod, to LPSW. IMPACT: More design work required on existing mods (T/P mod) or reduced service air capacity.		Active	Andy Ireland		06-May-16	Accept	01-Nov-17	2	1	1	2	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5376	In Progress	Turn off CP11 during U2 outage	MTL to coordinate with Operations to determine most efficient way to turn off CP11 during U2 outage.	Andy Ireland	Kris Dabiran	05-Jul-16	5Feb2016: An operations memo might not be necessary. MTL to discuss with Operations to determine path forward							
			5476	In Progress	Investigate impact of no alternate cooling water for SA compressors during U3 LPSW outage	SDLU to investigate the the impact of having no alternate cooling water to Service Air Compressors during the U3 LPSW outage.	Andy Ireland	Kris Dabiran	05-Jul-16	5Feb2016: For U3 outage, provisions available to supply temporary power/cooling water to SA compressor. Impact on U3 will be determined by beginning of U3 outage.							
14129	OPG Acceptance of Design ECs without having Final Certified Vendor (Atlas Copco) Documents [Window 505]	EVENT: Rework might be needed for Design EC to align with final approved Atlas Copco documents. CAUSE: Accepting the Design ECs without verifying information from Approved Atlas Copco Documents. IMPACT: Additional cost and schedule delay for rework.		Active	Andy Ireland	Kris Dabiran	06-May-16	Mitigate	30-Jun-16	1	1	2	2	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			7272	In Progress	Monitor Receipt of Atlas Copco Documentation	Refer to NK38-CORR-09701-0579150. Breathing Air Design for Header was accepted without all of vendor documentation provided. OPG MTL to track receipt of documents from vendor to DSP and ensure that documents are reviewed against design to ensure that no changes are required. Update this action as required until all documents in NK38-CORR-09701-0579150 are received all changes to EC are identified.	Andy Ireland	Kris Dabiran	30-Jun-16								
14323	Breathing Air Additional Scope Increase [Window 505]	EVENT: Breathing Air VBO compressor and Pre-Bulkhead tie-ins to new Refurb Breathing Air design is delayed CAUSE: Scope was not identified in the Scope of Work or the MDR and thus was identified late in the design IMPACT: Additional cost to expedite design and field work.	4	Active	Andy Ireland	Kris Dabiran	06-May-16	Mitigate	01-Dec-16	1	2	1	2	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6720	In Progress	Develop a strategy completion of design and installtion of modification required for VBO compressor connection to the new Breathing Air header	Upon acceptance of usage of VBO compressor as redundancy in the event of new breathing air compressor failure, a modification needs to be designed to provide means for connection of VBO compressor to the new breathing air header. 1) discussion to be held with OPG refurb design engineering to determine the availability of resources TCD April 08, 2016 2) In the event OSS funding is required to complete the design, project to secure the funding through CCF process 3) Construction scope to be added to the existing contract with ESFL through CCF/PCA process upon completion of design and acceptance of construction estimate 4) This modification to be AFS'd at the same time as the original breathing air modification scheduled for December 01, 2016	Andy Ireland	Kris Dabiran	01-Dec-16								
13588	Discovery work [No Window Related]	EVENT: There is a risk that there will be work that is not accounted for. Funding might not be allocated to something that is unplanned. CAUSE: Unforeseeable events such as a broken component in the field. For example, SG internal condition is different than expected. IMPACT: Addition of work during next phase which will increase cost and schedule delays.		Active	Andy Ireland		12-May-16	Accept	31-Oct-19	1	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Shutdown, Layup, Services - SL																	
	PHT Aux. SDLU - Dry Air Purge at risk due to Dead Legs [Window 481]	Following draining of the PHT auxiliary systems, there will be areas where liquid water is held up as stagnant legs (hereafter referred to as dead legs). The presence of dead legs will block the flow path for the drv air purgae and will result in an unsuccessful shutdown layup of the auxiliariw systems.	3	Active	Paul Ross	Carrie Smith	21-Apr-16	Avoid	01-May-17	4	2	4	16	3	2	3	9
There are no Not Started, In Progress Actions associated with the risk.																	

14392		At the very least, draining of dead legs may impact the installation window for the dry air purge if a strategy is not developed. If shutdown layup conditions are not met, then prolonged exposure of the carbon steel to wet conditions in the presence of air will result in corrosion and significant degradation. If not detected, that could compromise the system's pressure boundary when the system is returned to service and potentially cause inadvertent impacts on nuclear safety. If detected, it could result in major overhaul of equipment, components and piping significantly delaying Return to Service. This risk was previously identified during COMS and added to the ITF Item #78 and #144 under Master EC #125476. Detailed Design was completed with these risks not closed out.																																																													
14392	New 600 lb flanges not installed in Unit 2 BO1/2 [Window 3]	EVENT: New 600 lb flanges will not be installed prior to installation of the wet layup skids during U2 refurbishment on BO1/BO2. CAUSE: Based on OPEX from previous outages, WOs 2391690 and 32391692 were constantly pushed from outage to outage. IMPACT: Will impact Costs, schedule of DNRU2 if not implemented prior to outage.	<table><tr><td></td><td>Active</td><td>Andy Ireland</td><td></td><td>08-Apr-16</td><td>Mitigate</td><td>30-Oct-16</td><td>3</td><td>2</td><td>2</td><td>6</td><td>3</td><td>1</td><td>1</td><td>3</td></tr><tr><td>Action#</td><td>Status</td><td>Action Title</td><td>Action Description</td><td>Owner</td><td>Delegate</td><td>Due Date</td><td colspan="8">Comments</td></tr><tr><td>5166</td><td>In Progress</td><td>Ensure installation of 600 lb flanges in Unit 2 BO1/2.</td><td>Installation of new 600 lb flanges must occur before SG Wet layup work in U2 Refurbishment. SDLU Project to monitor WOs initiated to ensure they are scheduled, assessed and executed on time.</td><td>Andy Ireland</td><td>Alston Castelino</td><td>19-Oct-16</td><td colspan="8">5May2016: ESFL is following up with RCMT to determine if the skid can be re-registered with the TSSA to have a 300 lb flange connection as opposed to a 600 lb flange connection 14Apr2016: Assessing currently in progress. ENA hold placed on WOT 2391690-20 &amp; 2391692-21 for a workplan/ice plug coversheet since the boilers will not be drained and welding requires the isolation valve to be open. Outage Operations group to determine whether or not an ice plug is possible at elevated temperatures of 60°C 27Jan2016: Assessing in progress with maintenance. Parts hold WOT 02391690-05 MWFD STAGE PARTS FOR FLANGE REPLACEMENT. Follow up with maintenance on material risks. 9Dec2015: Initial assessing is in progress. Tasks have been added including resources needed. WO 02391690 has been approved while WO 02391692 is in plan state. 30Oct2015: Scope form submitted. WO approved for scope in D1621. NR Maintenance to assess work.</td></tr><tr><td colspan="15"></td></tr></table>		Active	Andy Ireland		08-Apr-16	Mitigate	30-Oct-16	3	2	2	6	3	1	1	3	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								5166	In Progress	Ensure installation of 600 lb flanges in Unit 2 BO1/2.	Installation of new 600 lb flanges must occur before SG Wet layup work in U2 Refurbishment. SDLU Project to monitor WOs initiated to ensure they are scheduled, assessed and executed on time.	Andy Ireland	Alston Castelino	19-Oct-16	5May2016: ESFL is following up with RCMT to determine if the skid can be re-registered with the TSSA to have a 300 lb flange connection as opposed to a 600 lb flange connection 14Apr2016: Assessing currently in progress. ENA hold placed on WOT 2391690-20 & 2391692-21 for a workplan/ice plug coversheet since the boilers will not be drained and welding requires the isolation valve to be open. Outage Operations group to determine whether or not an ice plug is possible at elevated temperatures of 60°C 27Jan2016: Assessing in progress with maintenance. Parts hold WOT 02391690-05 MWFD STAGE PARTS FOR FLANGE REPLACEMENT. Follow up with maintenance on material risks. 9Dec2015: Initial assessing is in progress. Tasks have been added including resources needed. WO 02391690 has been approved while WO 02391692 is in plan state. 30Oct2015: Scope form submitted. WO approved for scope in D1621. NR Maintenance to assess work.																						
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Project: Shutdown, Layup, Services - 73506																																																															
14451	Refurbishment Compressors AFS to support Bulkhead Tie-in [Window 505]	EVENT: ECR 24553 has been initiated to use the refurbishment breathing air system to install the refurbishment containment bulkhead. The ECR assumes that the breathing air compressors will be available to support bulkhead tie-in. CAUSE: There is little room for schedule slippage as the AFS data for the compressors is to be December 1, 2016 and installation of the bulkhead begins in February 2017. IMPACT: Delay to critical path of Refurbishment. Increased costs to expedite procurement/installation of compressors.	<table><tr><td>3</td><td>Active</td><td>Andy Ireland</td><td>Kris Dabiran</td><td>13-May-16</td><td>Mitigate</td><td>31-Dec-16</td><td>3</td><td>2</td><td>2</td><td>6</td><td>2</td><td>1</td><td>1</td><td>2</td></tr><tr><td colspan="15">There are no Not Started, In Progress Actions associated with the risk.</td></tr></table>	3	Active	Andy Ireland	Kris Dabiran	13-May-16	Mitigate	31-Dec-16	3	2	2	6	2	1	1	2	There are no Not Started, In Progress Actions associated with the risk.																																												
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There are no Not Started, In Progress Actions associated with the risk.																																																															
Project: Specialized Projects -																																																															
12253	Installation Delays due to Lack of Integration/Priority with RFR Activities [Window 64, 70]	Event: Due to other more urgent priorities execution widnow for Vault Cooler Refurbishment gets deferred. Cause: The RFR work is the largest and most complex portion of Refurbishment and the majority is on critical path increasing the possibility that work will be focused to finish that at hte expense of Vault Cooler Refurbishment. Impact: There would be an impact to both cost and schedule due to the shift of work windows.	<table><tr><td>2</td><td>Active</td><td>Sorin Marinescu</td><td>Greg Maggs</td><td>11-Apr-16</td><td>Mitigate</td><td>16-Jun-16</td><td>2</td><td>1</td><td>5</td><td>10</td><td>2</td><td>1</td><td>2</td><td>4</td></tr><tr><td>Action#</td><td>Status</td><td>Action Title</td><td>Action Description</td><td>Owner</td><td>Delegate</td><td>Due Date</td><td colspan="8">Comments</td></tr><tr><td>2670</td><td>In Progress</td><td>Mitigate Integration and Execution Issues for Vault Cooler Installation</td><td>Work with JV and Work Control to develop a schedule which is fully integrated into RFR schedule and minimizes impact from RFR and other projects.</td><td>Sorin Marinescu</td><td>Greg Maggs</td><td>07-Jun-16</td><td colspan="8">July 8, 2014: will be included in installation planning by JV.</td></tr></table>	2	Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Mitigate	16-Jun-16	2	1	5	10	2	1	2	4	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								2670	In Progress	Mitigate Integration and Execution Issues for Vault Cooler Installation	Work with JV and Work Control to develop a schedule which is fully integrated into RFR schedule and minimizes impact from RFR and other projects.	Sorin Marinescu	Greg Maggs	07-Jun-16	July 8, 2014: will be included in installation planning by JV.																						
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<a href="#">11982</a>	Delay In Contracting Process Impacting SDS Project Schedule [Window 7]	Event: Delay in material availability. Cause: Delay in SDS procurement contract issuance results in a delay of material availability for installation. Impact: Cost and schedule of the project would be impacted if materials were unavailable on time.	4	Active	Sorin Marinescu	P Sharawy	11-Apr-16	Mitigate	30-Jun-16	2	1	4	8	2	1	4	8
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">2713</a>	In Progress	Expedite new contract process	Hold regular periodic meetings are held with Supply Chain to review the status and expedite pending contracts until all Project contracts have been issued.	Sorin Marinescu	P Sharawy	30-Jun-16	Regular periodic meetings are held with Supply Chain to review the status and expedite pending contracts. As a result, a number of contracts have been issued. This level of oversight will continue as required. All the other contracts, including service and cables (regarding to 3220)							
<a href="#">12254</a>	Installation Delays due to Assessment Issues [Window 64, 70]	Event: JV CWP's do not address the field configurations, ITP's and materials. Cause: RFR quality of assessment is less than adequate. Impact: Poor quality assessment could lead to installation issues which would have an impact on both cost and schedule.	1	Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Mitigate	31-May-16	2	2	3	6	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">2694</a>	In Progress	Actions to avoid cost and schedule impact due to unidentified structural members in front of vault coils	Investigation into potential interferences prior to commencement of field work.	Sorin Marinescu	Greg Maggs	31-May-16	Feb 4, 2015: will be included in installation planning by JV. Sept. 18/15: Project is co-ordinating a vault walkdown for JV staff to verify installation methodology and any potential interefence issues. A walkdown was attempted earlier in 2015, but JV staff were not given access to the specific locations required. A further walkdown is planned during Q3. Feb 2016: Project provided feedback to JV in 2015 that Vault Cooler frames can be temporarily removed to allow coil removal and replacement. JV would need to prepare a weld package to document the frame removal and re-installation. OPG has requested that this be addressed as part of the CWP preparation.							
			<a href="#">5735</a>	In Progress	Mitigation of Assessment Risk for Vault Cooler CWPs	OPG to work collaboratively with contractor in preparation and review of CWPs and schedule to ensure installation does not delay project completion. Support to include obtaining all available technical information (drawings, manufacturers manuals, etc.), obtaining input from station and Refurb SME's, and facilitating any required walkdowns.	Sorin Marinescu	Greg Maggs	31-May-16								
<a href="#">12323</a>	Hardware Delivery Delay Impacting SDS Software Integration [No Window Related]	Event: Hardware delivery is late reducing the time available to integrate hardware components with available software. Cause: The late issuance of hardware contracts squeezes the equipment suppliers reducing their available float and their ability to handle unexpected changes. Impact: This risk would cause a significant schedule impact which would in turn impact cost.	1	Active	Sorin Marinescu	P Sharawy	11-Apr-16	Monitor	29-Nov-16	2	1	3	6	2	1	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
	Vault Cooler Scope Change [Window 64, 70]	Event: Station mandates that the split coil design is used for the Vault Cooler refurbishment Cause: Revised split coil design hasbeen partially implemented in the station. Decision may be made to change over to the new design. Impact: There would be an impact on both cost and schedule if the split ocil design were mandated as it would have to be processed as a project scope change.	2	Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Monitor	30-Jun-18	3	2	1	6	3	2	1	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">2689</a>	In Progress	Actions to prepare a Mod of fan motors	Early initiation of purchasing process to engage vendors and confirm that there are no ECC issues with motor replacements.	Sorin Marinescu	Greg Maggs	30-Jun-18	July 8, 2014: will be included in OPG Supply Chain purchasing strategy. PE assessment is in progress.							

<a href="#">13394</a>			<a href="#">5236</a>	In Progress	Incorporation of Split Coil Design Into Vault Cooler Installation	1) Project to monitor status of station initiative to implement the split coil design. 2) Project to initiate a project change directive if split coil design is implemented by station and brought into Refurb scope. Split coil would be used in selected locations dependent on removal/installation interferences.3) Project to submit PCD to JV for cost and schedule impact, contingency to be utilized.	Sorin Marinescu	Greg Maggs	30-Jun-18										
<a href="#">13463</a>	SDS Interface Compatibility Issues Discovered During Installation [Window 7]	Event: SDS computer compatibility issues during installation. Cause: The system will be thoroughly tested prior to installation under simulated conditions but some conditions (Ispecifically driving actual field solenoid valves) cannot be simulated and therefore must be tested in the field. Impact: Both cost and schedule would be impacted by the interface compatibility issues if they arise.	1	Active	Sorin Marinescu	P Sharawy	11-Apr-16	Monitor	30-Jun-18	2	1	3	6	1	1	3	3		
<a href="#">12327</a>	SDS Computer Project Failure to Meet Hardware Design Requirements [No Window Related]	Event: The system as designed fails to meet design requiprements during design testing and qualification. Cause: Latent design flaws. Impact: Both cost and schedule could be impacted due to substantial rework being required.	1	Active	Sorin Marinescu	P Sharawy	11-Apr-16	Monitor	30-May-17	1	1	4	4	1	1	4	4		
<a href="#">12328</a>	SDS Computer Project Grounding Problem [Window 7]	Event: SDS Computer grounding discovered during install. Cause: Grounding has been an issue in past computer system installations therefore there is a risk tha the same issue will arise with the installation of the new equipment. Impact: Both cost and schedule ofthe project would be impacted.	1	Active	Sorin Marinescu	P Sharawy	11-Apr-16	Mitigate	30-Jun-18	1	1	4	4	1	1	3	3		
<a href="#">13397</a>	Execution delays due to quality or fit-up of vault cooler components results in impact to cost and schedule [Window 64, 70]	Event: Vault Cooler components found to have quality issues making it necessary to perform re-work during installation. Cause: Quality or fit-up issues with Vault Cooler components. Impact: Both cost and schedule would be impacted if re-work had to be performed on the Vault Coolers.		Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Mitigate	31-May-17	2	1	2	4	1	1	2	2		
<a href="#">13399</a>	Vault Cooler Cat ID exceptions due to changes in material/design results in cost impact to material procurement [No Windows Related]	Event: Significant Cat ID tech specs, or drawings exceptions are found for vault cooler components. Cause: Changes in the material or design by the bendor since the original Cat ID was created Impact: Increased cost due to material/design changes	2	Active	Sorin Marinescu	Greg Maggs	11-Apr-16	Mitigate	31-May-16	2	2	2	4	1	2	2	2		
<a href="#">13464</a>	SDS Equipment Fails During Installation [Window 7]	Event: SDS Equipment fails during or before installation. Cause: All SDS computer components are being prcured at the same time therefore, by the time the parts are installed for U4 refurbishmnet they will have been in storage for 7 years creating a risk that they will fail when installed. Impact: The failure of the equipment will have an impact on both cost and schedule as replacement components will have to be procured and installed.	2	Active	Sorin Marinescu	P Sharawy	11-Apr-16	Mitigate	30-Jun-18	1	1	3	3	1	1	3	3		
<a href="#">14398</a>	unit temp power distribution (12 carts) co-ordination during execution	unit temp power dist system being installed by sdlu has 12 power carts located across unit . Install and remove only under po. No one is coordinated usage during execution when supplies will be lost to class 4 cyclic mtce. Also no one coordinating usage to prevent overloading and conflicts between venders on how has prioty. Also no one assigned to move cables when outages occuring	3	Active	Val Bevacqua	Tom Carvin	12-May-16	Accept	01-Sep-16	1	1	1	1	1	1	1	1		



ONTARIOPOWER  
GENERATION

Risk Report by Project with Associated Actions

Project: Steam Generators -																			
13450	SG Demobilization Activities Extended Due to Layup and Inspection Schedule [Window: 62]	EVENT: EPC vendor will need to carry resources (trades and PMT) for an extended duration in order to support SG demobilization activities at the end of the SG primary side maintenance window while IMS is executing work. CAUSE: Changes to the overall refurbishment schedule that are not driven by the EPC contractor. IMPACT: This could result in an extension to the baseline schedule and a significant cost increase to the project.	3	Active	Pejman Asgaripour	Mike Lutz	03-May-16	Mitigate	24-Jun-16	5	2	4	20	5	2	1	10		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5217	In Progress	Explore alternative options for PS demob and layup activities to reduce/elimnate holding costs for SG EPC vendor	Explore alternative options for PS demob and layup activities to reduce/elimnate holding costs for SG EPC vendor: -contract out PS demob activities (remove tent/scaffold, remove temp power, etc) to contractor working inside vault -Vendor to utilize terms of the Project Agreement, and coordinate trades sharing between other contractors to eliminate holding costs.	Pejman Asgaripour	Mike Lutz	31-Jul-16	Status update May 3, 2016: Primary Side civil demob activities will be performed by a subcontractor to BWXT. This should reduce risk associated with carrying costs for trades. To be confirmed once subcontractor agreement is in place. Agreement to allow trades sharing between vendors has not been implemented. This will be monitored up to execution as a cost savings opportunity, but base plan and funding for execution will not include this scenario.									
13415	Site services/support unavailable [Window 34, 37, 62, 34-132]	EVENT: Field services like electrical connections, water connections, layout areas, service air, breathing air, station provided PPEs, permitry, scaffolding area, and/or rad protection may not be available when required by the schedule. CAUSE: Two groups assigned to the same resource at the same time. Priority being given to other project groups to use services identified by the SG project. IMPACT: Delays to project schedule and/or increased costs.		Active	Pejman Asgaripour	Jennifer Nodwell	29-Apr-16	Mitigate	15-Oct-16	3	4	4	12	2	1	2	4		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			7016	Not Started	Provide SG project site requirements to refurb SPOCS	Provide site requirements from the Site Infrastructure Plan to Refurb SPOCS	Pejman Asgaripour		31-May-16										
13417	OPG Causes Delays to the Vendor Schedule due to Other Projects [Window 34, 37, 62, 104]	EVENT: OPG causes delays to the contractor's ability to execute the work in accordance with their schedule. CAUSE: OPG and / or the vendor for other refurbishment projects. IMPACT: This risk captures significant delays, change in outage dates.  This risk is to the overall SG project. Specific risks will be created as potential conflicts with other project's are identified during schedule reviews.		Active	Pejman Asgaripour	Jennifer Nodwell	29-Apr-16	Monitor	16-Mar-19	4	2	3	12	4	2	3	12		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			7594	In Progress	Participate in Window Integation Meetings	Participate in integration meetings for SG related windows in order to identify / mitigate pushes to the SG vendor's schedule based on other projects in the window. Ensure the necessary interface points are identified and coded in the schedule. Due date set to align with issuance of the Rev. 0 schedule (August 25/16)	Pejman Asgaripour	Jennifer Nodwell	31-Aug-16	Confirmed Window 37 interfacing projects: boiler blowdown, dry layup, Potential window 37 interfacing projects: adjuster rods, electrical maintenance, D1711, PIP inspections									
14158	Steam Generator Schedule impacts with Emergnecy Heat Sink (EHS) [Window 68]	Event: Steam Generator Primary Side Clean Window 062 is potentially impacted by a delay to Emergency Heat Sink (EHS) Window 068 CAUSE: Due to delay in Emergency Heat Sink (EHS) Window 068, the SG vendors will not be able to move from the west side boilers to the east side boilers IMPACT: Cost increases due to resource availability, schedule delays impacting the finish date of the Steam Generator Primary Side Clean Window 062, as well as, impacting the return to service since the Fuel Load is immediately succeeding the Steam Generator Primary Side Clean Window 062.	2	Active	Pejman Asgaripour	Melanie Lahti	29-Apr-16	Monitor	01-Aug-16	3	2	4	12	2	2	4	8		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5808	In Progress	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C Following the issue of DNRU2 Rev C, evaluate SG Project Primary Side Maintenance and Inspection window for changes and impact to execution strategy. -Window condensed, expanded, split -EPC Vendor or IMS conflicts with execution schedule date changes Additionally, -Review DNRU2 L1 IMS inspection window against IMS blackout chart to ensure IMS is not scheduled in conflict with Gen Plan commitments. Ensure issues are raised up to Refurb Outage Director.	Pejman Asgaripour	Mike Lutz	17-Jun-16										

[illegible]

13824	Window Related]	adhere to. IMPACT: This could lead to an increase in the EPC contract price.  This risk is identified based on recent project OPEX where new requirements for reporting frequency and execution schedule requirements have resulted in Contractor initiated change requests to increase the fixed price portion of the project.	6143	In Progress	Review New / Revised OPG Governance for Impact to SG Agreement	Review new / revised OPG governance that the refurbishment program requires the contractor to adhere in order to determine the impact to the SG agreement. Project change directives may be required for changes that impact the overall contract schedule and / or price.	Pejman Asgaripour	Mike Lutz	30-Jun-16	Dec. 22/15: On-going activity that will need to be revised as new requirements are issued.									
13968	Munter is Not Available for Bleed Cooler Inspection	EVENT: The risk is that a munter is not available for the bleed cooler inspection. CAUSE: Munter in use by other projects. IMPACT: Increase costs and / or schedule delays.		Active	Pejman Asgaripour	Mike Lutz	29-Apr-16	Mitigate	07-Oct-16	3	2	3	9	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			6145	In Progress	Determine Munter Availability During Bleed Cooler Inspection	During meeting with RP group it was identified that a munter would be required for the bleed cooler inspection. Need to determine munter availability when the bleed cooler inspection is scheduled.	Pejman Asgaripour	Mike Lutz	31-Jul-16	April. 29/16: Munter is available as per verbal agreement with Tommy Hansen at Deer Creek. A MOU is to be drafted in order to document the verbal agreement. Dec. 22/15: Action created. Due date set to align with assessing complete milestone.									
12317	Steam Generator Manway Manipulator Damaged or Not Available For Use [Window 34]	EVENT: Existing OPG steam generator primary head manway cover manipulators not available as required in the project schedule. CAUSE: Equipment is deployed on another unit planned or forced outage or it may have been damaged during a previous outage IMPACT: Delays in executing the SG primary side layup activities.	1	Active	Pejman Asgaripour	Mike Lutz	21-Apr-16	Mitigate	07-Dec-16	4	1	2	8	5	2	1	10		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			7017	In Progress	Finalize DRAS for manipulators	Finalize DRAS for manipulators and receive approval from stakeholders	Pejman Asgaripour	Mike Lutz	16-May-16	DRAS 758 prepared and reviewed. To be finalized by May 12, 2016 and used as a supporting document for CCF #898									
			7019	Not Started	Recieve funding for Manipulators through CCF	Recieve funding for Manipulators through CCB	Pejman Asgaripour	Mike Lutz	25-May-16										
			7020	Not Started	Prepare Mod Design Package for Manipulators	Prepare Mod Design Package for Manipulators via OPG or OSS.	Pejman Asgaripour	Mike Lutz	25-May-16										
			7021	Not Started	Complete PCD for Manipulators	Complete PCD for Manipulators	Pejman Asgaripour	Mike Lutz	09-Jun-16	Complete PCD for Manipulators									
13729	Non-adherence to chemistry specified cleanliness requirements during field execution [Window 34, 37, 62]	EVENT: The contractor does not adhere to cleanliness requirements during field execution.  CAUSE: Lack of adherence to cleanliness requirements by the contractor during field execution.  IMPACT: Negative impact to the plant's system chemistry.	2	Active	Pejman Asgaripour	Jennifer Nodwell	29-Apr-16	Monitor	30-Jul-17	2	4	1	8	1	4	1	4		
			There are no Not Started, In Progress Actions associated with the risk.																
14236	Access Port Installation Introduces Coolant into the SGs [Window 37]	EVENT: Coolant is introduced into the SGs during Access Port Installation CAUSE: 1) Coolant is not diluted enough 2) Inadequate human performance 3) Incorrect work processes IMPACT: Delay to the schedule in order to potentially refill and re-drain the boilers in order to meet chemistry requirements		Active	Pejman Asgaripour	Jennifer Nodwell	08-Apr-16	Mitigate	31-Jul-17	4	2	1	8	4	1	1	4		
			There are no Not Started, In Progress Actions associated with the risk.																
12461	Inadequate Quality Control on PSC control software [Window 62]	EVENT: Improper tracking of blast plan and inability to monitor pressure and duration setpoints during primary side cleaning of the SGs. CAUSE: PSC system control software not tested and controlled prior to execution. IMPACT: Blasting of the same tubes more than intended and / or blasting of small radius tube regions at a higher pressure setpoint than what is qualified. This could result in tube damage.	1	Active	Pejman Asgaripour	Mike Lutz	29-Apr-16	Mitigate	01-Oct-16	3	2	2	6	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			3679	In Progress	Inadequate Quality Control for PSC Control Software	-Software Validation on mockup (test failure modes and cleaning sequence) -Implement Procedural controls for software changes/modifications prior to and during execution	Pejman Asgaripour		05-Aug-16										
	Foreign Material Enters Steam Generator- SSC [Window 37]	EVENT: Foreign materials is introduced into station systems during waterlancing and access port installation CAUSE: Inadequate human performance. work processes and / or design features.		Active	Pejman Asgaripour	Jennifer Nodwell	29-Apr-16	Mitigate	30-Dec-19	3	2	2	6	1	1	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									





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13302		IMPACT: Additional cost and schedule for FME retrieval																		
			<a href="#">1379</a>	In Progress	Provide Oversight in procedural development, tooling design and contractor training	Provide Oversight in procedural development, tooling design and contractor training	Pejman Asgaripour	Mike Lutz	01-Feb-17											
			<a href="#">1380</a>	In Progress	Include mock-up evaluation for tooling/training to ensure FME processes work	Include mock-up evaluation for tooling/training to ensure FME processes work	Pejman Asgaripour	Jennifer Nodwell	01-Feb-17											
			<a href="#">1381</a>	Not Started	Provide adequate field presence during critical evolutions during execution	Have adequate field presence during critical evolutions where FME risks are high during execution	Pejman Asgaripour	Jennifer Nodwell	16-May-19											
13411	Steam Generator does not meet dryness criteria as requested by SNC Lavalin [Window 62]	EVENT: Steam generator does not meet the dryness criteria requestedby SNC Lavailin potentially cause by OPG not providing a dry SG to the contractor. CAUSE: Drying performed by layup contractor does not sufficiently dry the steam generator. IMPACT: Schedule delays while waiting for additional drying to be performed. Additional costs for crews waiting for access to the SG.		Active	Pejman Asgaripour	Mike Lutz	29-Apr-16	Monitor	15-Aug-18	2	1	3	6	1	1	1	1			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			<a href="#">5227</a>	In Progress	Confirm dryness specification are met from SG Primary side layup	This is action is too ensure SG Primary side meets dryness crteria required for most effective primary side cleaning, and add task in schedule to confirm dryness criteria is met at T-9.	Deepak Dhar	Mike Lutz	31-May-16	March 8, 2016 - ES Fox temporary equipment monitoring oproject will monitor dryness of SGs. Work Orders and schedule are in prgress of being assessed. once this is finalized, SG Project to communicate with ES Fox to ensure SG dryness criteria is met and maintained prior to SG maintenance window.  OPEX from pt. lepreau indicated that vac dry was sufficient for drying. SG will be undergoing addiitonal layup dry.Follow up with layup to determine if they will be monitoring humidity levels, and confirm their target is achieved and maintained per the design requirements.										
13416	Workplace congestion during refurb [Window 34, 37, 64, 104]	EVENT: Workplace congestion due to other project groups causes changes to the detailed plan for the SG project. CAUSE: Other project groups using laydown areas assigned to the SG project. Laydown areas not correctly identified by the project. IMPACT: Delays to the project schedule and/or increased project costs		Active	Pejman Asgaripour	Jennifer Nodwell	21-Apr-16	Mitigate	14-Oct-16	3	1	2	6	1	1	2	2			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			<a href="#">5808</a>	In Progress	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C Following the issue of DNRU2 Rev C, evaluate SG Project Primary Side Maintenance and Inspection window for changes and impact to execution strategy. -Window condensed, expanded, split -EPC Vendor or IMS conflicts with execution schedule date changes Additionally, -Review DNRU2 L1 IMS inspection window against IMS blackout chart to ensure IMS is not scheduled in conflict with Gen Plan commitments. Ensure issues are raised up to Refurb Outage Director.	Pejman Asgaripour	Mike Lutz	17-Jun-16											

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11278			<a href="#">1810</a>	Not Started	Access Port installation tooling is to be demonstrated on mock-up prior to field execution	Access Port installation tooling is to be demonstrated on mock-up prior to field execution	Pejman Asgaripour	Jennifer Nodwell	01-Jul-16									
			<a href="#">1811</a>	In Progress	Access Port installation procedure to address work stopage/backout provisions if tolling is not operating as designed.	Access Port installation procedure to address work stopage/backout provisions if tooling is not operating as designed.	Pejman Asgaripour	Jennifer Nodwell	15-Oct-16									
			<a href="#">1812</a>	Not Started	Workers to be trained to operate tooling on mockup, before being approved to execution work at the station	Workers to be trained to operate tooling on mockup, before being approved to execution work at the station	Pejman Asgaripour	Mike Lutz	01-Feb-17									
11925	Foreign Material Enters Steam Generator-PSC [Window 34, 62]	EVENT: Foreign materials are introduced into station systems during divider plate inspections, bunge install, and IMS inspections CAUSE: Inadequate human performance, work processes and design features. IMPACT: Cost and schedule impacts for FME retrieval and / or additional tube plugging.	1	Active	Pejman Asgaripour	Mike Lutz	29-Apr-16	Mitigate	15-Jan-17	2	2	2	4	1	1	2	2	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">1379</a>	In Progress	Provide Oversight in procedural development, tooling design and contractor training	Provide Oversight in procedural development, tooling design and contractor training	Pejman Asgaripour	Mike Lutz	01-Feb-17									
			<a href="#">1380</a>	In Progress	Include mock-up evaluation for tooling/training to ensure FME processes work	Include mock-up evaluation for tooling/training to ensure FME processes work	Pejman Asgaripour	Jennifer Nodwell	01-Feb-17									
			<a href="#">1381</a>	Not Started	Provide adequate field presence during critical evolutions during execution	Have adequate field presence during critical evolutions where FME risks are high during execution	Pejman Asgaripour	Jennifer Nodwell	16-May-19									
12467	Risk of Vendor Default/ Business Continuity [No Window Related]	The risk is that the vendor is unable to meet the contractual obligations due to vendor default.	3	Active	Pejman Asgaripour	Jennifer Nodwell	21-Apr-16	Accept	16-Oct-16	1	3	4	4	1	3	4	4	
			There are no Not Started, In Progress Actions associated with the risk.															
13460	IMS Holding Costs during SG Primary Side Inspections [Window 62]	EVENT: During the SG primary side maintenance and inspection window, IMS encounters delays in being able to execute their work. CAUSE: Delays from the predecessor primary side cleaning work. or other vendor's scope (RFR, etc). IMPACT: IMS will be utilizing contract staff. IMS may incur substantial holding costs.	1	Active	Pejman Asgaripour	Mike Lutz	21-Apr-16	Accept	04-Jun-19	2	1	2	4	2	1	2	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">5808</a>	In Progress	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C Following the issue of DNRU2 Rev C, evaluate SG Project Primary Side Maintenance and Inspection window for changes and impact to execution strategy. -Window condensed, expanded, split -EPC Vendor or IMS conflicts with execution schedule date changes Additionally, -Review DNRU2 L1 IMS inspection window against IMS blackout chart to ensure IMS is not scheduled in conflict with Gen Plan commitments. Ensure issues are raised up to Refurb Outage Director.	Pejman Asgaripour	Mike Lutz	17-Jun-16									

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11928	Activity Loading Exceeds Limits [Window 62]	shielding flask design/selection. IMPACT: Cleaning execution delays or incomplete cleaning and the need to store wastes on site until repackaging for shipment within license limits for activity.															
			1383	In Progress	Investigate location for temporary storage for containers	Investigate location for temporary storage for containers.	Pejman Asgaripour	Mike Lutz	30-Jun-16	Feb. 26/16: Changed action due date to end of June Jan 27, 2016: SATM request for EFFA laydown area in progress. Refurb Waste Management supporting MOU with station identifying waste container laydown requirements for PSC. Dec. 18/15: Plans for radioactive material shipments being finalized. Due date moved to align with the assessing complete milestone (April 15/16) refurb Ops/maint issued a refurb radioactive storage assessment. Sg has provided input on what's req'd for this project. As the final options for radioactive material storage prior to offsite shipment has not been determined, this action cannot close.							
12460	Inadequate Quality Control for Waterlancing Control Software [Window 37]	EVENT: Honing issues, system shutoff parameters, and / or repeat lane visits during waterlancing of the steam generator. CAUSE: Inadequate control of the waterlancing control software. IMPACT: Inadequate sludge removal and / or steam generator asset damage.	1	Active	Pejman Asgaripour	Jennifer Nodwell	21-Apr-16	Mitigate	29-Aug-16	1	2	3	3	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			3677	In Progress	Inadequate Quality Control for Waterlancing Control Software	Inadequate control on Waterlancing control software could result in homing issues, system shutoff parameters, and repeat lane visits leading to: -Asset Damage (Damage to tubes) -Inadequate Sludge Removal	Pejman Asgaripour		05-Aug-16								
13398	Execution Quality-CWP & ITPs are in compliance with vendor's quality program [No Window Related]	EVENT: The contractor performs execution activities without a robust CWPs and ITPs. This could lead to damage to the Steam Generators, ineffective cleaning, or loss of FME controls. CAUSE: The contractor does not properly execute the work. IMPACT: Damage to the Steam Generators, ineffective cleaning and / or loss of FME controls. This could lead to increased costs and schedule delays.		Active	Pejman Asgaripour	Mike Lutz	03-May-16	Mitigate	30-Jun-16	1	3	3	3	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6141	In Progress	Perform Oversight of SG Contractor's CWPs	Perform oversight of the SG contractor's CWPs and ITPs to ensure they meet the contractor's Qa program and OPG's expectations. Oversight should be performed on documents prepared by both BWXT and Candu Energy.	Pejman Asgaripour	Jennifer Nodwell	31-May-16	Mar. 31/16: Due date moved to April 20 March 29/16: Oversight being performed and observations recorded in the oversight log. Due date moved to April 15/16 to align with the milestone for completion of the CWPs. Step one approved.							
	Changes to SG Primary Side Inspection window may conflict with IMS support	EVENT: IMS have committed to the original Refurbishment inspection window in order to coordinate support for Pickering and Darlington Planned outages (per IMS blackout dates). As the window moves. it may conflict with the planned outaage blackout dates resulting in resource conflicts for	2	Active	Pejman Asgaripour	Mike Lutz	29-Apr-16	Monitor	01-Aug-16	3	1	1	3	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

13975	during Darlington and Pickering Planned Outages [Window 62]	Refurbishment and Planned Outages. CAUSE: Changes to the SG primary side inspection and maintenance window as work control finalizes and refines the DNRU2 Level 1 Schedule IMPACT: IMS resources not available as required by the SG project. Additional costs to the projects and delays to the execution window	5808	In Progress	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C Following the issue of DNRU2 Rev C, evaluate SG Project Primary Side Maintenance and Inspection window for changes and impact to execution strategy. -Window condensed, expanded, split -EPC Vendor or IMS conflicts with execution schedule date changes Additionally, -Review DNRU2 L1 IMS inspection window against IMS blackout chart to ensure IMS is not scheduled in conflict with Gen Plan commitments. Ensure issues are raised up to Refurb Outage Director.	Pejman Asgaripour	Mike Lutz	17-Jun-16								
			5809	Not Started	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev 0	Following the issue of DNRU2 Rev 0, evaluate SG Project Primary Side Maintenance and Inspection window for changes and impact to execution strategy. -Window condensed, expanded, split -EPC Vendor or IMS conflicts with execution schedule date changes Additionally, -Review DNRU2 L1 IMS inspection window against IMS blackout chart to ensure IMS is not scheduled in conflict with Gen Plan commitments. Ensure issues are raised up to Refurb Outage Director.	Pejman Asgaripour	Mike Lutz	17-Aug-16								
14356	SG vendor P6 schedule is lost or unavailable [No Window Related]	EVENT: SG vendor is using the OPG schedule and is unable to maintain a backup in the event of a system crash, leading to the schedule being lost CAUSE: P6 Software crashes IMPACT: Potential costs and delay to the schedule to recover the schedule		Active	Pejman Asgaripour		29-Apr-16	Mitigate	17-Aug-16	1	1	3	3	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6808	Not Started	Investigate schedule backup protocols and processes	Investigate with program schedule backup protocols and processes	Melanie Lahti		31-May-16								
11959	Steam Generator Legacy Foreign Material Cannot Be Removed [Window 37]	EVENT: Steam Generator Vendor FME removal tooling may not be able to support the removal of all known legacy foreign material in hard to reach regions of the steam generator. CAUSE: Legacy FME located in a hard to reach region of the SG that the contractor's tool can't reach. IMPACT: This will result in additional FME tooling development by the vendor or engineering to disposition leaving material in the SG.	3	Active	Pejman Asgaripour	Jennifer Nodwell	21-Apr-16	Mitigate	15-Jan-17	2	1	1	2	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			1899	In Progress	FME Plans and Controls in Place Prior to Field Execution	FME plans and controls in place prior to field execution. includes having a process flowchart on steps to build a new tool for "must retrieve" FME that includes authorization to use.	Pejman Asgaripour	Jennifer Nodwell	15-Oct-16	FME contingency approach identified via e-mail August 28th. Further work to follow. FME contingency plan will be an appendix to future CWP for secondary side work.							
			2659	In Progress	FME contingency plan	BWC to create SG secondary side FME contingency plan. CEI will need a more basic plan given PHT bung and nature of FME risks. Plan needs to address IMS FME plan level as well.	Pejman Asgaripour	Jennifer Nodwell	30-Jun-16	May 12, 2016: Vendor FME process currently under review with OPG. Due date moved to June 30, 2016. Initiator changed from Amir to Mike since system will not allow past employee.							
13412	Work area restrictions due to Hot Particle [Window 62]	EVENT: Work area restrictions due to high radiological conditions. CAUSE: Hot particle being trapped in the primary side clean system or SG. IMPACT: Schedule delays, costs, and increased dose to crew.		Active	Pejman Asgaripour	Mike Lutz	21-Apr-16	Monitor	15-Oct-16	1	1	2	2	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6144	In Progress	Known Hot Particle Information for Steam Generators	Obtain Dose Data from OPG for any known Hot Particles before each unit outage.	Pejman Asgaripour	Mike Lutz	14-Oct-16	Dec. 22/15: Due date set as start of refurbishment outage. This may need to be revised.							



ONTARIOPOWER GENERATION Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

<a href="#">13418</a>	Defects in the Shell [Window 37]	EVENT: Will require redesign of port location or require a repair before proceeding. CAUSE: Defects identified in the shell during mag particle and UT scans. IMPACT: This could lead to significant schedule delays and cost impact.		Active	Pejman Asgaripour	Jennifer Nodwell	21-Apr-16	Mitigate	01-Oct-16	1	1	2	2	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6140</a>	Not Started	Review Results of UT Scans of the SG Shell	UT scans are scheduled as a pre-req to the installation of the access ports to check for defects in the SG shell. The results of the UT scans need to be reviewed by OPG to confirm that the planned access port location is acceptable.	Pejman Asgaripour	Jennifer Nodwell	30-Jan-17	Dec. 22/15: Due date of Jan. 30/17 based on the current project schedule. This will need to be confirmed once rev. 0 of the program schedule is released.								
<a href="#">11989</a>	IMS Unable to Support Steam Generator Inspections [Window 37, 62, 104]	EVENT: IMS is unable to support steam generator inspections as scheduled during refurbishment CAUSE: IMS has schedule conflict due to the need to support other planned, forced, or external business activities. IMPACT: Delays to the refurbishment steam generator execution window and additional costs.	1	Active	Pejman Asgaripour	Mike Lutz	21-Apr-16	Monitor	01-Aug-16	1	1	1	1	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">1919</a>	In Progress	Via IMS workforce planning, determine if potential resource conflicts exist for future work, determine impacts and prevent cost creep.	Via IMS workforce planning, determine if potential resource conflicts exist for future work, determine impacts and prevent cost creep.	Pejman Asgaripour	Mike Lutz	30-Oct-16									
<a href="#">13919</a>	PSC - CWP completion far in advance of execution date may result in CWP revisions/rework [No Window Related]	EVENT: Changes are required to the CWP's based on validation testing performed by the contractor prior to field execution. CAUSE: OPG imposing early CWP completion date for PSC CWPs and procedures. IMPACT: Re-work to the CWP's which will be an extra cost to the project. CWP will be aproved in April. The validation testing will take place following CWP approval. It does not get executed until 2018	1	Active	Pejman Asgaripour	Mike Lutz	29-Apr-16	Accept	08-Oct-17	1	1	1	1	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6142</a>	Not Started	Determine Impact of Validation Testing on PSC CWP	The CWP for primary side clean is being prepared in advance of validation testing at the contractor's facility. Post validation testing the approved CWP needs to be reviewed to determine if the results of the validation testing drives any changes to the CWP.	Pejman Asgaripour	Mike Lutz	25-Nov-16	Dec. 22/15: Need to revise completion date to align with completion of the validation testing.								
<a href="#">14357</a>	Contractor Field Staff Impact Station Operations [Window 34, 37, 62, 104]	EVENT: Contractor field staff negatively impact station operations CAUSE: Lack of contractor awareness of impact to station operations during field execution IMPACT: Delay to the station schedule April 13, 2016: Risk raised based on OPEX from Service Air project		Active	Pejman Asgaripour		29-Apr-16	Mitigate	31-May-16	1	1	1	1	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6800</a>	In Progress	Assess station operations which the SG project impacts	SG project to assess which station operations the project can impact. Once these are known, separate risk and actions will be created for those operations	Waleed Ahmed		31-May-16									
<a href="#">14358</a>	Contractors Field Staff Not Prepared To Perform Field Work [Window 34, 37, 62, 104]	EVENT: Contractor field staff are not prepared (knowledge, experience) to perform field work CAUSE: Contractor field staff lack required qualifications RESULT: Delay to the execution schedule and rework Risk raised on OPEX based on the VVRS project		Active	Pejman Asgaripour		29-Apr-16	Mitigate	01-Mar-17	1	1	1	1	1	1	1	1	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			<a href="#">6799</a>	Not Started	Perform oversight of training records prior to execution	Perform oversight of training records prior to execution	Mike Lutz		31-Jan-17									
Project: Steam Generators - IR																		
	PSC Execution Window Extended as a Result of Integrating Schedule with	EVENT: Baseline execution window for primary side clean work impacted and extended. CAUSE: Schedule integration between multiple work groups performing work during the SG primary side window, including IMS and other projects.	3	Active	Pejman Asgaripour	Mike Lutz	21-Apr-16	Monitor	01-Aug-16	5	2	4	20	4	2	4	16	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								

ONTARIOPOWER  
GENERATION

Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
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Data Refreshed: 12-May-16 10:30 PM

13448

Other Work Groups

IMPACT: This will impact SG critical path and result in additional costs to the project.

5808	In Progress	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C Following the issue of DNRU2 Rev C, evaluate SG Project Primary Side Maintenance and Inspection window for changes and impact to execution strategy. -Window condensed, expanded, split -EPC Vendor or IMS conflicts with execution schedule date changes Additionally, -Review DNRU2 L1 IMS inspection window against IMS blackout chart to ensure IMS is not scheduled in conflict with Gen Plan commitments. Ensure issues are raised up to Refurb Outage Director.	Pejman Asgaripour	Mike Lutz	17-Jun-16	
5809	Not Started	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev 0	Following the issue of DNRU2 Rev 0, evaluate SG Project Primary Side Maintenance and Inspection window for changes and impact to execution strategy. -Window condensed, expanded, split -EPC Vendor or IMS conflicts with execution schedule date changes Additionally, -Review DNRU2 L1 IMS inspection window against IMS blackout chart to ensure IMS is not scheduled in conflict with Gen Plan commitments. Ensure issues are raised up to Refurb Outage Director.	Pejman Asgaripour	Mike Lutz	17-Aug-16	

Project: Steam Generators - PC

13448	PSC Execution Window Extended as a Result of Integrating Schedule with Other Work Groups	EVENT: Baseline execution window for primary side clean work impacted and extended. CAUSE: Schedule integration between multiple work groups performing work during the SG primary side window, including IMS and other projects. IMPACT: This will impact SG critical path and result in additional costs to the project.	3	Active	Pejman Asgaripour	Mike Lutz	21-Apr-16	Monitor	01-Aug-16	5	2	4	20	4	2	4	16	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			5808	In Progress	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C	Assess SG Primary Side Execution Window Changes - DNRU2 Level 1 Rev C Following the issue of DNRU2 Rev C, evaluate SG Project Primary Side Maintenance and Inspection window for changes and impact to execution strategy. -Window condensed, expanded, split -EPC Vendor or IMS conflicts with execution schedule date changes Additionally, -Review DNRU2 L1 IMS inspection window against IMS blackout chart to ensure IMS is not scheduled in conflict with Gen Plan commitments. Ensure issues are raised up to Refurb Outage Director.	Pejman Asgaripour	Mike Lutz	17-Jun-16									



12 first time evolution in the

1302		CAUSE: The unavailability of validated procedures for first time maintenance activities presents some level of unknowns. IMPACT: This can potentially result in adverse cost/schedule/quality impact.																
11217	TG- Lack of skilled and experienced EPC Vendor Staffing [Window 61, 100]	EVENT: Lack of Skilled and experienced craft labour, QC and supervision resources in Definition, Planning and Execution phases for TG project for performing the work as per schedule with sufficient quality; avoiding any potential rework. CAUSE: Ability of vendor to hire the experienced and skilled personnel and the unavailability of experienced and skilled personnel. IMPACT: Potential rework that can impact cost and schedule.	1	Active	Peter Moore	Todd Josifovski	12-Apr-16	Mitigate	31-Oct-16	2	2	4	8	1	2	3	3	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			2332	In Progress	Project will conduct oral review board to assess the capability and experience of the all trades supervision.	Given known lack of turbine / generator experienced craft labour resources, in Canada and globally, the action is to investigate potential augmenting of JV craft labour with OPGturbine crew support and resources to participate in install/commissioning forcross pollination of this specialty knowledgeto the JV resources, and also to assistturbine crew in terms of hands on training to prepare for future AFS/turnover.	Peter Moore	Dave Owens	12-Dec-16									
13309	TG Crane, all lifting Equipment and Tools Availability and Capability. Ie. Slings, lifting tools [Window 61,100]	EVENT: The condition of the crane is degraded to a point where it cannot support the requirements of the TG project. Due to the condition of the crane there is a possibility of performing standard maintenance, incremental maintenance or a modification to the crane in order to meet the TG project requirement. OPEX on similar installation has shown that the crane would require modification in order to meet the load demand required for this turbine work. CAUSE: Additional aspects is the residual reliability risk of the TH Crane after refurbishment. If the TH Crane experience any break down during the critical path of the TG window, cost and schedule will be negatively impacted. Also, there is a risk related to plant integration, related to any forced outages or other station emergency requirements to use the cranes which may supersede TG Project needs, resulting in negative impact to cost and schedule. IMPACT: This event can lead to cost and schedule impact.	1	Active	Peter Moore	Todd Josifovski	13-May-16	Mitigate	30-Sep-16	2	3	4	8	2	3	4	8	
			There are no Not Started, In Progress Actions associated with the risk.															
13446	TG - Material delays due to incomplete documentation, wrong material or improper storage [No Window Related]	EVENT: Alstom may not be able to provide pedigree documentation that JV requires for completion of receipt inspection of OEM supplied materials activities in accordance with JV's Quality Assurance Program. This can lead to materials not being released on time from the JV's warehouse. CAUSE: This risk might occur due to the OEM not following QA, improper material or quantiites, or documentation missing from sub-vendors or due to human error.In addition, the risk is also JV non-compliance with storage requirements conditions of Alstom parts, resulting in parts that cannot be used, or additional analysis must be performed resulting in delays. This risk may also occur due to OPG cat id documentation not being correct / up to date, causing delays or rework in Alstom or JV ordering materials, or rework in drawings or documentation. IMPACT: This can lead to schedule impact due to materials being unavailable	3	Active	Peter Moore	Mina Boghdady	11-May-16	Mitigate	30-Oct-16	2	1	4	8	1	1	3	3	
			There are no Not Started, In Progress Actions associated with the risk.															
13531	TG Risk of Schedule Delay / Cost Due to OPG and Vendor Handoffs / Dependent Activities [Window 61,100]	EVENT: Due to multiple vendor handoffs, the TG contacting strategy has been optimized to reflect strengths of vendors and internal OPG groups involved. CAUSE: Late or incomplete handoffs, or late completed activities may result in delay or rework by other vendors or OPG groups.These contactors are in a very high demand therefore if they are let go there is high chance we might not be able to rehire them on time. Project also might not be able to redeploy this resources on another project. IMPACT: However the risk is that there will be schedule delay or additional costs due to the multiple handoffs / dependent activities between OPG / Alstom / JV / IMS.	1	Active	Peter Moore		11-May-16	Monitor	01-Dec-16	2	3	4	8	2	3	4	8	
			There are no Not Started, In Progress Actions associated with the risk.															
13575	Stator Mid Section transportation risk [No Window Related]	EVENT: As part of the TG scope of work a new generator stator mid section is being procured. CAUSE: The transportation of the stator mid section is currently in the ESES scope. However a risk is imposed that infrastructural upgrades (St. Mary's Cement Dock, Gravel road connection, etc.) are required to complete the stator transportation. IMPACT: The infrustructure upgrade will impact cost.	1	Active	Peter Moore		11-May-16	Accept	01-Dec-16	4	2	1	8	4	2	1	8	
			There are no Not Started, In Progress Actions associated with the risk.															
1	TG - IMS work window for TG could coincided with their blackout dates	EVENT: IMS has been hired by the refurb organization to perform inspection on the Turbine Generator and Auxiliaries. CAUSE: The fluidityv of Refurb execution schedule is posina a risk since IMS work window for TG	1	Active	Peter Moore		11-May-16	Monitor	30-Sep-16	2	1	4	8	2	1	4	8	
			There are no Not Started, In Progress Actions associated with the risk.															

<a href="#">3973</a>	[Window 61]	could coincided with their blackout dates that IMS has identified for support of planned outages in PNGS and DNGS as part of generation plan initiative. IMPACT: There is significant impact on schedule that might occur. The SG bundle and TG project could fall into the same category.																
<a href="#">14030</a>	TG - New Stator Midsection risk [No Window Related]	EVENT: The TG project is procuring a new stator to be used on U3 generator from Alstom. The new stator is specified and expected to be delivered on site as a direct replacement item. CAUSE: There is a risk that the new stator can arrive at the darlington site not with the right components and the design does not have the correct specification. Therefore the stator functionality and operability is not similar to the original. IMPACT: This will lead to great schedule and cost impact.	3	Active	Peter Moore		31-Aug-16	Mitigate	31-Aug-16	2	2	4	8	1	1	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">11221</a>	TG Risk of Schedule delay due to inefficient vendors cooperation/interface [No Window related]	EVENT: The selected vendor may not obtaining, or not obtaining on time, technical information from the ESES required to support the T/G work due to lack of EPCs ability to obtain required information from ESES. CAUSE: Inability to answer/excessive response time RFI's from EPC. IMPACT: There might be schedule delay and additional cost	3	Active	Todd Josifovski	Peter Moore	13-May-16	Mitigate	13-Jun-16	2	2	3	6	1	1	2	2	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			2229	In Progress	TG Trubine Control Replacement	Work with vendors to establish an resoucetransition plan to retain skilled workers during low peak and unlapping.	Todd Josifovski	Peter Moore	30-Oct-16	The preparation of the strategy plan is currently in progress.								
<a href="#">11250</a>	TG Discovery work scope caused by inspections with impact on long lead items or major repairs [Window 61]	EVENT: The risk is that parts/resources for contingent (inspection based) work is not readily available when needed to support TG objectives or when major repairs are required. CAUSE: Following inspections, material lead time is evaluated against recommended contingent work and adverse schedule impact may result. (such as thyristor inspection but not including major items such as Stress Corrosion Cracking on the Turbine Rotor) IMPACT: It will affect greatly affect the TG window risking to make it a critical path.	1	Active	Todd Josifovski	Peter Moore	13-May-16	Monitor	29-Dec-17	2	3	3	6	2	3	3	6	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">11965</a>	TG - Risk of EPSCA Costs Above Current Estimate [Window 61, 100]	EVENT: There is a large number of craft, technical or supervision labor required for this refurbishment project. CAUSE :The risk is that upon hiring craft, technical or supervision labour, a greater percentage of workers than estimated must be drawn from beyond the range that requires maximum per diems (lodging etc.). IMPACT: Resulting in greater expenditures than estimated.	1	Active	Todd Josifovski	Pejman Asgaripour	13-May-16	Monitor	31-Oct-16	3	2	1	6	3	2	1	6	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			2247	In Progress	TG Risk of EPSCA Costs above current estimate	EPC and OPG to Monitor labour market conditions and ensure contingency values are in place to support any increase that may be required to bring resouces in from out of province if necessary.	Todd Josifovski	Pejman Asgaripour	30-Jun-16	In progress along with RQE road								
<a href="#">12401</a>	Misunderstanding the requirements, or errors in vendor's submittals to OPG. [No Window Related]	EVENT: Vendor is submitting a large number of documents to OPG. The requirements for this deliverables are listed in the VOIR interface requirements. CAUSE: Vendor may misunderstand VOIR interface requirements, requirements for integration, or requirements (deliverables) of the contract and there can be quality and level of errors on vendor's submittals to OPG for review. IMPACT: There is a potential delay in completing the milestone and can impact the schedule.	3	Active	Peter Moore	Ken Russell	13-May-16	Monitor	30-Jun-15	2	2	3	6	2	2	3	6	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">13443</a>	TG – Risk of Ability to Implement OPG Project Team Resourcing Assumptions [No Window Related]	EVENT: In support of 4D estimating in 2014, TG implemented a variable resourcing profile for OPG core project management personnel, assuming that personnel could be ramped up and down as dictated by the Refurbishment outage schedules and work profile. CAUSE: Due to considerations of maintaining project team continuity, this resourcing profile cannot be realized or can only be partially realized. IMPACT:The impact would be increased cost to the project.	1	Active	Peter Moore		11-May-16	Monitor	31-Dec-17	3	2	1	6	3	2	1	6	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">14112</a>	TG- in situ retaining ring inspection [Window 61]	EVENT: There is a high possibility of GE to implement in situ retaining ring inspection. CAUSE: Due to the unavailability of power sources in the plant to remove the retaining ring for inspection. GE, OPG and JV are discussing various method of performing the retaining ring inspection. IMPACT: This inspection has the potential to carry extra cost for OPG.	3	Active	Peter Moore	Marcel Fiterau	15-Jun-16	Accept	15-Jun-16	3	2	1	6	3	2	1	6	
			There are no Not Started, In Progress Actions associated with the risk.															
<a href="#">1</a>	TG - GE to incorporate comments of stator third partv review INo Window	EVENT: GE is producing a new stator mid section and producing the technical specification of this product. CAUSE: GE has already incorporated OPG's comments on the U3 Generator Stator technical	4	Active	Peter Moore		11-May-16	Monitor	31-May-16	2	2	3	6	2	2	3	6	
			There are no Not Started, In Progress Actions associated with the risk.															



ONTARIOPOWERGENERATION

Risk Report by Project with Associated Actions

130	100]	CAUSE: There is a risk that the contractor may not adhere to cleanliness requirements during field execution that may adversely impact plant's system chemistry. IMPACT: This had the potential to have a cost and schedule impact on the project.															
Project: Turbine Generator - 73273																	
13863	Turbine Controls / Excitation Controls / Hydraulics unexpected issues/delays in static or dynamic commissioning [No window related]	EVENT: The modification to be implemented, the turbine controls, excitation controls and hydraulic controls are being upgraded. This new modification will be tested during static and dynamic commissioning. IMPACT: There is various unexpected issues that can occur during the static or dynamic commissioning from schedule window delay to the whole system not functioning or behaving as expected. CAUSE: This can lead to a big impact on the cost, schedule and might delay the entire refurbishment of U3.	1	Active	Peter Moore		11-May-16	Mitigate	01-Jul-21	3	3	2	9	2	2	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Turbine Generator - 73272																	
14407	TG - FOAK Cost and schedule impact due to high voltage bushings and current transformers replacement [WINDOWS 61]	EVENT: The high voltage bushings and transformers haven't been replaced since installation in original turbine generator set erection. CAUSE: Due to this being a first of a kind work, particular concern are: 1. Size/Weight, tight working space and lack of experience with the required tooling 2. CT Wiring Connections correct installation and quality control 3. HV Bushing Replacement and potential damage to spare bushing used for mock-up 4. IPB Disassembly, first time evolution (FME, control of parts, spares, mechanical joints, broken parts). IMPACT: Unknown factors in the replacement of high voltage bushings and transformers could impact the cost and schedule for the generator portion of TG refurbishment scope.	2	Active	Peter Moore	Arber Puci	11-May-16	Mitigate	30-Sep-16	2	2	4	8	1	1	3	3
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Turbine Generator - 73277																	
14410	TG - FOAK LP Spindles Removal for U2 refurbishment [WINDOW 61]	EVENT: Due to the legacy strategy of maintenance in place the LP spindles have not been removed since turbine generator set erection. The scope also requires first time complete disassembly work on the intercept valves. Of particular concern are: 1) Tooling 2) Uncoupling of turbines 3) Testing/Commissioning 4) Resource Challenges 5) Lifting Equipment 6) Procedures 7) Discovery Work 8) OPG unsuccessfully attempttd to disasseble these intercept valves before. CAUSE: This is a first of a kind work conducted with a high potential for risk. IMPACT: These tasks could involve impacts to cost/schedule if not planned adequately or executed as planned.	1	Active	Peter Moore	Mina Boghdady	11-May-16	Mitigate	30-Sep-16	3	4	4	12	2	3	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
14407	TG - FOAK Cost and schedule impact due to high voltage bushings and current transformers replacement [WINDOWS 61]	EVENT: The high voltage bushings and transformers haven't been replaced since installation in original turbine generator set erection. CAUSE: Due to this being a first of a kind work, particular concern are: 1. Size/Weight, tight working space and lack of experience with the required tooling 2. CT Wiring Connections correct installation and quality control 3. HV Bushing Replacement and potential damage to spare bushing used for mock-up 4. IPB Disassembly, first time evolution (FME, control of parts, spares, mechanical joints, broken parts). IMPACT: Unknown factors in the replacement of high voltage bushings and transformers could impact the cost and schedule for the generator portion of TG refurbishment scope.	2	Active	Peter Moore	Arber Puci	11-May-16	Mitigate	30-Sep-16	2	2	4	8	1	1	3	3
			There are no Not Started, In Progress Actions associated with the risk.														
	TG - FOAK Generator Stator drain and dry during U2 refurbishment [Window 61]	EVENT: The generator stator is infrequently drained, and has never been vacuum dried. This will have to be completed as part of the TG refurbishment scope. CAUSE: This is a First of a Kind Work Cost. of particular concern are:	1	Active	Peter Moore	Arber Puci	11-May-16	Mitigate	25-Jan-17	2	3	4	8	1	2	2	2
			There are no Not Started, In Progress Actions associated with the risk.														



Risk Report by Project with Associated Actions

14409		1)The lack of skilled and experienced labour. 2)The unavailability of a validated procedure due to the task's status as FOAK work. 3)Vacuum pump details/tool and process not finalized. 4) Stator winding corrosion if inadequately dried. IMPACT: Schedule and cost impacts could result from unknown factors during the drain and dry process.																	
Project: Turbine Generator - 73032																			
14409	TG - FOAK Generator Stator drain and dry during U2 refurbishment [Window 61]	EVENT: The generator stator is infrequently drained, and has never been vacuum dried. This will have to be completed as part of the TG refurbishment scope. CAUSE: This is a First of a Kind Work Cost, of particular concern are: 1)The lack of skilled and experienced labour. 2)The unavailability of a validated procedure due to the task's status as FOAK work. 3)Vacuum pump details/tool and process not finalized. 4) Stator winding corrosion if inadequately dried. IMPACT: Schedule and cost impacts could result from unknown factors during the drain and dry process.	1	Active	Peter Moore	Arber Puci	11-May-16	Mitigate	25-Jan-17	2	3	4	8	1	2	2	2		
			There are no Not Started, In Progress Actions associated with the risk.																
Project: Unit Islanding - 73461																			
11950	Containment Isolation work in the Fuel Handling duct could increase the critical path schedule and lead to cost overruns due to fueling requirements [Window 23, 88]	[Execution Phase] Event:The critical path isolation of the refurb unit from containment (bulkhead installation), and subsequent removal post fuel channel and feeder replacement, may extend beyond scheduled windows. The frequency/availability and duration of no-fueling windows is determined by operating unit zone levels, trolley reliability and required trolley maintenance. Cause: Reasons for no fueling windows not occurring as planned could include unit zone conditions and trolley reliability. The JV planning basis is that any work below the 100m elevation 87% efficient for U2 BH install and drops to 50% for U2 removal and all other work on subsequent unit. This risk documents delay above and beyond the JV planning basis. Impact:If no fueling windows are shortened or do not occur per plan, critical path schedule delays will result as well as cost overruns due to crew standby time. This risk is to identify project level impacts. Program risk #685 is to identify impact at the program level (i.e. critical path that affects all of NR)*QUAD CHART RISK*	2	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	30-May-16	4	1	5	20	3	1	4	12		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			1763	In Progress	Risk Action	Review/modify AWPP's to allow working below 100m elevation under certain condition. These modified AWP's will be supported by Fuel Handling. Current AWPP's would interrupt Bulkhead installation and removal when used fuel is below 'Y' row on units 1,3 or 4 (fueling of these units). Modified AWPP's would allow installation of BH's to continue when fueling units 3 & 4 and also unit 1 once BH panels are in place.	Ross Mccord	Mike Fox	30-Apr-16	Actions: -Develop scope/strategy. Owner: Ross McCord TCD: 30 Sept 2015 (complete) -Draft Access Procedures. Owner: Ross McCord TCD: 31 Dec 2015 -Confirm RP readings in Duct. Owner: June Burke TCD: 30 Nov 2015. Readings obtained. Interporation in progress. -Approved procedure available. Owner: Ross McCord TCD 31 March 2016 Managed task set up. Resource to start 16 Nov. Complete. Mike Fox on board Rad measurements during D1531 to validate calculated values. TCD 18-21 Nov. Complete To be turned to Operations.									
11933	The calandria seal will no longer be EQ qualified if there are outage delays exceeding expected life of the seal [window N/A]	[Execution Phase] Event: The calandria seal will no longer be EQ qualified if there are outage delays exceeding expected life of the seal Cause: If the refurbishment of Unit 1start is delayed >6 months past March 2016 (Start of Unit 1) this will exceed the EQ qualification life of the calandria seal for Unit 1 Impact:Resulting in a cost and schedule impact	1	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	31-Oct-17	4	2	3	12	2	1	1	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5955	In Progress	Investigate the margin on the seal for unit 1 can be increased through testing and analysis	Investigate the margin on the seal for unit 1 can be increased through testing and analysis	Luca Mucciarone	Rick Russell	31-Oct-17	JV EQ SPOC has provided preliminary analysis indicating additional margin may be possible. By 29April16, document in ITF and put A/R in asset suite.									
	Containment boundary calandria seal may fail during interspace pressure	[Execution Phase] Event: Containment boundary calandria seal may fail during interspace pressure test during NR outage. Risk may not pass initial testing and it may degrade after initial testing prior to unit	2	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	28-Feb-18	3	2	4	12	2	2	4	8		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									



11993	test during NR outage [Window 23]	[Execution Phase] Event:Shielding may not provide adequate protection during fuelling operations resulting in work stoppages. Cause:Seal may degrade after initial tests, requiring replacement of the seal Impact:significant scheduling impact on critical path and material costs	5822	In Progress	Inject D1831 calandria pressure test into scope	Review Engineering results. If needed, Inject D1831 calandria pressure test and troubleshooting into scope.	Luca Mucciarone	Alex Markovsky	31-May-16	Engineering evaluation to determine if seal leakage is acceptable as is. Preliminary results are favourable. This action will not be required once formalized.							
			5823	In Progress	Inject D1711 calandria pressure test into scope as D1511 was cancelled	Review engineering results. If needed, Inject D1711 calandria pressure test into scope as D1511 was cancelled	Luca Mucciarone	Alex Markovsky	16-May-16	OPG received letter recommending further action for unit 1							
11486	Inadequate Bulkhead shielding may result in work stoppages at the vault during station fuelling operations [Window 23]	[Execution Phase] Event:Shielding may not provide adequate protection during fuelling operations resulting in work stoppages. Cause: Cause can be due to design deficiency, manufacturing deficiency, and error in modeling. Impact: Schedule delays	3	Active	Marc Paiment	Alex Markovsky	02-May-16	Accept	28-Feb-17	2	1	5	10	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2070	In Progress	Complete assessment and develop shielding requirements.	Vendor to develop radiation protection "As Low As Reasonably Achievable" (ALARA) plan in conjunction with detailed design to add shielding or remove workers during fuel trolley movement. Vendor toperform sensitivity analysis to determine appropriate amount and typeof shielding required.	Alex Markovsky	Alex Markovsky	15-Apr-16	Vendor shielding assessment has been submitted. Needs to be revised by JV and accepted by OPG. Draft received.							
11449	Failure of Containment Boundary pressure tests resulting in critical path delays [Window 23, 88]	[Execution Phase] Event: Failure of Containment Boundary pressure tests resulting in critical path delays Cause: The specified leak rates may not be achieved which would require theleak to be found, addressed, and the pressure test repeated. Portions of the U2 and U3 new Temporary Containment Boundary have never been part of the containment boundary and therefore have never been pressure tested.This new boundary may contain leak paths. Also, there may be unusual system alignments during the pressure tests which may inadvertently introduce leak paths. Lastly, Unit 2 and Unit 3 permanent bulkheads could fail the commissioning pressure test causing schedule delays. Also leaking closure plugs may cause leakage into PHT or increase humidity levels in the vault causing inaccurate readings.' to 'EVENT: The specified leak rates may not be achieved which would require the leak to be found, addressed, and the pressure test repeated. Portions of the U2 and U3 new Temporary Containment Boundary have never been part of the containment boundary and therefore have never been pressure tested. Impact: Schedule delays	3	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	31-May-16	2	1	2	4	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2496	In Progress	Complete Temporary Containment Boundary walkdowns to identify potential leak paths	Complete walkdowns in planned outages prior to refurbishment. Identify potential leak paths and develop a plan for executing repairs as required.	Luca Mucciarone	Alex Markovsky	15-May-16	Units 1, 2 and 4 complete. Unit 3 walkdown completed in D1531. JV to submit walkdown report.							
12391	Critical Path extension in refurb unit due to inadequate Vault Vapour Recovery System performance. [Window 23, 24]	Event: Delays to Containment Pressure tests to commission the Bulkhead due to high vault humidity. Cause: The pressure tests require low vault humidity which is obtained through efficient operation of the Vault Vapour Recovery System (VVRs). A pre-req project is being executed to address inadequate performance of the VVRs. This also impacts the time required to reduce tritium to allow both airlock doors open. Current unit Vault Vapour Recovery System reliability and efficiency levels are low which is currently acceptable because a common containment structure provides Vault Vapour Recovery Systemredundancy from other units. Installation of the containment Bulkhead will eliminate the redundancy for the Refurb unit and reduce the redundancy for the operating station. Impact: Inadequate performance of the refurb unit Vault Vapour Recovery System will potentially delay obtaining the required humidity levels for testing and delay critical path	3	Active	Marc Paiment	Joanne Mercieca	04-May-16	Mitigate	15-Oct-16	2	1	2	4	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2172	In Progress	Develop plan for optimizing efficiency and reliability of Vault Vapour Recovery System in U2	Monitor station progress on Vault Vapour Recovery repairs. If repairs are not planned to be completed by then refurb will develop an action plan for assessing and taking necessary actions to ensureoptimum efficiency and reliability of Vault Vapour Recovery Systemin U2	Joanne Mercieca	Chris Rodrigues	15-Sep-16	Systems Available for refurb initiative in progress. There are currently no significant reliability issues with the VVRs system that will impact refurb. No requirement to take action at this point Continue to monitor until the start of NR							
Project: Unit Islanding - 73462																	
	Containment Isolation work in the Fuel Handling duct could increase the critical	[Execution Phase] Event:The critical path isolation of the refurb unit from containment (bulkhead installation), and subsequent removal post fuel channel and feeder replacement, may extend beyond scheduled	2	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	30-May-16	4	1	5	20	3	1	4	12
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

11950	path schedule and lead to cost overruns due to fueling requirements [Window 23, 88]	windows. The frequency/availability and duration of no-fueling windows is determined by operating unit zone levels, trolley reliability and required trolley maintenance. Cause: Reasons for no fueling windows not occurring as planned could include unit zone conditions and trolley reliability. The JV planning basis is that any work below the 100m elevation 87% efficient for U2 BH install and drops to 50% for U2 removal and all other work on subsequent unit. This risk documents delay above and beyond the JV planning basis. Impact:If no fueling windows are shortened or do not occur per plan, critical path schedule delays will result as well as cost overruns due to crew standby time. This risk is to identify project level impacts. Program risk #685 is to identify impact at the program level (i.e. critical path that affects all of NR)*QUAD CHART RISK*															
			1763	In Progress	Risk Action	Review/modify AWPP's to allow working below 100m elevation under certain condition. These modified AWP's will be supported by Fuel Handling. Current AWPP's would interrupt Bulkhead installation and removal when used fuel is below `Y` row on units 1,3 or 4 (fueling of these units). Modified AWPP's would allow installation of BH's to continue when fueling units 3 & 4 and also unit 1 once BH panels are in place.	Ross Mccord	Mike Fox	30-Apr-16	Actions: -Develop scope/strategy. Owner: Ross McCord TCD: 30 Sept 2015 (complete) -Draft Access Procedures. Owner: Ross McCord TCD: 31 Dec 2015 -Confirm RP readings in Duct. Owner: June Burke TCD: 30 Nov 2015. Readings obtained. Interporation in progress. -Approved procedure available. Owner: Ross McCord TCD 31 March 2016 Managed task set up. Resource to start 16 Nov. Complete. Mike Fox on board Rad measurements during D1531 to validate calculated values. TCD 18-21 Nov. Complete To be turned to Operations.							
11913	Shield Tank Over Protection installation may delay Bulkhead in-service [Window 23]	[Execution Phase] Event:The risk is that there may be insufficient time available to complete Shield Tank Over Protection mods in Units 1,3 and 4 prior to installing the Unit 2 Bulkhead. Cause: The bulkhead cannot be put in-service until Shield Tank Over Protection has been installed on all operating units to avoid a Beyond Design Basis Accident which is beyond the Bulkhead design pressure. Impact: IF STOP is not installed then Unit 1 must be down 30 days prior to Bulkhead AFS. The plan is to install Shield Tank Over Protectionin D1531, D1641,D1711 and NRU2. Timing of D1711 has been advanced to help mitigate the risk to refurb U2 critical path. *QUAD CHART RISK*	3	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	31-May-16	3	1	4	12	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2175	In Progress	Shield Tank Over Protection Installation Bulkhead	Shield Tank Over Protectioninstallation has been moved to D1711 from D1511.Shield Tank Over Protection installation requires continuous monitoring to make sure modification occurs before Bulkhead Available For Service. Work Control to logic tie the refurb and D1711 outage schedules, follow up with Dennis Curley to ensure completion.	Luca Mucciarone		29-Sep-17	this action may not be required depending on the outcome of action 6190.							
			6190	In Progress	Nuclear Safety to Complete Containment Structural Integrity Report	Nuclear Safety to complete the Darlington Containment Structural Integrity During Refurbishment Outage Report NK38-NR-REP-03611-10001. In support of the PRA for refurb, this report will show that the Temporary Containment Boundary is as robust as the permanent containment boundary and therefore will not be affected by BDBA. Following other successfully completed confirmatory analysis ( redoing MAAP runs to demonstrate acceptable containment pressure transients without STOP installed on several units) the STOP mod installations on various units can be appropriately linked to the Bulkhead installation	Gerry Martin		30-May-16	Assessment still in progress. First draft was received for comments and comments were provided to vender. second draft was received for OPG review on March 22, 2016. Current schedule has comments being dispositioned and OPG accepting the document by April 15, 2016. Due date for action has been updated to take into consideration revised schedule and some float - Gerry Martin March 24, 2016 Due Date for action updated to account for final round of comment disposition and issue - S. Burrell 29 April 2016							
11993	Containment boundary calandria seal may fail during interspace pressure test during NR outage [Window 23]	[Execution Phase] Event: Containment boundary calandria seal may fail during interspace pressure test during NR outage. Risk may not pass initial testing and it may degrade after initial testing prior to unit refurbishment, particulary the U3 seal pressure test in D1531 did not meet test criteria.' Cause:Seal may degrade after initial tests, requiring replacement of the seal Impact:significant scheduling impact on critical path and material costs	2	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	28-Feb-18	3	2	4	12	2	2	4	8
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			5822	In Progress	Inject D1831 calandria pressure test into scope	Review Engineering results. If needed, Inject D1831 calandria pressure test and troubleshooting into scope.	Luca Mucciarone	Alex Markovsky	31-May-16	Engineering evaluation to determine if seal leakage is acceptable as is. Preliminary results are favourable. This action will not be required once formalized.							
			5823	In Progress	Inject D1711 calandria pressure test into scope as D1511 was cancelled	Review engineering results. If needed, Inject D1711 calandria pressure test into scope as D1511 was cancelled	Luca Mucciarone	Alex Markovsky	16-May-16	OPG received letter recommending further action for unit 1							



11486	Inadequate Bulkhead shielding may result in work stoppages at the vault during station fuelling operations [Window 23]	[Execution Phase] Event:Shielding may not provide adequate protection during fuelling operations resulting in work stoppages. Cause: Cause can be due to design deficiency, manufacturing deficiency, and error in modeling. Impact: Schedule delays	3	Active	Marc Paiment	Alex Markovsky	02-May-16	Accept	28-Feb-17	2	1	5	10	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2070	In Progress	Complete assessment and develop shielding requirements.	Vendor to develop radiation protection "As Low As Reasonably Achievable" (ALARA) plan in conjunction with detailed design to add shielding or remove workers during fuel trolley movement. Vendor toperform sensitivity analysis to determine appropriate amount and typeof shielding required.	Alex Markovsky	Alex Markovsky	15-Apr-16	Vendor shielding assessment has been submitted. Needs to be revised by JV and accepted by OPG. Draft received.							
11449	Failure of Containment Boundary pressure tests resulting in critical path delays [Window 23, 88]	[Execution Phase] Event: Failure of Containment Boundary pressure tests resulting in critical path delays Cause: The specified leak rates may not be achieved which would require theleak to be found, addressed, and the pressure test repeated. Portions of the U2 and U3 new Temporary Containment Boundary have never been part of the containment boundary and therefore have never been pressure tested.This new boundary may contain leak paths. Also, there may be unusual system alignments during the pressure tests which may inadvertently introduce leak paths. Lastly, Unit 2 and Unit 3 permanent bulkheads could fail the commissioning pressure test causing schedule delays. Also leaking closure plugs may cause leakage into PHT or increase humidity levels in the vault causing inaccurate readings.' to 'EVENT: The specified leak rates may not be achieved which would require the leak to be found, addressed, and the pressure test repeated. Portions of the U2 and U3 new Temporary Containment Boundary have never been part of the containment boundary and therefore have never been pressure tested. Impact: Schedule delays	3	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	31-May-16	2	1	2	4	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2496	In Progress	Complete Temporary Containment Boundary walkdowns to identify potential leak paths	Complete walkdowns in planned outages prior to refurbishment. Identify potential leak paths and develop a plan for executing repairs as required.	Luca Mucciarone	Alex Markovsky	15-May-16	Units 1, 2 and 4 complete. Unit 3 walkdown completed in D1531. JV to submit walkdown report.							
			2503	In Progress	Inspect vertical bulkheads to ensure no obvious leak paths	Inspect vertical bulkheads in planned outages prior to refurb to ensure that there are no obvious possible leak paths prior to conducting the test. Next walkdown is D1531.	Luca Mucciarone	Alex Markovsky	15-May-16	JV to submit walkdown report.							
11790	JV may not obtain and incorporate industry OPEX for Containment Isolations [No Window Related]	[Definition Phase] Event: JV may not incorporate OPEX as they don't have access to competitors OPEX or they may miss OPEX already provided. Cause: <div></div> Impact:Run into problems that were already identified in OPEX.	3	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	31-May-16	4	1	1	4	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2641	In Progress	Perform oversight on use of OPEX by JV for Containment Isolation scope and review CWP's.	JV has not obtained OPEX on other refurbishments from competitors.OPG to collect OPEX and make available to JV (Complete).Perform oversight to ensure OPEX is incorporated into design and installation plans. Refer to Oversight plan#29 for design. Newoversight plan entry for installation planning to be entered.	Luca Mucciarone	Alex Markovsky	31-May-16	Oversight was performed on the design plan but haven't started oversight on the installation							
12391	Critical Path extension in refurb unit due to inadequate Vault Vapour Recovery System performance. [Window 23, 24]	Event: Delays to Containment Pressure tests to commission the Bulkhead due to high vault humidity. Cause: The pressure tests require low vault humidity which is obtained through efficient operation of the Vault Vapour Recovery System (VVRS). A pre-req project is being executed to address inadequate performance of the VVRS. This also impacts the time required to reduce tritium to allow both airlock doors open. Current unit Vault Vapour Recovery System reliability and efficiency levels are low which is currently acceptable because a common containment structure provides Vault Vapour Recovery Systemredundancy from other units. Installation of the containment Bulkhead will eliminate the redundancy for the Refurb unit and reduce the redundancy for the operating station. Impact: Inadequate performance of the refurb unit Vault Vapour Recovery System will potentially delay obtaining the required humidity levels for testing and delay critical path	3	Active	Marc Paiment	Joanne Mercieca	04-May-16	Mitigate	15-Oct-16	2	1	2	4	1	1	1	1
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			2172	In Progress	Develop plan for optimizing efficiency and reliability of Vault Vapour Recovery System in U2	Monitor station progress on Vault Vapour Recovery repairs. If repairs are not planned to be completed by then refurb will develop an action plan for assessing and taking necessary actions to ensureoptimum efficiency and reliability of Vault Vapour Recovery Systemin U2	Joanne Mercieca	Chris Rodrigues	15-Sep-16	Systems Available for refurb initiative in progress. There are currently no significant reliability issues with the VVRS system that will impact refurb. No requirement to take action at this point Continue to monitor until the start of NR							
12400	Potential critical path schedule delay during Unit 2 bulkhead removal resulting from overlap with D1941 outage [Window 88]	[Execution Phase] Event: Potential critical path schedule delay during Unit 2 bulkhead removal resulting from overlap with D1941 outage Cause:There is a schedule risk during the removal of the bulkheads on Unit 2 due to overlap with the D1941 outage. Fueling of Unit 3 will require irradiated fuel to traverse past unit 2 or 4. Impact: Once the bulkhead shielding is removed there will be a delay to one of the outages when the vault is vacated to allow for irradiated fuel movement.	1	Active	Marc Paiment	Alex Markovsky	02-May-16	Monitor	31-May-19	2	1	1	2	2	1	1	2
			There are no Not Started, In Progress Actions associated with the risk.														

Project: Unit Islanding - 73463																			
11950	Containment Isolation work in the Fuel Handling duct could increase the critical path schedule and lead to cost overruns due to fueling requirements [Window 23, 88]	[Execution Phase] Event:The critical path isolation of the refurb unit from containment (bulkhead installation), and subsequent removal post fuel channel and feeder replacement, may extend beyond scheduled windows. The frequency/availability and duration of no-fueling windows is determined by operating unit zone levels, trolley reliability and required trolley maintenance. Cause: Reasons for no fueling windows not occurring as planned could include unit zone conditions and trolley reliability. The JV planning basis is that any work below the 100m elevation 87% efficient for U2 BH install and drops to 50% for U2 removal and all other work on subsequent unit. This risk documents delay above and beyond the JV planning basis. Impact:If no fueling windows are shortened or do not occur per plan, critical path schedule delays will result as well as cost overruns due to crew standby time. This risk is to identify project level impacts. Program risk #685 is to identify impact at the program level (i.e. critical path that affects all of NR)*QUAD CHART RISK*	2	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	30-May-16	4	1	5	20	3	1	4	12		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			1763	In Progress	Risk Action	Review/modify AWPP’s to allow working below 100m elevation under certain condition. These modified AWP’s will be supported by Fuel Handling. Current AWPP’s would interrupt Bulkhead installation and removal when used fuel is below ‘Y’ row on units 1,3 or 4 (fueling of these units). Modified AWPP’s would allow installation of BH’s to continue when fueling units 3 & 4 and also unit 1 once BH panels are in place.	Ross Mccord	Mike Fox	30-Apr-16	Actions: -Develop scope/strategy. Owner: Ross McCord TCD: 30 Sept 2015 (complete) -Draft Access Procedures. Owner: Ross McCord TCD: 31 Dec 2015 -Confirm RP readings in Duct. Owner: June Burke TCD: 30 Nov 2015. Readings obtained. Interporation in progress. -Approved procedure available. Owner: Ross McCord TCD 31 March 2016 Managed task set up. Resource to start 16 Nov. Complete. Mike Fox on board Rad measurements during D1531 to validate calculated values. TCD 18-21 Nov. Complete To be turned to Operations.									
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			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								

11486	during station fuelling operations [Window 23]	Cause: Cause can be due to design deficiency, manufacturing deficiency, and error in modeling. Impact: Schedule delays	2070	In Progress	Complete assessment and develop shielding requirements.	Vendor to develop radiation protection "As Low As Reasonably Achievable" (ALARA) plan in conjunction with detailed design to add shielding or remove workers during fuel trolley movement. Vendor toperform sensitivity analysis to determine appropriate amount and typeof shielding required.	Alex Markovsky	Alex Markovsky	15-Apr-16	Vendor shielding assessment has been submitted. Needs to be revised by JV and accepted by OPG. Draft received.							
11449	Failure of Containment Boundary pressure tests resulting in critical path delays [Window 23, 88]	[Execution Phase] Event: Failure of Containment Boundary pressure tests resulting in critical path delays Cause: The specified leak rates may not be achieved which would require theleak to be found, addressed, and the pressure test repeated. Portions of the U2 and U3 new Temporary Containment Boundary have never been part of the containment boundary and therefore have never been pressure tested.This new boundary may contain leak paths. Also, there may be unusual system alignments during the pressure tests which may inadvertently introduce leak paths. Lastly, Unit 2 and Unit 3 permanent bulkheads could fail the commissioning pressure test causing schedule delays. Also leaking closure plugs may cause leakage into PHT or increase humidity levels in the vault causing inaccurate readings.' to 'EVENT: The specified leak rates may not be achieved which would require the leak to be found, addressed, and the pressure test repeated. Portions of the U2 and U3 new Temporary Containment Boundary have never been part of the containment boundary and therefore have never been pressure tested. Impact: Schedule delays	3	Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	31-May-16	2	1	2	4	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2496	In Progress	Complete Temporary Containment Boundary walkdowns to identify potential leak paths	Complete walkdowns in planned outages prior to refurbishment. Identify potential leak paths and develop a plan for executing repairs as required.	Luca Mucciarone	Alex Markovsky	15-May-16	Units 1, 2 and 4 complete. Unit 3 walkdown completed in D1531. JV to submit walkdown report.							
			2503	In Progress	Inspect vertical bulkheads to ensure no obvious leak paths	Inspect vertical bulkheads in planned outages prior to refurb to ensure that there are no obvious possible leak paths prior to conducting the test. Next walkdown is D1531.	Luca Mucciarone	Alex Markovsky	15-May-16	JV to submit walkdown report.							
12391	Critical Path extension in refurb unit due to inadequate Vault Vapour Recovery System performance. [Window 23, 24]	Event: Delays to Containment Pressure tests to commission the Bulkhead due to high vault humidity. Cause: The pressure tests require low vault humidity which is obtained through efficient operation of the Vault Vapour Recovery System (VVRS). A pre-req project is being executed to address inadequate performance of the VVRS. This also impacts the time required to reduce tritium to allow both airlock doors open. Current unit Vault Vapour Recovery System reliability and efficiency levels are low which is currently acceptable because a common containment structure provides Vault Vapour Recovery Systemredundancy from other units. Installation of the containment Bulkhead will eliminate the redundancy for the Refurb unit and reduce the redundancy for the operating station. Impact: Inadequate performance of the refurb unit Vault Vapour Recovery System will potentially delay obtaining the required humidity levels for testing and delay critical path	3	Active	Marc Paiment	Joanne Mercieca	04-May-16	Mitigate	15-Oct-16	2	1	2	4	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			2172	In Progress	Develop plan for optimizing efficiency and reliability of Vault Vapour Recovery System in U2	Monitor station progress on Vault Vapour Recovery repairs. If repairs are not planned to be completed by then refurb will develop an action plan for assessing and taking necessary actions to ensureoptimum efficiency and reliability of Vault Vapour Recovery Systemin U2	Joanne Mercieca	Chris Rodrigues	15-Sep-16	Systems Available for refurb initiative in progress. There are currently no significant reliability issues with the VVRS system that will impact refurb. No requirement to take action at this point Continue to monitor until the start of NR							
Project: Unit Islanding - 73466																	
13501	Risk that Barriers may not be able to be reused for subsequent outages. [No Window Related]	Event: Risk that Barriers may not be able to be reused for subsequent outages. Cause: More barriers than planned may be worn out, or damaged, and need to be replaced. Impact: This will lead to increased material cost and possibly schedule delay.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	31-Oct-16	4	1	1	4	4	1	1	4
			There are no Not Started, In Progress Actions associated with the risk.														
11623	The construction island barriers may need to be adjusted for individual projects [Window 500]	Event:The Refurb Island barriers (which typically reside along the unit boundaries) have been designed to accommodate many lay down areas and work areas. Cause: Late identification of new areas may mean the barriers need to be adjusted. Impact: This will result in costs associated with Engineering Change revisions. If barriers can't be moved quickly, then EPC delay claims may also result.	2	Active	Marc Paiment	Bimal Gandhi	10-May-16	Mitigate	31-Jul-16	3	1	1	3	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			3644	In Progress	Consult stakeholders and challenge vendors on SATM	Consult stakeholders of other refurbishment projects andchallenge vendors on SATM requirements.	Bimal Gandhi		31-Jul-16	3 pending changes have been identified.							
1	Risk that we may have to switch back to more robust fencing leading to	Event: During Refurb, it may be determined that more robust barriers are needed to separate the construction Island from the operating units. Cause: Regulator requirements or internal project requirements.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	31-Aug-17	1	2	1	2	1	2	1	2
			There are no Not Started, In Progress Actions associated with the risk.														

<a href="#">13502</a>	engineering rework, higher material cost, and schedule delays. [No Window Related]	Impact: This will lead to engineering rework, additional material costs, and schedule delays.														
<a href="#">13485</a>	While anchoring materials for the barriers project a bolt may hit burried piping or cable [Window 500]	Event: To anchor the material to the ground in seismic areas, bolts must be used on the stanchions. When these bolts are drilled into the concrete they may hit cables or piping that are embedded in the concrete. Cause: Stanchions are near seismic equipment so anchoring will be required. Floor scans did not pick up cables and/or piping. Impact: This will lead to schedule delays and cost impacts as the work will be stood down and the damage assessed.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	15-Oct-16	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.													
Project: Unit Islanding - 73467																
<a href="#">13501</a>	Risk that Barriers may not be able to be reused for subsequent outages. [No Window Related]	Event: Risk that Barriers may not be able to be reused for subsequent outages. Cause: More barriers than planned may be worn out, or damaged, and need to be replaced. Impact: This will lead to increased material cost and possibly schedule delay.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	31-Oct-16	4	1	1	4	4	1	1
			There are no Not Started, In Progress Actions associated with the risk.													
<a href="#">11623</a>	The construction island barriers may need to be adjusted for individual projects [Window 500]	Event:The Refurb Island barriers (which typically reside along the unit boundaries) have been designed to accommodate many lay down areas and work areas. Cause: Late identification of new areas may mean the barriers need to be adjusted. Impact: This will result in costs associated with Engineering Change revisions. If barriers can't be moved quickly, then EPC delay claims may also result.	2	Active	Marc Paiment	Bimal Gandhi	10-May-16	Mitigate	31-Jul-16	3	1	1	3	2	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments						
			<a href="#">3644</a>	In Progress	Consult stakeholders and challenge vendors on SATM	Consult stakeholders of other refurbishment projects andchallenge vendors on SATM requirements.	Bimal Gandhi		31-Jul-16	3 pending changes have been identified.						
<a href="#">13502</a>	Risk that we may have to switch back to more robust fencing leading to engineering rework, higher material cost, and schedule delays. [No Window Related]	Event: During Refurb, it may be determined that more robust barriers are needed to separate the construction Island from the operating units. Cause: Regulator requirements or internal project requirements. Impact: This will lead to engineering rework, additional material costs, and schedule delays.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	31-Aug-17	1	2	1	2	1	2	1
			There are no Not Started, In Progress Actions associated with the risk.													
<a href="#">14284</a>	Risk that PO for barriers PC contract could delay refurb work [Window 500]	Event: Risk that PO for barriers PC contract could delay refurb work. Cause: Islanding has been directed by senior management to direct award the Islanding Barriers project to a different ES MSA vendor. Impact: Schedule and cost impact. Ideally, Barriers need to be up before breaker open.		Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	30-Jun-16	2	1	1	2	2	1	1
			There are no Not Started, In Progress Actions associated with the risk.													
<a href="#">13485</a>	While anchoring materials for the barriers project a bolt may hit burried piping or cable [Window 500]	Event: To anchor the material to the ground in seismic areas, bolts must be used on the stanchions. When these bolts are drilled into the concrete they may hit cables or piping that are embedded in the concrete. Cause: Stanchions are near seismic equipment so anchoring will be required. Floor scans did not pick up cables and/or piping. Impact: This will lead to schedule delays and cost impacts as the work will be stood down and the damage assessed.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	15-Oct-16	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.													
Project: Unit Islanding - 73468																
<a href="#">13501</a>	Risk that Barriers may not be able to be reused for subsequent outages. [No Window Related]	Event: Risk that Barriers may not be able to be reused for subsequent outages. Cause: More barriers than planned may be worn out, or damaged, and need to be replaced. Impact: This will lead to increased material cost and possibly schedule delay.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	31-Oct-16	4	1	1	4	4	1	1
			There are no Not Started, In Progress Actions associated with the risk.													
<a href="#">11623</a>	The construction island barriers may need to be adjusted for individual projects [Window 500]	Event:The Refurb Island barriers (which typically reside along the unit boundaries) have been designed to accommodate many lay down areas and work areas. Cause: Late identification of new areas may mean the barriers need to be adjusted. Impact: This will result in costs associated with Engineering Change revisions. If barriers can't be moved quickly, then EPC delay claims may also result.	2	Active	Marc Paiment	Bimal Gandhi	10-May-16	Mitigate	31-Jul-16	3	1	1	3	2	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments						
			<a href="#">3644</a>	In Progress	Consult stakeholders and challenge vendors on SATM	Consult stakeholders of other refurbishment projects andchallenge vendors on SATM requirements.	Bimal Gandhi		31-Jul-16	3 pending changes have been identified.						



<a href="#">13500</a>	Risk that design assumptions for barrier configurations are different when two units are overlapped for refurbishment [No Window Related]	Event: Design assessments performed for the design of the NR barrier projects may be impacted by the configuration with two units overlapped in refurb. E.g. fire safety assessments, NS assessments, etc. Cause: Improper assessment and assumptions made when the two units are overlapped. Impact: This will lead to additional engineering work and schedule delays.	2	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	30-Jun-22	2	1	1	2	2	1	1	2
	There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">13502</a>	Risk that we may have to switch back to more robust fencing leading to engineering rework, higher material cost, and schedule delays. [No Window Related]	Event: During Refurb, it may be determined that more robust barriers are needed to separate the construction Island from the operating units. Cause: Regulator requirements or internal project requirements. Impact: This will lead to engineering rework, additional material costs, and schedule delays.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	31-Aug-17	1	2	1	2	1	2	1	2
	There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">13485</a>	While anchoring materials for the barriers project a bolt may hit burried piping or cable [Window 500]	Event: To anchor the material to the ground in seismic areas, bolts must be used on the stanchions. When these bolts are drilled into the concrete they may hit cables or piping that are embedded in the concrete. Cause: Stanchions are near seismic equipment so anchoring will be required. Floor scans did not pick up cables and/or piping. Impact: This will lead to schedule delays and cost impacts as the work will be stood down and the damage assessed.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	15-Oct-16	1	1	1	1	1	1	1	1
	There are no Not Started, In Progress Actions associated with the risk.																
Project: Unit Islanding - 73469																	
<a href="#">13501</a>	Risk that Barriers may not be able to be reused for subsequent outages. [No Window Related]	Event: Risk that Barriers may not be able to be reused for subsequent outages. Cause: More barriers than planned may be worn out, or damaged, and need to be replaced. Impact: This will lead to increased material cost and possibly schedule delay.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	31-Oct-16	4	1	1	4	4	1	1	4
	There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">11623</a>	The construction island barriers may need to be adjusted for individual projects [Window 500]	Event:The Refurb Island barriers (which typically reside along the unit boundaries) have been designed to accommodate many lay down areas and work areas. Cause: Late identification of new areas may mean the barriers need to be adjusted. Impact: This will result in costs associated with Engineering Change revisions. If barriers can't be moved quickly, then EPC delay claims may also result.	2	Active	Marc Paiment	Bimal Gandhi	10-May-16	Mitigate	31-Jul-16	3	1	1	3	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">3644</a>	In Progress	Consult stakeholders and challenge vendors on SATM	Consult stakeholders of other refurbishment projects andchallenge vendors on SATM requirements.	Bimal Gandhi		31-Jul-16	3 pending changes have been identified.							
<a href="#">13500</a>	Risk that design assumptions for barrier configurations are different when two units are overlapped for refurbishment [No Window Related]	Event: Design assessments performed for the design of the NR barrier projects may be impacted by the configuration with two units overlapped in refurb. E.g. fire safety assessments, NS assessments, etc. Cause: Improper assessment and assumptions made when the two units are overlapped. Impact: This will lead to additional engineering work and schedule delays.	2	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	30-Jun-22	2	1	1	2	2	1	1	2
	There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">13502</a>	Risk that we may have to switch back to more robust fencing leading to engineering rework, higher material cost, and schedule delays. [No Window Related]	Event: During Refurb, it may be determined that more robust barriers are needed to separate the construction Island from the operating units. Cause: Regulator requirements or internal project requirements. Impact: This will lead to engineering rework, additional material costs, and schedule delays.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	31-Aug-17	1	2	1	2	1	2	1	2
	There are no Not Started, In Progress Actions associated with the risk.																
<a href="#">13485</a>	While anchoring materials for the barriers project a bolt may hit burried piping or cable [Window 500]	Event: To anchor the material to the ground in seismic areas, bolts must be used on the stanchions. When these bolts are drilled into the concrete they may hit cables or piping that are embedded in the concrete. Cause: Stanchions are near seismic equipment so anchoring will be required. Floor scans did not pick up cables and/or piping. Impact: This will lead to schedule delays and cost impacts as the work will be stood down and the damage assessed.	1	Active	Marc Paiment	Bimal Gandhi	10-May-16	Monitor	15-Oct-16	1	1	1	1	1	1	1	1
	There are no Not Started, In Progress Actions associated with the risk.																
Project: Unit Islanding -																	

13481	Turnover within the project or functional support groups could cause delays to the project schedule. [No Window Related]	Event:Staff turnover of project personnel or in functional stakeholders support groups. Cause: Staff turnover is inevitable, a result of promotions, retirements, opportunities. Impact: Turnover of staff will impact the schedule of the project as the new resources are brought up to speed on the project. New functional stakeholders may not concur with decisions of their predecessors which will lead to rework within the project.	1	Active	Marc Paiment	Joanne Mercieca	04-May-16	Mitigate	30-Dec-16	5	1	3	15	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6161	In Progress	Islanding to secure replacement for replacement staff	Islanding is currently looking into hiring replacement staff.	Joanne Mercieca	Joanne Mercieca	29-Jul-16	7March: One candidate has been secured. 6April: One new employee started March 31. Second employee starting end of June. Hiring new Eng Lead in progress. 4May: Second employee started 27April.							
14351	Refurb resources unavailable to support project execution [No Window Related]	Event: Station and Corporate resources supporting Islanding project execution as Refurb resources are unavailable. Several specialized resources are required to execute the Islanding scope including Safety System-qualified Control Techs to perform tie ins for the Negative Pressure Containment pre-req project. These resources may be unavailable or not duplicated in the Refurb organization. Cause: Specialized skill sets and delay in refurb functional support staffing result in the requirement to use resources from other groups in OPGN. Impact: Additional costs will be incurred to fund the support that is not available in Refurb, in addition, schedule delays may be encountered if special skill set staff is unavailable, and as gap support is obtained.	3	Active	Marc Paiment	Joanne Mercieca	04-May-16	Monitor	30-May-17	5	1	3	15	5	1	3	15
			There are no Not Started, In Progress Actions associated with the risk.														
13479	Strategy to address nuisance alarms (particularly on U0) may impact Islanding scope. [No Window Related]	Event: Nuisance alarms may impact Islanding scope. Cause:The strategy for addressing Nuisance alarms in the control room has not yet been finalised. Impact:The outcome of the strategy may create rework for the Islanding modifications, or new scope for engineering changes that are required to mask alarms that impact the running units.	3	Active	Marc Paiment	Chris Rodrigues	02-May-16	Monitor	31-May-16	3	1	3	9	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
13478	A pre-req task may not be completed before islanding work is scheduled to begin. [Window 23]	Event: Pre-req tasks for Islanding work not completed as scheduled. Cause: Before Islanding work can begin, there is pre-requisite work which must be completed first. Current issues affecting pre-reqs are Work Plan and field execution quality. Impact: If pre-reqs are not completed as planned, Islanding work must be delayed with potential burn rate cost increases.	1	Active	Marc Paiment	Joanne Mercieca	04-May-16	Monitor	17-Feb-17	3	1	2	6	3	1	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
14166	Possible hoisting and/or rigging failure for the bulkheads [Window 23, 88]	[Execution Phase] EVENT: While hoisting and/or rigging the bulkheads, there is a possibility that the hoisting and/or rigging will fail. CAUSE: JV's hoisting and/or rigging plan might fail and JV might not have the proper qualifications.IMPACT: This will impact the whole project because it is on critical path.		Active	Marc Paiment	Alex Markovsky	02-May-16	Mitigate	31-Oct-16	1	5	5	5	1	5	5	5
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6316	In Progress	Review hoisting and rigging plans for bulkhead installation	Review JV's hoisting and rigging plan for installing bulkhead to prevent hoisting and/or rigging failure while installing the bulkhead.	Luca Mucciarone	Luca Mucciarone	31-May-16	Reviewer to be identified.							
			6317	In Progress	Review JV quals	To prevent failure while hoisting and/or rigging the bulkhead, Islanding will review JV quals.	Luca Mucciarone	Luca Mucciarone	30-Sep-16								
			6318	In Progress	Inspect hoisting and rigging equipment	To prevent hoisting and/or rigging failure while installing the bulkhead, Islanding will inspect the hoisting and rigging equipment.	Luca Mucciarone	Luca Mucciarone	31-Oct-16								
12250	A second set of Bulkhead panels are not available should the 1st and 2nd unit outages overlap. [Window 23]	[Execution Phase] Event: A second set of Bulkhead panels are not available should the 1st and 2nd unit outages overlap. Cause: The risk is that Unit 3 will come down early (see Risk 678) which may result in overlapping with Unit 2 outage and there will not be a second Bulkhead available. This would require expedited procurement of a second bulkhead set Based on unlapping of therefurb first and second outages, an economic decision (DRAS 539) has been made to postpone fabrication of a second bulkhead until it is required for overlapping of the 2nd and 3rdrefurb outages. Impact: Schedule delay and material cost	1	Active	Marc Paiment	Alex Markovsky	02-May-16	Accept	31-Oct-19	1	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														

Project: Unit Islanding - IL																					
<a href="#">13930</a>	Associated Isolations Bellows Installation Possible Delay to Refurb Critical Path [Window N/A]	[Execution Phase] Event: During review of the JV stage 3 CWP's it was identified by Operations that the bellows installation on the D20 and Moderator transfer lines has to be completed prior to the refurb outage. If this work is not completed prior to the outage there is a risk to either the start of refurbishment or a risk to the refurb critical path as the containment isolations work would not be completed and AL doors couldn't be opened. Cause: An available work window exists to complete this work in January 2016. There is a risk that the JV may not be ready in time to complete this work in that window. Impact: Schedule delays	4	Active	Bert Boston	Alex Markovsky	02-May-16	Monitor	31-Aug-16	3	2	4	12	3	1	2	6				
			There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">12416</a>	Projectization of functional costs may require the project to request additional budget [No Window Related]	Event: Functional costs to be charged directly to projects. Cause: Strategic decision on strategy Impact:Projectization of functional costs has been documented in P+C communication. Gate 3 funding request has been developed based on this. From OPEX this approach may change and project will be required to fund additional scope not planned for. Change Control process will have to be implemented to transfer funding from Functional budgets to Project budgets.	3	Active	Marc Paiment	Joanne Mercieca	04-May-16	Monitor	01-Aug-16	3	2	1	6	3	2	1	6				
			There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">14036</a>	Risk to EQ qualification/fitness for service of Unit 4 Calandria Seal [Window N/A]	[Execution Phase] Event:Risk to EQ qualification/fitness for service of Unit 4 Calandria Seal Cause: During replacement of the Unit 4 calandria seal in the VBO the outer calandria seal was damaged. Due to contact with the outer and inner seal, a piece of rubber on the innter seal became dislodged during removal of the outer seal. This is documented in JV NCR 001107-00-00-NC-0162 and SCR D-2015-22043. Impact:As a result there is a risk that the Unit 4 seal may no longer be EQ qualified or fit for service and may require replacement.	2	Active	Luca Mucciarone	Alex Markovsky	02-May-16	Mitigate	31-May-16	2	2	3	6	1	1	1	1				
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											
			<a href="#">5988</a>	In Progress	JV to provide NCR to disposition Unit 4 Calandria Seal Damage	Due to damage on the Unit 4 outer calandria seal that ocured the JV is to provide a disposition to NCR 001107-00-00-NC-0162 that addresses the seal design margin and EQ basis.	Marc Paiment	Alex Markovsky	31-May-16												
Project: Unit Islanding - 73457																					
<a href="#">12436</a>	NR project groups may be planning to execute scope on systems, structures, or components that make up the new containment boundary on the refurbishment unit. [Window 85]	Event: Because the design for the temporary containment boundary that is going to be established on the refurbishment unit is not yet finalised and other work is progressing in parallel, there is a risk that other NR project groups may unknowingly be planning to execute scope on systems, structures, or components that will make up the new containment boundary on the refurbishment unit. Cause: Design work and installation planning happening in parallel. Impact: This may lead to engineering rework to revise designs, cost increases, and schedule delays.	4	Active	Marc Paiment	Chris Rodrigues	02-May-16	Mitigate	31-May-16	2	2	1	4	1	1	1	1				
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											
			<a href="#">4207</a>	In Progress	Continue Containment Boundary Memo follow-up	Continue with a second round of follow up with Eng Leads and Design Section Manager to discussContainment Boundary Memo.	Simon Burrell	Chris Rodrigues	31-May-16	Will progress second round of follow up when modification packages are available for other projects to view in asset suite. Design EC 134137 to issue containment boundary manual.											
<a href="#">13311</a>	Late identification of Islanding scope due to the outage planning activities [No Window Related]	Event: The Nuclear Safety Outage Risk assessments, Islanding Plan Updates, or the planned cold body review may identify areas of high risk which may add unexpected scope or mitigating actions to be developed by the Islanding project. Cause: Late indentification of Islanding scope Impact: This presents a risk of late scope identification for the Islanding project. Similarly, other outage planning activities such as the work order assessing may identify scope additions for the project. This additional scope may impact upcoming milestones and project budgets.	2	Active	Marc Paiment	Chris Rodrigues	02-May-16	Monitor	30-Jun-16	2	2	1	4	2	2	1	4				
			There are no Not Started, In Progress Actions associated with the risk.																		
<a href="#">13346</a>	Assumptions made for the Spill response strategy may become invalidated as planning progress [No Window Related]	Event: The Islanding spill response strategy was developed based on assumptions in the level 1 refurbishment outage plan at the time the strategy was authored. Cause: Invalidated assumptions made for the spill response strategy Impact: Major changes to the refurbishment outage planning logic (e.g. Heat Transport flush) may impact or invalidate the assumptions of the spill response strategy and contingency plans which will require rework for the project.	2	Active	Marc Paiment	Chris Rodrigues	02-May-16	Mitigate	16-May-16	3	1	1	3	1	1	1	1				
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments											
			<a href="#">5081</a>	In Progress	Review of Islanding Spill Response Strategy	Review Islanding spill response strategy against revisions of the level 1 refurbishment outage plan as they are issued. If any major work planning logic has changed then update the strategy.	Simon Burrell	Jean Forest	16-May-16	Review in progressStrategy will need to align with PHT RTS HIT.											
<a href="#">13311</a>	Risk that there may be gaps between the scope being	Event: Risk that there may be gaps between the scope being executed by EPC and scope being executed in house to establish the Temporary Containment Boundary	3	Active	Marc Paiment	Chris Rodrigues	02-May-16	Monitor	31-May-16	2	1	1	2	1	1	1	1				
Run by: <i>For Internal Use Only</i>																					
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13343	between the scope being executed by EPC and scope being executed in house to establish the Temporary Containment Boundary [No Window Related]	executed in house to establish the Temporary Containment Boundary Cause:The scope to establish the temporary containment boundary (TCB) on the refurbishment unit has been divided between an EPC vendor and in-house resources. Impact: Scope will need to be revised and reviewed again which will delay the islanding project.	There are no Not Started, In Progress Actions associated with the risk.														
Project: Unit Islanding - 73456																	
13311	Late identification of Islanding scope due to the outage planning activities [No Window Related]	Event: The Nuclear Safety Outage Risk assessments, Islanding Plan Updates, or the planned cold body review may identify areas of high risk which may add unexpected scope or mitigating actions to be developed by the Islanding project. Cause: Late identification of Islanding scope Impact: This presents a risk of late scope identification for the Islanding project. Similarly, other outage planning activities such as the work order assessing may identify scope additions for the project. This additional scope may impact upcoming milestones and project budgets.	2	Active	Marc Paiment	Chris Rodrigues	02-May-16	Monitor	30-Jun-16	2	2	1	4	2	2	1	4
There are no Not Started, In Progress Actions associated with the risk.																	
Project: Unit Islanding - 73458																	
13311	Late identification of Islanding scope due to the outage planning activities [No Window Related]	Event: The Nuclear Safety Outage Risk assessments, Islanding Plan Updates, or the planned cold body review may identify areas of high risk which may add unexpected scope or mitigating actions to be developed by the Islanding project. Cause: Late identification of Islanding scope Impact: This presents a risk of late scope identification for the Islanding project. Similarly, other outage planning activities such as the work order assessing may identify scope additions for the project. This additional scope may impact upcoming milestones and project budgets.	2	Active	Marc Paiment	Chris Rodrigues	02-May-16	Monitor	30-Jun-16	2	2	1	4	2	2	1	4
There are no Not Started, In Progress Actions associated with the risk.																	
Project: Unit Islanding - 73459																	
13311	Late identification of Islanding scope due to the outage planning activities [No Window Related]	Event: The Nuclear Safety Outage Risk assessments, Islanding Plan Updates, or the planned cold body review may identify areas of high risk which may add unexpected scope or mitigating actions to be developed by the Islanding project. Cause: Late identification of Islanding scope Impact: This presents a risk of late scope identification for the Islanding project. Similarly, other outage planning activities such as the work order assessing may identify scope additions for the project. This additional scope may impact upcoming milestones and project budgets.	2	Active	Marc Paiment	Chris Rodrigues	02-May-16	Monitor	30-Jun-16	2	2	1	4	2	2	1	4
There are no Not Started, In Progress Actions associated with the risk.																	
Project: Unit Islanding - 73490																	
13528	While anchoring the airlock restraint into the floor a bolt may hit burried piping or cable [Window 8]	Event: While anchoring the airlock restraint into the floor a bolt may hit burried piping or cable. Cause: Floor scans didn't pick up piping and/or cables. Impact: When the bolts to restrain the airlock are drilled into the concrete they may hit cables or piping that are embedded in the concrete which will lead to schedule delays and cost impacts as the work will be stood down and damage assessed.	2	Active	Marc Paiment	Chris Rodrigues	02-May-16	Monitor	17-Feb-17	1	1	3	3	1	1	3	3
There are no Not Started, In Progress Actions associated with the risk.																	
Project: Unit Islanding - 73492																	
13528	While anchoring the airlock restraint into the floor a bolt may hit burried piping or cable [Window 8]	Event: While anchoring the airlock restraint into the floor a bolt may hit burried piping or cable. Cause: Floor scans didn't pick up piping and/or cables. Impact: When the bolts to restrain the airlock are drilled into the concrete they may hit cables or piping that are embedded in the concrete which will lead to schedule delays and cost impacts as the work will be stood down and damage assessed.	2	Active	Marc Paiment	Chris Rodrigues	02-May-16	Monitor	17-Feb-17	1	1	3	3	1	1	3	3
There are no Not Started, In Progress Actions associated with the risk.																	
Project: Unit Islanding - 73471																	
13854	D20 Mods and NPC Islanding Pre-req execution vendor costs may exceed estimate [Window 508, 511, 518, 531]	Event: This risk is to identify potential cost overruns by the execution vendor for the Negative Pressure Containment and D20 mods Pre-req work. Cause: Based on OPEX, vendor estimates have been increasing to complete project work. This is a result of estimate maturity once Engineering is complete, understimation of effort required, discovery work, and integration issues, Impact: Funding for the two projects is part of the Islanding bundle and contingency may be required to cover additional costs.	3	Active	Marc Paiment	Joanne Mercieca	03-May-16	Accept	31-Aug-16	4	2	2	8	4	2	2	8
There are no Not Started, In Progress Actions associated with the risk.																	
Project: Unit Islanding - 73472																	

13854	D20 Mods and NPC Islanding Pre-req execution vendor costs may exceed estimate [Window 508, 511, 518, 531]	Event: This risk is to identify potential cost overruns by the execution vendor for the Negative Pressure Containment and D20 mods Pre-req work. Cause: Based on OPEX, vendor estimates have been increasing to complete project work. This is a result of estimate maturity once Engineering is complete, understimation of effort required, discovery work, and integration issues, Impact: Funding for the two projects is part of the Islanding bundle and contingency may be required to cover additional costs.	3	Active	Marc Paiment	Joanne Mercieca	03-May-16	Accept	31-Aug-16	4	2	2	8	4	2	2	8
			There are no Not Started, In Progress Actions associated with the risk.														
Project: Unit Islanding - 73460																	
14450	APT tool may not be delivered on time [window 38]	Event: Accessibility Platform Trolley (APT) is expected to be delivered by mid December 2016 from manufacturer. The bulkhead installation is schedule for mid February 2017. If the APT is delivered on time, this leaves only 2 months to drop the APT in the vault and get the proper training. Cause: Manufacturer might miss the delivery date Impact: If the APT is delivered late, it could significantly impact the schedule (on critical path) since the bulkheads can't be installed unless the APT is in.	2	Active	Marc Paiment	Alex Markovsky	06-May-16	Monitor	30-Dec-16	2	3	3	6	2	3	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
Program: Contract Management -																	
705	Refurbishment Major Contracts Increase in Scope of Work	The risk is that Contract Management may be insufficiently resourced during project execution to deal with new and emergent Contract Management Activities including increased oversight requirements not accounted for during planning process. This could lead to formal claims, impair OPG vendor relationships, increased cost and schedule delays, etc.  Contract Management is currently procuring a Contract Management Support Services to provide support in the above areas. A PO is expected to be awarded in late Q2 or early Q3 2016.	2	Active	Doug Semple	Garry Lam	02-Mar-16	Monitor	31-Dec-27	3	2	2	6	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6086	In Progress	Create service contract of third party expert claim processing	Hire third party expert for claim processing for potential complicated claim situation, and to avoid damage to vendor relationship. RFP for third party contract management expert services in Q1 2016. Contract to be finalized and program initiated by end of Q2 2016.	Doug Semple	Garry Lam	30-Nov-16								
715	Funding for Unexpected Legal Costs	Additional and/or emergent legal support may be required over the duration of refurbishment to support, disputes, change management, etc. Insufficient funding to deal with these matters may lead to delays in legal clarifications, resolution of items and unnecessary litigation.	1	Active	Doug Semple	Garry Lam	02-Mar-16	Monitor	31-Dec-25	3	2	1	6	3	2	1	6
			There are no Not Started, In Progress Actions associated with the risk.														
714	Potential Contract Management Function Resources Required for future Master Services Contract(s) or Replacement Contracts	There is a risk that insufficient contract management resources have been budgeted beyond 2016 to support future MSA's (OSS replacement contracts, DESA, NSASA, Construction, etc). The contract management team achieved significant savings through identifying and correcting inefficiencies, ensuring alignment, and implementing issue resolution processes during the initial phase of the OSS contract. It is expected that similar issues will need to be managed with future contracts.	1	Active	Doug Semple	Garry Lam	02-Mar-16	Mitigate	31-Dec-27	3	1	1	3	2	1	1	2
			There are no Not Started, In Progress Actions associated with the risk.														
Program: EA and Licensing -																	
496	CNSC does not grant timely approval for unit return to service post refurbishment	The risk is that CNSC does not grant the necessary approvals for clearing of restart regulatory hold points in a timely manner thus impacting the return to service schedule.	1	Active	David Train	Paul Dunn	13-Apr-16	Avoid	31-Oct-19	1	3	1	3	1	3	1	3
			There are no Not Started, In Progress Actions associated with the risk.														
342	Regulatory Approvals Delayed	Regulatory Approvals not obtained in a timely manner to allow refurbishment activities to occur as scheduled.	1	Active	David Train	Paul Dunn	13-Apr-16	Mitigate	31-Oct-16	1	1	2	2	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			1820	In Progress	Risk Action	Licensing plan to be prepared identifying approvals required through life of project.	R J Maceacheron		31-Oct-25	Licensing Plan is in place. This is a living document and is revised as new approvals are identified.							
			1821	In Progress	Risk Action	Formalize agreement with CNSC on turnaround times for reviews and approvals.	R J Maceacheron		15-Jan-16	In- Progress							
	Hours of Work Limited by New CNSC Regulation	The risk is that the proposed new regulatory document on hours of work (REGDOC-2.2.1, Human Performance: Managing Worker Fatigue and Hours of Work) which will include casual construction trades workers will be onerous to implement and will limit the availability of construction trades	1	Active	Roy Martin	Robin Manley	13-Apr-16	Monitor	31-Dec-16	2	1	1	2	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

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Risk Report by Project with Associated Actions

639		workers for execution of Refurbishment.	3431	In Progress	Risk Action	NRAD, Human Resources, VP of Fleet O&M and the Refurbishment VP of Execution to review and comment through appropriate processes any new CNSC regulation on hours of work to ensure they are not too onerous to implement and will not limit the availability of construction trade workers for refurbishment.	R J Maceacheron		15-Oct-16	This action is associated with Risk 639 (Risk Response Type - Monitor).							
673	Licensing Fees Higher than Release 4c Budget Estimate	The risk is that the licensing fees are expected to be higher than projected in the 4c release estimate. The release estimate uses the 2014 CNSC projected costs for Darlington, and for Refurbishment, and assumes future increases over the life of the project remain constant at the 1.5% year over year increase projected for CNSC fiscal 2015/2016 and 2016/2017. The 2015 CNSC projected costs for Darlington and for refurbishment are due in early May. This risk will be updated at that time as required. April	1	Active	David Train	Paul Dunn	13-Apr-16	Accept	30-Jun-15	2	1	1	2	2	1	1	2
There are no Not Started, In Progress Actions associated with the risk.																	
Program: Engineering -																	
822	Completion of Refurbishment SIOs (Safety Improvement Opportunities)	The risk is that the 5 Safety Improvement Opportunity Projects (SIOs), which are a regulatory requirement to complete prior to starting refurbishment, are not complete and appropriate contingency plans to progress the Unit 2 refurbishment cannot be developed and negotiated with the CNSC, resulting in delays to Unit 2 execution and consumption of all the schedule contingency duration for on Unit 2.	3	Active	Art Rob	Art Rob	19-Apr-16	Avoid	15-Sep-16	3	3	5	15	1	3	5	5
There are no Not Started, In Progress Actions associated with the risk.																	
797	Vendor technical proficiency and less than adequate adherence to design governance may lead to unforeseen issues during design implementation/execution, leading to rework, cost overruns and schedule delays.	Failure to follow processes as written in design governance and failure to rigorously complete all required steps may not allow the full benefit of the robustness of the ECC design process to be realized. The many steps in the process are typically built upon previously identified process short-comings, and failure to rigorously execute each step may lead to re-work, for example failure to rigorously complete system heath/component health report research, failure to complete an effective COMs meeting, failure to complete a meaningful OPEX search, and failure to identify and address issues in the Issue Tracking file (ITF) may lead to an inadequate design. The inadequate design may not be fully released until the point of installation/execution, at which time rework, cost overruns or schedule delays may occur.	4	Active	Gregg Mccabe	Rajeev Leekha	11-May-16	Mitigate	30-Sep-16	3	3	3	9	2	1	2	4
There are no Not Started, In Progress Actions associated with the risk.																	
820	Discovery work arising from valve replacements	The risk is that there is a large amount of discovery work encountered in the valve replacement program resulting in cost impacts and schedule delays to the planned valve replacement schedule. This is caused by limitations in the ability to examine/inspect valves internals prior to refurbishments and OPEX from previous refurbishment projects.	1	Active	Michael Allen	Val Bevacqua	12-May-16	Monitor	28-Jun-18	3	3	1	9	3	3	1	9
There are no Not Started, In Progress Actions associated with the risk.																	
792	Scope Increase for Entrainment and Benthic Invertebrate Community Study & Entrainment and Benthic Invertebrate Community Study	Effluent Characterization: It is a CNSC commitment that the Effluent Characterization study be completed and used in the updated DN Environmental Risk Assessment, which is to be submitted to the CNSC by the end of 2016. The sampling plan for the effluent characterization has been reviewed and accepted by the CNSC. If this funding is not approved, we will not meet the CNSC commitment.  Entrainment and Benthic Invertebrate Community Study: OPG has committed to the CNSC and other regulators to confirm findings discussed in the DNGS EA for refurbishment and continued operations by implementing follow-up monitoring program (FUMP) which includes the entrainment and benthic invertebrate Community Studies and associated aquatic sampling work that must be completed prior the start of Refurbishment. Two reports must be submitted to the CNSC at the end of 2016 and one in 2017 to address the additional monitoring required for the Fisheries Authorization. Sample results may result in additional sampling being required.  Potential Impact: Delay in meeting the CNSC commitment.	4	Active	Nienke Smith		09-Mar-16	Mitigate	15-Jan-16	4	2	2	8	1	1	2	2
There are no Not Started, In Progress Actions associated with the risk.																	
	The risk is that less than adequate Engineering Proficiency by OPG or	Despite having fully capable, experienced and qualified individuals, insufficient awareness of proficiency factors and challenges contributes to errors. The risk is that less than adequate Engineering Proficiency by OPG or vendors results in quality issues or technical errors impacting	3	Active	Neil A Mitchell	Nienke Smith	11-May-16	Mitigate	30-Nov-16	2	2	4	8	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

811	Vendors since Proficiency has never been measured.	Proficiency report cards have been created to measures INPO's proficiency building blocks (list below). Gaps in proficiency will be determined by evaluating vendors and OPG personnel against the scorecards. Mitigating action 6748 (references AR 28184215-04) is to develop and implement the report card for OPG and each of OPG's primary vendor: General Electric, SNC, Sargent Lundy, RCMT, AMEC NSS, Tetra Tech, Worley Parsons and Areva. INPO Proficiency Building Blocks 1) Education 2) Skills Training 3) Repetition with feedback 4) Experience in a variety of situations 5) Timeliness or currency of performance	6782	In Progress	Proficiency The action is to formalize the requirement for monitoring and managing OPG and Vendor proficiencies by developing and implementing a report card. Reference AR 28184215-04, 5, 6. The proficiency scorecard has been developed and has been sent out to vendors and internally in OPG for feedback and comments by May 18, 2016. The feedback received from the vendor partners and OPG will be examined and incorporated into the scorecard as necessary. May 13, 2016 S. Malakhail	Nienke Smith	Saad Malakhail	30-Nov-16									
770	Discovery and Emergent work impacting Engineering	During inspections or detailed reviews of tasks it is possible that new work will be identified and will require Engineering support. It is expected that discovery work will be found during refurbishment outage and other IIP related work. The causes may be varied but centrerd around either inspections or re evaluation based on OPEX, or extent of condition, or new analysis. The impact of such emergent work could be further Engineering input as required beyond that has been included in the budget.	1	Active	Neil A Mitchell	Gregg Mccabe	11-May-16	Monitor	15-Oct-16	3	1	2	6	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			4919	In Progress	Engineering workload; Ability to meet the milestone for the completion of Engineering and Monitoring of schedule, cost, and quality related to the completion of engineering needs to be improved.	Engineering workload; Ability to meet the milestone for the completion of Engineering and Monitoring of schedule, cost, and quality related to the completion of engineering needs to be improved. Report wording for clarification: The challenge associated with the management of the large engineering workload has been identified in monthly reports to the MOE since June 2013. In Q2, 2014, refurbishment senior management recognized the issues related to engineering and initiated interim actions and a root cause investigation. The focus of the improvement actions has been the implementation of a collaborative approach to planning (preliminary engineering, scope definition and cost/schedule estimations) and detailed design engineering. This has resulted in examples of faster response for requested information and shorter review cycles for approval of an engineering package by the Design Authority. However, there has not been sufficient progress in the management of the engineering workload to remove the current challenge. This is based on on-going weaknesses in the management of engineering scheduled work to ensure overall ability to complete the workload, as well as monitoring the quality of engineering work to identify and correct adverse performance trends. The Nuclear Oversight Committee (NOC) of the OPG Board of Directors has also expressed concern over the ability to complete the large amount of engineering work by the engineering complete milestone of May 2015. Work down curve was presented to the NOC at its November meeting shows that the large majority of engineering packages (225 of 300) will be completed between March 1 and May 15, 2015. The NOC has sufficient concern over the detailed engineering schedule that it has requested an update in January 2015. Curve represents the completion of engineering work associated with the core refurbishment projects. It does not include the remaining engineering work for the Campus Plan and Safety Improvement Opportunity (SIO) projects. This engineering work will require some of the same resources that will be used for the engineering for the core refurbishment projects. Since there is not a similar work down curve for the Campus Plan and SIO projects, it is not possible to assess the impact of this parallel work load. However, it is not trivial. At the December 19th engineering project meeting, a table was provided identifying the number of engineering packages managed by the refurbishment organization as 244 and the number managed by the Projects & Modifications (PM&M) organization for the nuclear refurbishment as 421. In addition, there are an unknown number of station projects that are managed by the PM&M organization that must be completed prior to the start of the Unit 2 refurbishment outage. One example for which assistance has been requested from refurbishment engineering is PHF LRV Modifications to address waterhammer issues. The total engineering effort for the first six months of 2015 includes the work for the core refurbishment projects, the Campus Plan projects, the SIO projects, and other prerequisite projects. The core refurbishment projects have a work down curve for the engineering packages, but the others don't - thus not permitting an assessment of the aggregate engineering workload. By its nature, the large engineering workload in a relatively short period of time introduces a challenge to maintain high levels of quality. The monitoring and trending of engineering quality are critical for a large project. During Q4, refurbishment engineering has developed an engineering quality dashboard of nine sections that include both quality results and quality enablers. One key indicator of quality is the number of engineering Event Free Day Resets (EFDRs) during the period. During the first three quarters of 2014, there were 4 EFDRs declared, while in Q4, there have been 5 declared. The likely cause of the increase in number is improvement in sensitivity of quality issues rather than degradation in quality. OPG management correctly states that its engineering change control (ECC) process is consistent with industry practices. However, the ECC process is one aspect of quality engineering. With the EPC contracting model is used for projects, an equivalently critical process is the owner acceptance of design agency products. It is not clear that OPG's owner acceptance is fully aligned with industry practice. Given the cost impact and latent risk of engineering errors, it is recommended that OPG request WANO/INPO to perform a review of its engineering processes, specifically its owner acceptance of design agency products. In conclusion, further management focus is required to support the timely completion of quality engineering packages.	Neil A Mitchell	31-Dec-16	OPG Response: o OPG is on track for substantial completion of Engineering by the August 2015 milestone. o Currently, 65% of Engineering is complete. o Engineering for Re-tube & Feeder Replacement and Turbine Generators, which represents ~75% of direct execution phase work, is nearly 90% complete. o Detailed schedules and performance metrics are in place. o Engineering is performed in accordance with OPG's and the contractors' quality programs, and follows a rigorous change control process. o A program level Engineering quality dashboard is being implemented o Engineering is done under nuclear industry best practice processes developed by the industry over many years o Engineering processes are regularly reviewed and assessed, including WANO o We are not re-designing the plant o Identify what drives the need for a design change, e.g. largely regulatory o Put the workload in context; e.g. how many modifications and design changes, at a system level, are being made o Separate new facilities/systems, e.g. SIO's and campus plan, from other design changes o Bring out the point about the risk based approach that's used o How is quality monitored and managed o Identify that metrics are in place and dashboards to help track and manage the work are being developed Updated on June 2/15: OPG Response (1) Detailed design for the Darlington Refurbishment Program is 79% complete; 5% below target of 84%. (2) The variance is due to delays in the design of the Turbine Generator control system modifications which have been deferred from Unit Refurbishment. These design delays will be recovered by of July , 2015 and will have no impact on the RQE. (3) One of the lessons learned from all previous refurbishments was to complete detailed design before starting construction. Darlington Refurbishment Project will be the first Refurb project to meet this objective 13 months before the start of Refurbishment. 2016May06 - Meeting								
	Software Quality not fully implemented leading to delays in acceptance.	Software Quality not fully implemented may be caused by: - Incorrect Software categorization; - Incorrect or incomplete Software QA program, development or testing		Active	Rajeev Leekha	Bhaskar Pillarisetty	30-Mar-16	Monitor	23-Sep-16	2	3	3	6	1	2	2	2
	There are no Not Started, In Progress Actions associated with the risk.																

<a href="#">809</a>	testing or AFS	- Lack of documentation (e.g. Software verification, software maintenance plan etc.) These can delay the acceptance of the software EC package(s), delay in fully test the software systems, concessions / exceptions for missing/missed software processes and delay in commissioning and AFS of modification.															
<a href="#">702</a>	Resource Risk for Unit RTS, Commissioning and Close-Out	The risk is that there are not enough Systems and Components Engineering resources for the following phases of the project: 1) Execution readiness preparations (ie. CWP review/approval, Workplan preparation, Holds assessment and removal, TPAR review, Procedure review and approval, etc.) 2) Unit Return to Service (RTS) (i.e. Restart specifications and Workplan preparation/execution, etc.) 3) Commissioning (i.e. commissioning report preparation/approval, commissioning Workplan preparation/execution,. etc.) This is primarily due to major milestone/delivery changes (i.e. removal of segmented documentation & holds removal milestones); as well as, incrementally higher resource demands during the overlap of subsequent outages which delay the project execution. The cause of this may be inadequacy of appropriately trained staff in terms of numbers or Money available to add FTES that may be available to complete the work in a timely way.	1	Active	Paul Ross	Paul Ross	09-Mar-16	Monitor	01-May-19	2	1	2	4	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">789</a>	New scope for Modification added to Refurbishment Project	During detailed assessing and schedule development it is possible for alternative support supplies (electrical, water, air) to be identified. Past experience is unit outages has typically identified these requiriements well after the milestone for design complete and often continues through out the outage. The impact is the resource in Design Engineering and Project Support to cope with the additional demand.	2	Active	Gregg Mccabe	Rajeev Leekha	11-May-16	Mitigate	17-Mar-17	4	1	1	4	2	1	1	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">5811</a>	In Progress	Establish simplified processes to enable existing resources to responced in a timley fashion	In order to respond to discovery and/or as found issues, the processes for responce need to be streamlines where possible. the FIC process has already been optimized. Use the results of the Lean analysis to simplify other processes.	Rajeev Leekha		25-May-16	14MAR2016 - FIC presented at RTE meeting, monitoring of FIC generation on test phase work is showing only 1 FIC generated and these have been completed within the shift. No additional recommendations on the FIC process. FIC was revised, to be presented at RTE meeting. Other processes being examined include NICR and Commissioning Specification.							
<a href="#">823</a>	Vacuum dry slower than expected	The risk is that the vacuum dry of the heat transport system is slower than expected, caused by inadequate design or implementation challenges resulting in cost increase/schedule to the refurb program.	1	Active	Neil A Mitchell	Paul Ross	26-Apr-16	Monitor	26-Apr-16	2	2	2	4	2	2	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">750</a>	Impact of Discovery work during execution of IIP Commitments classified as Acceptable Deviations	The risk is that OPG may not be able to complete a number of IIP commitments classified as Acceptable Deviations. The risk covers a number of IIP commitments that involve inspection of components not normally accessible while the UNit is in operation.. These inspections may result in critical discovery work that may result in increased costs and a deviation of to the original IIP schedule.	1	Active	Nienke Smith	Nienke Smith	11-May-16	Mitigate	31-Mar-16	1	1	3	3	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">824</a>	PHT Pressure restricted to below 6 Mpa	The risk is that the primary heat transport system pressure is restricted to below 6 MPa due to continue use of current operation envelope designed for aged pressure tube, resulting in (cost increase/schedule delay/latent operating condition, increased operations, production, or safety risk during operation/other) to the (station, project bundle, refurb program)	1	Active	Neil A Mitchell	Paul Ross	19-Apr-16	Accept	26-Apr-16	1	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Program: Engineering - FN																	
<a href="#">796</a>	Increased Scope of Environmental Assessment Follow-up Program Elements Resulting from CNSC Negotiations	The original estimate for the Environmental Assessment (EA) follow up program elements was based on preliminary understanding of the commitments presented in the EA. Recent negotiations with the CNSC on the Effluent Characterization and Entrainment and Benthic Invertebrate Community Studies resulted in expansion of the scope of work. Negotiations with the regulator is ongoing for the other sampling plans and may impact other EA follow up program elements. The impact of this risk is increased scope, increased cost and delays in schedule. This risk can impact completion of Integrated Implementation Plan (IIP) Items IIP-EA-010, IIP-EA-011, IIP-EA-012 and IIP-EA-013.	3	Active	Nienke Smith		09-Mar-16	Monitor	30-Mar-16	2	1	2	4	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														

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Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

Program: Engineering - BA																		
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
Program: Engineering - BP																		
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
Program: Engineering - CI																		
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
Program: Engineering - DF																		
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
Program: Engineering - FH																		
	Less than adequate technical specifications impacts the procurement of	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															



808	materials, components or services.	2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.																		
Program: Engineering - LU																				
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2			
There are no Not Started, In Progress Actions associated with the risk.																				
Program: Engineering - ME																				
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2			
There are no Not Started, In Progress Actions associated with the risk.																				
Program: Engineering - RF																				
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2			
There are no Not Started, In Progress Actions associated with the risk.																				
Program: Engineering - SF																				
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2			
There are no Not Started, In Progress Actions associated with the risk.																				



Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

Program: Engineering - SG																		
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
Program: Engineering - SL																		
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
Program: Engineering - TC																		
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
Program: Engineering - TL																		
808	Less than adequate technical specifications impacts the procurement of materials, components or services.	Less than adequate technical specifications can be caused by: 1. Lack of proficiency for the task by the preparer/verifier - due to incomplete qualification or experience 2. Incomplete understanding of the Station systems etc. and the function of the component within the system. 3. over or under documentation of requirements related to the material, component or service. This can result in specifications that cannot be fulfilled by available sources causing delay in obtaining the required material, component or service, rework when specifications must be revised, processing of exceptions or concessions from vendors to allow them to bid, higher cost etc.	2	Active	Rajeev Leekha		24-Mar-16	Monitor	30-Sep-16	2	3	2	6	1	2	1	2	
			There are no Not Started, In Progress Actions associated with the risk.															
Program: Human Resources -																		
	Refurbishment leadership and specialized project management resources are	The risk is that OPG senior leadership team and key project management talent will not be retained on the Project over the 12 yr+ duration, putting the Project at risk of success. The risk can be characterized into the following categories: 1. OPG Nuclear is largely an operations and maintenance	3	Active	Candice Kay		21-Apr-16	Mitigate	31-Mar-16	4	3	3	12	3	3	3	9	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								



561	not in place and secured in role could result in significant impacts on cost, schedule and quality.	based organization with talent in large scale regulated mega-project management that is still maturing. As a result, project management leadership and talent streams need to be cultivated within the organization and/or sourced externally from the competitive market. 2. Demographics are such that close to 70% of those in the senior leadership roles on the Refurb Project (Band F and up) are eligible to retire by the next 3 years. 3. Succession planning and development initiatives have not been given the profile necessary needed to ensure leadership capacity needed for a successful refurbishment project. 4. Compensation and staffing restrictions resulting from external bodies such as the Auditor General and shareholder legislation has caused OPG to adjust policies in an effort to balance reputational harm.	3290	In Progress	Succession Planning / Process Improvements 2.4	Utilize standardized metrics for measuring leadership “Health Pipeline” for Projects	Candice Kay		31-May-16	<ul style="list-style-type: none"><li>· To be developed across the fleet in a standardized fashion by Talent COE.</li></ul> UPDATE MARCH 10 (L. Ainsworth for Candice Kay) Nuclear Projects Peert Team - launched the Succession Planning efforts. All Priority 1 roles to be updated by April 30, 2016. Nuclear Projects role have been further integrated into the Nuclear Succession Planning process by:  Adding more roles to Priority 1 reviews, and by defining Priority 2 Project roles. All IDP’s to be completed for MG & Priority 1 & 2 candidates by May 20, 2016
			3306	In Progress	PPR Health & Development Planning 4.4	Mandate Knowledge Transfer for current incumbents that are in a Priority 3 role – ensure Temps and Contractors in key roles have this as part of their performance measures	Candice Kay		31-May-16	<ul style="list-style-type: none"><li>· For 2015 PPR’s consideration or meet wide Knowledge Transfer.</li><li>· New tool to be rolled out to ELT &amp; NEC Q2, 2015.</li><li>· Nuclear Projects cascading to occur and embedded into PPRs as determined by Q3, 2015.</li></ul> UPDATE MARCH 10 (L Ainsworth for Candice Kay) PPR for 2016 to be aligned with Project Excellence goals - cascade to all staff. Nuclear Projects:  Staffing Plan to be approved/finalized by May 2016 (Draft completed by April 2016)  Project Management Capability Builder - Plan in place as per Project Management Peer Team

Program: Managed Systems Oversight - 10000

764	Vendor Performance and Inexperience Managing their CA Programs	EVENT: Vendor or OPG Poor Performance requiring additional oversight resources. CAUSE: Cause of Vendor or OPG Poor Performance may be due to lack of capability, lack of experience or time pressure. IMPACT: Impact would be to conduct additional oversight surveillances to identify and correct the problems and potential delays to field work. EVENT: Increased number of SCRs requiring additional OBU Resources from Corrective Action Control Group. CAUSE: Cause of increased number of SCRs would be due to vendor's inability or inexperience in managing their corrective action programs to OPGs expectations. IMPACT: This would prompt OPG Senior Management to request MSO to include all vendor adverse conditions in the OPG SCR database. Further, poor vendor performance of the CA programs would result in recurring field issues and potential cost impacts and schedule delays to NR.	2	Active	Dave Stiers	Frank Dias	11-May-16	Mitigate	31-Jan-17	3	1	3	9	2	1	3	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			6019	In Progress	Execute Plan for implementation of guideline on Use of OPG Corrective Action Process for Vendor Issues	Execute Attached Plan for implementation of guideline on Use of OPG Corrective Action Process for Vendor Issues.	Dave Stiers	Frank Dias	30-Jun-16								

Program: Operations and Maintenance -

	Return to Service funding does not support RTS operating as a proiect	RTS is currently set-up as a functional support group. Funding is to provide oversight of the RTS process with work being completed by other groups such as operations, maintenance, engineering and chemistry. During the RTS process. modifications are required to support evolutions such as hot		Active	Boris Vulcanovic	Mike Stewart	10-May-16	Mitigate	30-May-16	5	1	5	25	5	1	1	5
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

804		conditioning and the HTS hydro test. For the purposes of the RQE submission, these projects were to be supported by a currently establish refurbishment project bundle. Following the RQE submission, it was decided that RTS would act as a project to support these evolutions and any other that arise. RTS requires additional funding to be able to perform this role. If funding is not provided, there is a risk to the current schedule as engineering, procurement and installation needs to be initiated to meet the target dates.	5906	In Progress	Hot Conditioning project bundle assignment (HTS RTS HIT)	Project bundle required for HTS Hot Conditioning. Management has asked RTS and Eng to review taking this project. Mike Stewart and Paul Ross are reviewing the doability of performing project functions. Recommendation to be given on feb 5th and due date updated. 02/03/2016	Mike Stewart		15-May-16	DRAS is ready for M. Allen signature. It will then go to PSRB for review and acceptance. Following PSRB, a project bundle will be assigned for the hot conditioning process. 30 Nov 2015 January 8, 2016: DRAS is signed and bundle assignmet on the agenda for the next PSRB. Jan 11: Action owner requested a project bundle to be assigned the scope. Issue is to be presented to Mike Allen for bundle assignment. Jan 15 - due date moved to reflect PSRB assigning bundle with mike Allen. Feb 23 - due date moved, RTS is considering the efficiency of creating a new project versus using the infastructurer of a current project. Mike Allen/Boris Vulcanovic to make the final decision. New due date to reflect time for review. March 6/2016: CCF initiated for RTS to become a project by hiring a PM and an MTL. Closure of this action will be done on acceptance by CCB and funds allocated. March 15, CCF ready but not being presented until April CCB. Risk#804 initiated. Apr. 04/2016 updated by A. Kalafatis: CCF now being presented at May CCD. Due date moved to May 15/2016.									
			5907	In Progress	Hot Conditioning skid and monitoring equipment procurement, engineering and installation (HTS RTS HIT)	Establish the parameters of a DSR and drive the approval to get a funding stream released with a project manager assigned to get the necessary design and procurement completed	Mike Stewart		15-May-16	Awaiting action 5906 on assignment of project bundle. Due date move to April 15/2016 to allow time for HTS RTS path forward to be completed. CCF ready but not going to CCB until April, Risk#804 initiated Apr. 04/2016 update by A. Kalafatis: CCF now planned for May CCB. Due date moved to May 15/2016.									
805	Breaker Open Milestone at Risk due to the lack of required deliverables received by Ops and Mtce	Event: TPAR Milestone was missed and Vendors were given an additional 2 1/2 months to complete. Other TPAR milestones are not adjusted. O&M deliverables affected are TCR-FAR-Training Packages-Turnover Plans-TPARs. Cause: Originally the TPAR milestone was Oct 2015, one year prior to Breaker Open. This gave O&M 12 months to prepare for Refurbishment shutdown. Design was late and Milestone was re-adjusted and split up and now due February, giving only 9 months for O&M to complete their required Work. Vendors couldn't make that Milestone so Projects gave them an additional 2 1/2 months, giving only 6 1/2 months for O&M to do the same work we had planned and said we needed 12 months. Impact - O&M deliverable for TPARs, TCR FARs, Training packages and turnover plans are delayed and O&M is crushed for time due to Vendors not making milestones. TPARs and TCR-FARs are still trickling in. RTS is going around to Project Managers to get the Vendors to start Turnover Planning. Training is waiting on procedures (TPAR) to be completed so they can train the operators and maintainers in preparation for Refurbishment Breaker Open Milestone. April Update: OP2070 -Assessing Milestone (April 15) Missed and extended 2 1/2 months.	4	Active	Boris Vulcanovic	Mike Dance	12-May-16	Monitor	04-Jul-16	5	1	5	25	5	1	4	20	There are no Not Started, In Progress Actions associated with the risk.	
	Valve Program Vendor Contract not Secured	Event: Currently the Work Control department is creating a valve schedule. Schedule changes are very likely once Vendor is chosen. Resource leveling is not possible until figures are provided. Currently, there is no established strategy to execute the Valve Maintenance program for Unit 2. This	4	Active	Val Bevacqua	Val Bevacqua	12-May-16	Monitor	31-Aug-16	5	4	4	20	3	2	2	6	There are no Not Started, In Progress Actions associated with the risk.	

ONTARIO

POWER

GENERATION

Risk Report by Project with Associated Actions

Report ID:0707A [Tech Tips](#)

Report Owner:L. Greenland

Process Owner:R. Smith

Data Refreshed:12-May-16 10:30 PM

839		<p>poses significant risk to the planning exercise currently underway for the other projects in Refurb, Major impact: Missed milestones for Planning, Assessing, ITP's, and CWP's , BWXT declined to perform the cyclical valve maintenance. Currently there is \$12M allocated to perform 640 Crit 1 and 2 valves. The BWXT quote prior to their decline of the work was \$48M. Maintenance is preparing Scope of Work to initiate a contract to perform this valve work. This contract will also include ~ 480 crit 3 and 4 valves that were to be performed and funded by maintenance.</p> <p>The late awarding a new valve contract is documented in risk 14257. The risk of increase scope due to discovery in the valve program is documented in risk 718.</p> <p>This risk is to document the possibility that the valve contract may exceed the \$12M originally allocated for the crit 1 and 2 valves and the maintenance allocation for the crit 3 and 4 valves.</p>															
708	Materials budget for emergent broke-fix maintenance and scope growth during Shutdown, Layup and Runup is not included in MTCE budget.	<p>Event: Materials required for broke-fix maintenance and scope growth during Shutdown, Layup and Run up Phases is not in MTCE Budget</p> <p>Cause: Contingecy funds not included in business planning process</p> <p>Potential impacts: Unable to repair, required for start up equipment, affecting critical path duration.</p> <p>1. From Scope Freeze to Breaker Open: For the purpose of calculating the contingency for this specific risk, we assume, based on station IPG scope growth history, that there will scope growth between each Unit WO scope freeze and breaker open. Based on DNGS IPG history, 1-2 work orders are added to scope per day. The added work is then scheduled in the online schedule (not necessary FIN work to be executed immediately). It is expected that much of the work added during this period would be executed by DNGS IPG, however, some scope may be added to D1621 scope and executed during the outage proper. This type of 'cyclic' backlog scope will occur over a period of 16 months for each unit. We are estimating that, of the identified work during unit operation during this time period, 1 WO per week will actually be accepted into B/O-B/C scope. That equates to 64 new work orders. We assume a cost per work order of \$6,000 average per work order. In total, this calculates to \$400,000 per unit. (\$1.6 million for overall Program).</p> <p>2. From Breaker Open to Breaker Closed: For the purpose of calculating the contingency for this specific risk, we assume, based on station outage history, that there will be an average of 4 work orders per day of the outage, reviewed and approved for new scope, from breaker open to breaker closed. At Scope Freeze for D1621 and DNRU2, the D1621 WO # was 5,498. At 4 new WO per day, at ~1100 days, equals 4,400 work orders. We assume a cost per work order of \$6,000 average per work order. In total, this calculates to \$26 million per unit (\$104 million for overall Program).</p>	2	Active	Boris Vulcanovic	Val Bevacqua	12-May-16	Monitor	15-Oct-16	5	2	3	15	3	2	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
718	The Cyclic Maintenance budget may not have enough funds (Labour & Materials) to cover Shutdown Maintenance Backlog	<p>Event: An independant review of the Cyclic Maintenance Budget confirmed there will be a shortfall of funds assigned to the D1621 work Program associated with Shutdown Maintenance cyclic work orders. This work is part of the Equipment Reliability Index target that will be committed to for the return to service of Unit 2.</p> <p>Cause: Initial budget assigned to cyclical overflow was estimated at \$78M per unit. Present budget is \$34M. Estimates received to date from Vendors are totaling \$51M.</p> <p>Potential impact: Shortfall of funds impacting RTS of unit 2</p>	3	Active	Boris Vulcanovic	Val Bevacqua	12-May-16	Monitor	15-Oct-19	5	2	3	15	3	2	3	9
			There are no Not Started, In Progress Actions associated with the risk.														
	Documentation Milestones for Refurbishment are at RISK due to Hiring process	There is a gap in O&M Technical Procedures Team for a Verifier (DNG ANO qualification) the hiring process preferred vendors not having the necessary talent. There are only 23 individuals who have	4	Active	Boris Vulcanovic	Mike Dance	12-May-16	Monitor	12-Feb-16	5	1	3	15	5	1	3	15
			There are no Not Started, In Progress Actions associated with the risk.														



Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
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Data Refreshed: 12-May-16 10:30 PM

777	and Augmented Staff rules.	<p>this qualification and are retired. we have asked for exceptions around the rules in this case but denied. Still have no Verifier on the team and I am having to request NR OPs Manager to act as Verifier. He could be a bottle neck. The other part is the Augmented Staff Contract duration. Max for outside contractor is 5 yrs. Max for OPG rehire is 3 years. We are supporting a 10 yr project. If we cant keep contractors beyond these durations all the way through refurb we will be starting over with new talent constantly repeating lessons learned. Negotiations need to made with Auditor General to get an exception for the Refurbishment Project.</p> <p>Background: Refer to SCRs N-2015-21011 and N-2015-21102 on overall hiring process and governance. There is a lack of necessary talent in the present preferred Vendors supplying Augmented Staff. For the O&amp;M Technical Procedures Team it requires experienced Operations and Maintenance Staff previously employed by OPG. They have to knowledgeable of System and Change process for Technical Procedures owned by O&amp;M.</p> <p>HR AUGSTAFF group can only reach out to our Preferred Vendors (CPUS, CTSNA and Ian Martin). The Jobs have gone out to the agencies to advertise on July 10, 2015. Request for additional Resume has gone out to the Agencies numerous times. Once a month since July, we also had a conference call led by Aug staff so I could directly talk to all the preferred Vendors requesting these specialized staff. To do that I have one OPs staff and still waiting on Security Clearance, and I had one other OPs staff who accepted another Job Offer and a Mtce Staff who got another Job with a different company while still waiting for security clearance. The staffing plan was to have 2 OPs and 2 Mtce start in July to ensure we made our documentation milestones in 2016. The first being OP2160S1 February 15, 2016; this would be for Containment, Layup and Islanding documentation ready for Training and field staff to be successfully in Layup and Islanding of Unit 2.</p>															
565	Insufficient Qualified Radiation Protection Coordinators (BTU) to support Execution	Event: Insufficient number of qualified Radiation Protection Coordinators (RPCs) to successfully provide service protection oversight for radiological work performed by EPC contractors. Cause: due to low numbers of currently qualified Trades RPC's plus attrition and insufficient training and qualification of new Trades RPCs prior to execution of Refurbishment activities and opportunities with other industrial project in the province. Impact: may lead to schedule delays and cost overruns or could cause RP events due to lack of oversight or lack of properly experienced oversight.	3	Active	Johnathon Hash	Jeff Johansson	12-May-16	Monitor	29-Jul-16	4	2	3	12	2	1	3	6
There are no Not Started, In Progress Actions associated with the risk.																	
748	Transition/Transfer Plan commitments not met (Ops & Mtce Readiness)	Refurbishment may not have sufficient Ops and Mtce resources to execute pre-requiresite miletone deliverables (e.g. assessing, procedures, permitry, strategic plans, licensing) as well as field staff to execute pre-requisite field work for D1621 and DNRU2. NK38-PLAN-09701-10113 Sht OPS-01 Operations Ownership Transfer Plan andNK38-PLAN-09701-10113 Sht OPS-01 Maintenance Ownership Transfer Plan require additional details and clarification on roles and accountabilities of both site and refurb organizations. This includes the plan for transition of staff from Darlington to Refurbishment for both preparation and execution phases of the project. A comprehensive review of the state of Readiness of Ops & Mtce is required to ensure metrics are in place, strategic plans are progressing and resources are being applied for success.	2	Active	Boris Vulcanovic	Ross Mccord	12-May-16	Monitor	15-Sep-16	4	2	3	12	2	2	2	4
There are no Not Started, In Progress Actions associated with the risk.																	
860	Vault Projects Window (104) working opportunities	Event: There is the possibility of extending the working window availability by 25 days in Window 104. This is the period of time during the Dummy FB Removal and PT Sever. No work is currently being scheduled due to lack of clarity on the RP rules required for such work. This needs to be resolved to allow maximum use of this near critical path work window.		Active	Johnathon Hash		11-May-16	Monitor	16-Sep-16	3	2	4	12	1	1	1	1
There are no Not Started, In Progress Actions associated with the risk.																	
864	Identifying priority for staff within our BTU Project ranks and staff assigned to BTU Refurbishment	A risk was raised to ensure we have documented direction and planning for staff who are assigned to Refurb when non routine events occur. The risk identified includes (but is not limited too) response to IPG events, response to events within the refurb project but outside of our U2 island, various facility events and work priorities during significant competing projects (such as an outage).	2	Active	Johnathon Hash	Jeff Johansson	11-May-16	Monitor	07-Oct-16	4	2	3	12	1	2	1	2
There are no Not Started, In Progress Actions associated with the risk.																	
	Availability of DN Authorized Staff for Station and Refurb Support	Event: Insufficient authorized staff (certified Authorized Nuclear Operator (ANO), Control Room Shift Supervisors (CRSS) and Shift Managers (SM)) staff (2013-2017) and Non-Licensed Operator (NLO) staff (2013 >2020) to support Operations (outage. On-Line work (IPG). Emergaent Work (FIN).	4	Active	Boris Vulcanovic	Ross Mccord	12-May-16	Mitigate	02-Apr-17	5	1	2	10	3	1	2	6
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

677		<p>procedures, training) and Refurbishment planning and execution. Causes: 1) Attrition due to retirements of ANO, CRSS/SM, NLO and Authorized Training Staff (ATS) due to demographic pool. 2) ANO initial training program throughput has historically been lower than the 60.0% previously assumed. 3) CRSS initial training previously have not been successful in producing new candidates for two (2) consecutive groups. 4) Lack of Authorization Training program-ready candidates has resulted in 40% to 50% smaller than Business Plan class sizes causing refloat to NR OM&amp;A budget for ANOITs. 5) Knowledge gap between NLO and ANO In Training (ANOIT) results in lower entry calibre. 6) Shortages in Authorized Training Staff (ATS) to support ANO recovery plan needs. The risk is compounded by a high reliance on augmented staff to support a recovery plan and operate the business. Impact: This has the potential to impact on refurbishment planning and execution, Unit outages and VBO durations, efficiency of FIN and IPG, support for Authorization Training and backlogs in Ops Procedure.</p>	1481	In Progress	Risk 677 - action 12 to mitigate the effects on critical path due to the lack of certified staff	Remediation Plan (Plan B) For refurbishment, key positions are being filled by Darlington previously licensed contract staff. Plan B requires that augmented staff previously licensed at other CANDU stations be used where necessary. Although this strategy is not optimal it partly mitigates the shortfall risk as a larger pool of previously licensed staff is available for use in the refurb planning phase. This strategy may need to be extended into the execution phase of the refurb project. An agreement is in place between the station, training and refurb on the placement of contract staff previously licensed at Darlington to ensure qualified augmented staff is placed as priorities dictate. Preparations are underway to staff the refurb unit with non licensed staff once fuel and D2O has been removed. This could allow the refurb ANO to perform other refurb duties (such as IA) while non licenesed staff monitors the unitthus increasing the availability of currently authorized staff for refurb execution.	Ross Mccord	Dan Cowley	29-Feb-16	updated plan B actions to include non licensed staffing of refurb unit, changed due date to May 31th to monitor potential impacts of new NR contracting policy on authorized staff availability for contract work. All actions are on track and progressing. Authorized Nuclear Operators are no longer the critical group. CRSS authorized personnel are now the recognized critical resource. There is sufficient CRSS in the training program and their progress is being monitored closely. Plans are in progress to accelerate the co piloting of the successful candidates to meet refurb needs however for the lead unit however we will be unable to co pilot adequate numbers in time. In order to mitigate this senior ANO staff will be considered for step up during the initial phases of the outage. These numbers have been built into the RQE estimate.									
758	Chemistry Laboratory Support	Event: a Chem. Lab technician (1 FTE) was to be assigned from January 2015 to support the DNR Chemistry/Technical section. This didn't materialize as planned. Starting on May 20th the lab was expected to release someone to support refurbishment 2 days per week. This support has not been received consistently. Cause: Currently there is a shortage of resources due to some staff members being on a long term absence from work and due to the time lag associated with hiring a new technician following a retirement. In addition there are at least 7 staff members who are eligible to retire by the end of 2016. It takes 18 months minimum to qualify an individual. Impact: Refurbishment Chemistry & Environment is not confident that the Darlington Laboratory will have qualified staff and analytical equipment in place within 16 months to support work that is in approved scope.	3	Active	Boris Vulcanovic	Roger Daly	10-May-16	Monitor	31-Aug-16	5	1	2	10	3	1	1	3		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			5396	In Progress	Implement a lab readiness plan	Implement a lab readiness plan that will bring the laboratory into position to support Refurbishment earlier than breaker open. The plan would involve a regular meeting where areas that are being tracked are discussed and work down curves are presented where applicable. Items that are currently deemed at risk include: i) Hiring to address increased attrition expected. ii) Training program for Refurbishment Unit access (health and safety training) and refurbishment sampling (From shut down to RTS) iii) Instrument commissioning	Roger Daly	Emily Cornthwaite	14-Sep-16	As of 28Jan2016 the laboratory has had 1 individual retire and 2 individuals on long term medical absences since this action was initiated. A review of the SCR database revealed that there were 13 Darlington SCRs raised since June 2015 when the lab started to provide regular support for the refurbishment project (It is important to note that the VBO and a forced U3 outage also occurred during the surveyed period). A 'day in the life of a refurbishment laboratory technician' exercise is currently being prepared. This exercise is the first step required to quantify any potential discrepancy in resources required to support refurbishment activities. SCRs were unable to be linked below. They include: D-2016-00739/ 01985 and D-2015-12824/ 14726/ 15220/ 15604/ 15991/ 17416/ 17597/ 18693/ 29981/ 30018/ 30137									
863	Evaluate hazard impact during changing system configurations and status during refurbishment	Dynamic system changes will occur during refurbishment. Ensuring we have the monitoring in place during these changes will ensure we do create unintended risk to staff and other work due to increased hazards. This is a learning event from the End Shield Cooling drain during 2014. For refurbishment, the critical risk is to identify during significant changes to systems the appropriate type and frquency of monitoring PRIOR to the change execution so RP and associated organizations can validate assumptions for intended impact. In some cases, systems will be drained as a first time activity. Regardless, any reduction in shielding or introduction of unsurveyed internals needs to be identified and mitigating actions in place.	2	Active	Boris Vulcanovic	Johnathon Hash	11-May-16	Monitor	10-Oct-16	5	2	2	10	1	2	2	2		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			7646	In Progress	Secure OSS contract to produce a Field Execution Manual	RP will commission a manual modeled on the Unit 2 Level 2 Logic reference manual. This manual will detail RP support plans and rational for use by Field staff to better understand the project goals.  The scope of work will maintain floor plans, system window timelines, REPs, day in the life expectations as well as critical fundamental reference items for everyday use as well as context for briefing by RP personnel.	Johnathon Hash	Joe Cicchini	07-Oct-16	Drafting the N Form for OSS support.									

706	Present ERT mincomp plan does not accommodate for and Islanded Unit while meeting adequate response time to emergent events	Event: DN Refurbishment organization is oblidge to comply with fire protection regulatory standards. Darlington's present ERT mincomp plan does not accommodate for and Islanded Unit while meeting adequate response time for potential emergent issues. Cause: A safety event that required ERT to respond either on Islanded Unit or Station. Other work requiring ERT to respond in the event of an emergency will be required to stop until ERT able to respond. eg, hot work, high angle rescue, confined space Potential impact: All work requiring ERM response to safety issue will stop if ERMs are required to attend to another event	1	Active	Boris Vulcanovic	Val Bevacqua	12-May-16	Accept	15-Oct-16	3	2	3	9	1	1	2	2	
			There are no Not Started, In Progress Actions associated with the risk.															
779	Shielding required to access vault via AI 2 and associated west stairs	Owing to the frequently changing nature of vault gamma beams, secure access and egress routes to vault work on the upper elevations is problematic. Coordination of work in windows with safe access paths in a manner those does not impact the RFR Joint venture, and thus delay critical path, may prove unmanageable, Additionally, analysis of the risk of an unplanned exposure may conclude that it is appropriate in terms of ALARA planning to provide this safe access route. The risk is that a decision will be made to install a shielding modification that is not covered in current program cost projections.	3	Active	Johnathon Hash	Johnathon Hash	11-May-16	Monitor	30-Sep-16	3	1	3	9	1	1	1	1	
			There are no Not Started, In Progress Actions associated with the risk.															
865	Acquisition, management, deployment and Storage of Contamination Control Equipment	Ownership and Control of HEPA units, Vacuums, and Munter Tritium scrubbers during refurbishment is not clear. At present, there is no program which describes the purchase, management, storage and use of semi-portable equipment required to ensure effective contamination control will be available and maintained on the project. This risk may include components of the plan to install the large Munter units in the vault however, the risk is raised to account for the other equipment expected to be needed during refurbishment activities.	2	Active	Johnathon Hash	Jeff Johansson	11-May-16	Monitor	30-Dec-16	3	1	3	9	1	1	1	1	
			There are no Not Started, In Progress Actions associated with the risk.															
728	Acute Tritium Release above Station IIL during NR Primary Side Drain and Dry Operation	Event: Potential to have an acute Tritium Emission that exceeds the Station Internal Investigation Limit (IIL)for tritium emissions during the NR Outage, particularly during Moderator and Heat Transportdraining and drying steps. Cause: -High tritium inventory in Moderator System, ineffective drying capacity from skids, poor condition of Vault Vapor Recovery Dryers or insufficient focus on Spills and Leaks. Potential Impacts. -Could delay work due to driers or skids needing regeneration. - Unfavourable Public Relations if high emissions persist and if insufficient preparation done ahead of time to mitigate.	2	Active	Roger Daly	Ray Kissel	10-May-16	Mitigate	14-Oct-16	4	2	1	8	3	1	1	3	
			There are no Not Started, In Progress Actions associated with the risk.															
	Large Potential Worker Doses due to Inadequate Internal (Alpha etc.) Hazard Characterization and Management	Event: Nuclear Refurbishment employees or Contractors are exposed to unexpected radionuclide(s) which leads to significant dose assignment. Cause: Source term chacterization was inadequate and thus radiological work planning, protective actions and dosimetry requirments do not properly protect workers from the hazards present. Impact: Potentially high doses that could exceed OPG dose limits or CNSC Dose limits, as well as a disruption to Nuclear Refurbishment work. Regulatory, public and union relations issues would be very problematic and would be amplified by the fact that Bruce Power had the same type of event during their refurbishment. Risk 508 closed to this risk, (564)	3	Active	Johnathon Hash	Johnathon Hash	11-May-16	Mitigate	30-Dec-16	3	2	2	6	2	2	2	4	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			5876	In Progress	Strategy for smear samples to determine radionuclide characterization for U2	a) Source Term Characterization · Section 2.2: Develop a strategy for taking smear samples for the purpose of source term characterization of Unit 2 when radioactive systems are opened up for refurbishment. Samples locations should include radioactive systems in Unit 2, RWPB, and Fuel Handling. Once samples are taken, they should be analyzed radio-chemically and the conclusions with respect to dose contributions from the AMEC report should be validated. Also calculate the beta-gamma: alpha ratio to confirm capability of WBM to indicate the presence of alpha emitting radionuclides in the body and continued use of pancake for both beta-gamma measurement and, by inference, alpha presence (as per N-INS-09071-10013). TCD: March 1, 2016	Johnathon Hash	Scott Stafford	30-Sep-16									



<a href="#">5877</a>	Not Started	Confirm Alpha Level III classification with U2 Smears	<ul style="list-style-type: none"><li>Section 2.2: Based on current source term knowledge, some areas where open work on contaminated HT system components is being done may fall into the Alpha Level III classification. Therefore the requirements for work as described in N-INS-09071-10013 should be implemented for those areas. The classification level should be confirmed on an ongoing basis with Unit 2 alpha characterization smears analyzed by the iSolo. TCD: March 1, 2016</li></ul>	Johnathon Hash	Scott Stafford	30-Jun-16	
<a href="#">5879</a>	In Progress	Test ICP-MS Method to Identify the presence of hard to detect Radionuclides	<ul style="list-style-type: none"><li>Section 2.2: Test the method of ICP-MS on Unit 3 outage samples to identify all potential radionuclides (especially those that are hard to detect). The ICP-MS method will identify all stable elements and their isotopes and then calculating the relative activity of the corresponding activation products knowing the absorption cross-section and neutron flux. This will provide assurance that all the hard to detect radionuclides (even those for which a radio-analytical or dosimetry method is not available) are identified and quantified. This will also assist in developing activity ratios for all hard to detect radionuclides for the purpose of dosimetry assessment and contamination monitoring. If the potential dose for the hard to detect radionuclides is high or surrogates are not available, the ICP-MS method will indicate that a radio-analytical method (assuming there is none yet in place) for the hard to detect radionuclide should be developed for dosimetry and contamination monitoring.</li></ul>	Johnathon Hash	Scott Stafford	02-Sep-16	<p>Further sampling is required and will be performed during the D1641 outage. The samples obtained will be sent to Kinectrics for testing as well as using the ICP-MS method of testing for hard to detect radionuclides. The results of the analysis will determine the requirement for further radio-analytical methods to be developed.</p> <p>Met with Kinectrics. Validating their proposal for ICP-MS sample counting for the project.</p>
<a href="#">5880</a>	In Progress	Define the policy for PAS sampling usage during U2 Refurbishment	<p>a) Dosimetry</p> <ul style="list-style-type: none"><li>Section 3.2: Develop a clear policy on the extent of PAS usage in the U2 refurbishment and implement the policy. Ensure laboratory resources are available to analyze the results. In order to reduce the pressure on the dosimetry laboratory to analyze the large volume of PAS samples, consideration should be given to perform a pre-screening of PAS filters using PIPS solid state detectors (i.e., iSolo or PIPS multi-sample instruments).</li></ul>	Johnathon Hash	Scott Stafford	30-Jun-16	recommendations from external report are being reviewed for path forward.
<a href="#">5881</a>	Not Started	Define and Implement a confirmatory Dosimetry Monitoring Program for Alpha Emitting Radionuclides	<ul style="list-style-type: none"><li>Section 3.2: Define and implement a confirmatory dosimetry monitoring program for alpha emitting radionuclides. This will consist of a sampling of individuals who are involved on alpha hazard work as part of the Unit 2 Refurbishment. The sampling will include the submission of fecal and urine samples followed by radio-analytical analysis by an outside laboratory. This will require identification of activities and workers selected for participation as well as the infrastructure to implement this (i.e., sampling kits, recording, lab analysis, calculation of dose, and communication with workers). One option to consider is to pre-select workers and have them submit baseline bioassay samples before work begins. TCD: October 1, 2016</li></ul>	Johnathon Hash	Scott Stafford	15-Sep-16	

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Report Owner: L. Greenland  
Process Owner: R. Smith  
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<a href="#">5882</a>	In Progress	Define Areas for ICAM Positions in Work Locations	<div><div></div><div>Sect 4.1.1: Define areas where iCAMS are to be positioned during work involving a significant potential for alpha exposure. It is recommended that an iCAM be positioned inside a work tent (where one is provided) if feasible due to space or dose rate limitations. If iCAMS cannot feasibly be placed inside the tent, then spot sampling should be performed frequently during refurbishment activities that have potential for airborne hazard. TCD: March 1, 2016</div></div>	Johnathon Hash	Scott Stafford	30-Jun-16	
<a href="#">5883</a>	In Progress	Darlington Routine Radiation Surveys Instruction Modified to include Unit 2 Refurbishment	<div><div></div><div>Sect 4.1.1: Modify D-INS-09071-10012, Darlington Routine Radiation Surveys, to expand the routine alpha monitoring program for Unit 2 refurbishment. TCD: March 1, 2016 Moving due date to June 30 in order to capture recommendations from an external report for Hard to Detect Nuclide Monitoring.</div></div>	Johnathon Hash	Scott Stafford	30-Jun-16	
<a href="#">5884</a>	In Progress	Develop a Strategy for Job Specific Non-Routine Surveys	<div><div></div><div>Sect 4.1.1: A strategy for non-routine surveys for specific jobs/locations for the Unit 2 refurbishment should be developed (i.e., frequency, timing). TCD: March 1, 2016  Date changed to June 30 in order to accommodate recommendations from the hard to Detect Nuclide external report.</div></div>	Johnathon Hash	Scott Stafford	30-Jun-16	
<a href="#">5886</a>	Not Started	Confirm Alpha Counting room for Refurbishment	<div><div></div><div>Sect 4.1.1: Confirm the availability of a facility for counting alpha contamination samples. TCD: March 1, 2016</div></div>	Johnathon Hash	Scott Stafford	30-Jun-16	
<a href="#">5887</a>	Not Started	Confirm Monitoring Compliance with Alpha Contamination Limits	<div><div></div><div>Sect 4.2.1/4.3.1: Confirm through ongoing source term/alpha characterization of Unit 2 that the beta-gamma: alpha activity ratio is greater than 5. This will confirm that pancake and WBM are sufficient to confirm compliance with alpha contamination limits.</div></div>	Johnathon Hash	Scott Stafford	30-Jun-16	



564							
<a href="#">5888</a>	In Progress	Sam Alarms will limit release of Alpha Contamination	<div><div></div><div>Sect 4.3.1: Confirm that SAM alarms based on gamma emitting contamination will also limit the release of alpha contamination below corporate limits. TCD: February 1, 2016</div></div>	Johnathon Hash	Scott Stafford	30-Jun-16	<div>The action has been assigned to the Senior Health Physicist for NR RP and he will be working with the Health Physics department at HPD to determine if the Small Article Monitor will adequately limit the release of alpha contamination and if it should be used for that application. An update will be provided by 3 March 2016. 3 March 2016 Summary The small article monitors will limit the release of alpha contamination present in most isotope mixes found in the station. Isotope mixes not guaranteed to trigger a SAM alarm have been identified in a small number of characterization surveys. Areas or systems known (or suspected) to contain this type of contamination are identified as Alpha Level 3 and subjected to enhanced monitoring requirements specific to the hazard. These requirements are sufficient to meet contamination control objectives without relying on SAM alarms. Details: As a gamma sensitive instrument that is not capable of detecting alpha particles, the SAM is not intended for Alpha contamination monitoring. Any ability to limit the release of alpha contamination would be dependent on the relative abundance of gamma emitters in the contamination mix. Based on discussion with HPD and a review of our source term data, it has been concluded that for most isotope mixed, the level of gamma activity is sufficient to trigger a SAM alarm for alpha levels below corporate release limits. However, this is not guaranteed for all possible isotope mixes. While a SAM does provide an additional barrier against the release of alpha contamination, it is not solely relied upon for this purpose. This is currently reflected in the design and execution of OPG contamination control process. In particular, areas or systems identified as having source terms with relatively large alpha components (i.e. alpha level 2 or 3) are subjected to an enhanced level of monitoring specific to the detection of alpha contamination. In addition, tools and equipment removed from the radiolo</div>
<a href="#">5889</a>	Not Started	Shielding for Icams located in high gamma background	<div><div></div><div>Sect 4.4.1: Shielding for iCAMs will be required when they are placed in high gamma background areas (i.e., on platforms near the feeders and reactor face). TCD: October 1, 2016</div></div>	Johnathon Hash	Scott Stafford	30-Sep-16	
<a href="#">5890</a>	Not Started	Shielding for WBM at U2 and RWPB	<div><div></div><div>Sect 4.4.1: Shielding for WBMs at Unit 2 and RWPB should be considered and implemented if the background levels are too high for the monitors to operate effectively. TCD: October 1, 2016</div></div>	Johnathon Hash	Scott Stafford	30-Sep-16	
<a href="#">5891</a>	In Progress	Contamination Control Initiatives for RFR, RWPB and SGs	<div><div></div><div>Sect 5.1: RP should review in detail the refurbishment work (e.g., CWPs for RFR in vault and RWPB, and SG work) for opportunities to reduce and control contamination spread and protection of workers against internal hazards. The outcome of this review should be documented and communicated to the Field group, HP assessors, project leaders, and REP preparers. The output from this review should be incorporated in the CWPs. TCD: May 1, 2016</div></div>	Johnathon Hash	Scott Stafford	30-Jun-16	

**Report Owner:** L. Greenland  
**Process Owner:** R. Smith  
**Data Refreshed:** 12-May-16 10:30 PM

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Risk Report by Project with Associated Actions

Report ID:0707A [Tech Tips](#)

Report Owner:L. Greenland

Process Owner:R. Smith

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<a href="#">2</a>	delaying layup activities																
<a href="#">844</a>	Initial vault crane maintenance	Event: Maintenance strategy for initial vault crane maintenance (on critical path immediately after defuel) has not been solidified. Consideration is being made for use of external contractors but this presents a schedule risk for FOAK work in plastics, in the vault. The conflict with using DN station resource is placement of D1711 outage. Present plans has the D1711 outage pushed back by 4 weeks so their will be no competition for resource.		Active	Val Bevacqua		12-May-16	Accept	11-May-16	2	3	2	6	2	2	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">861</a>	Shutdown to GSS Window 001 OM 09110 changes	Event: The current logic for unit shutdown contains the standard OM 09110 activities. Given the nature of the Refurb project, certain activities contained in this OM are unnecessary. A revised OM needs to be created for the Refurb shutdown.	3	Active	Ross Mccord	Dan Cowley	18-May-16	Mitigate	15-Aug-16	3	2	2	6	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
<a href="#">724</a>	Chemistry Control Procedural Review Risk	Event: Due to a short period of time from design been complete (Aug 2015) and where required documentation (Chemistry Control OM and Chemistry Lab Procedures) is needed (Aug 2016) the completed documentation being ready in time is at risk. Also, there will be required reviews on O&M documentation during the same time frame. This will be a challenge for Chemistry Department based on present resources and therefore putting deliverables been ready for breaker open at risk. Cause : NR design documentation is scheduled for issued for all projects at the same time. Potential impacts : Chemistry Control documentation preparation may be late affecting chemistry control during initial stage of layup.	2	Active	Boris Vulcanovic	Roger Daly	10-May-16	Mitigate	30-Nov-16	5	1	1	5	3	1	1	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			<a href="#">3811</a>	In Progress	Chemistry Control Procedural Review Risk /link to milestones in P6 schedule	Link Chemistry Control Manual and Chemistry Laboratory Procedures preparation TCD to the milestone in P6 schedule. Coordinate NR Work Plans review with Chemistry Control Manual and Chemistry Laboratory Procedures preparation.	Roger Daly	Sergei Voitchenko	14-Sep-16	Milestone entitled "Chemistry Laboratory Lay-Up Generic Routine Sheet "has been identified as a target. Chemistry Control Manual and Chemistry Laboratory Procedures preparation TCD is set at September 15, which is three months prior to this milestone's due date of Dec 15, 2015. Chem. Lab Technician starts to work 2days/week on CLP preparation starting from April 2015.  Update Aug 18 2015: draft version of "Chemistry Laboratory Lay-Up Generic Routine Sheet " or Chemistry Tasks required for refurbishment has been created in CEM. These tasks are all set to inactive until all CLPs are prepared, system placed in layup, and chemistry control initiated as per layup Chemistry Control OMs. Preparation of CLPs is also identified in Risk # 758. Therefore TCD for Risk # 758 and Risk #724 should be the same as Action #5396 : 2016/09/14 Update Nov 23/2015: 4 CLPs out of 23 are sent for approval.							

			<table><tr><td>5006</td><td>In Progress</td><td>Chemistry Control Procedural Review Risk/staffing requirements</td><td>Exercise the option to involve “: Chemistry Support “ Qualified OPG staff to perform Work Plans and Operating Manuals review. Assess availability of Chemistry qualified staff within OPG Nuclear and outside sources: - Regularly attending quarterly Chemistry Work Group Meeting and providing updates on NR chemistry support requirements to CMWD manger - Continuous - Contract with Worley Parsons for 2015 is in place. Option to extend contract to 2015 and/or request “augmented staff” is under consideration.- TCD 31 Dec 2015-In progress - Scope of support required from DND Chemistry Technical and DND Chemistry Lab have been sent to Manager Darlington Chemistry and Environment. Transfer plan NK38-PLAN-09701-10113-CHE-01 that identifies NR and DND Chemistry responsibilities is under review - TCD 30 June 2015 – in progress</td><td>Roger Daly</td><td>Sergei Voitchenko</td><td>17-Aug-16</td><td colspan="10">1. Chemistry Technician from DND Lab started to work 2 days per week from May 15. 2. NR Chemistry Control Manual is under review to implement available design changes. 3. Transfer plan NK38-PLAN-09701-10113-CHE-01 Rev.002 has been submitted for final approval by DND DOM ( May 2015) 4. NR Chemistry technical second Sr. Engineer position has been approved and Internal Hiring process is in progress</td></tr></table>																5006	In Progress	Chemistry Control Procedural Review Risk/staffing requirements	Exercise the option to involve “: Chemistry Support “ Qualified OPG staff to perform Work Plans and Operating Manuals review. Assess availability of Chemistry qualified staff within OPG Nuclear and outside sources: - Regularly attending quarterly Chemistry Work Group Meeting and providing updates on NR chemistry support requirements to CMWD manger - Continuous - Contract with Worley Parsons for 2015 is in place. Option to extend contract to 2015 and/or request “augmented staff” is under consideration.- TCD 31 Dec 2015-In progress - Scope of support required from DND Chemistry Technical and DND Chemistry Lab have been sent to Manager Darlington Chemistry and Environment. Transfer plan NK38-PLAN-09701-10113-CHE-01 that identifies NR and DND Chemistry responsibilities is under review - TCD 30 June 2015 – in progress	Roger Daly	Sergei Voitchenko	17-Aug-16	1. Chemistry Technician from DND Lab started to work 2 days per week from May 15. 2. NR Chemistry Control Manual is under review to implement available design changes. 3. Transfer plan NK38-PLAN-09701-10113-CHE-01 Rev.002 has been submitted for final approval by DND DOM ( May 2015) 4. NR Chemistry technical second Sr. Engineer position has been approved and Internal Hiring process is in progress									
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765	Civil Functions to support Radiation Protection EPC Breakout	The Refurbishment Project Radiation Protection EPC contract was not awarded and there are services normally provided by Civil Maintenance within the operating island that will need to be established by Refurbishment Maintenance. There is additinal FTE's and budget requirements to support these services:Laundry receiving/shippingTLD Badge ProcessingBioassay Sample collectionPortable RP instrument transport to/from calibration facility	3	Active	Val Bevacqua	Tom Carvin	12-May-16	Monitor	10-Aug-15	5	1	1	5	4	1	1	4																		
	There are no Not Started, In Progress Actions associated with the risk.																																		
597	Reactor Safety Incident Impacts Refurbishment	Event: A reactor safety issue causing a prolonged stoppage of work or extensive rework Cause: A loss of configuration control / configuration management, safety culture event, significant decrease in Ops, Mtce, Engineering or EPC vendor standards during execution and RTS. Impacts: Major impact to the cost and schedule of refurbishment units	2	Active	Boris Vulcanovic	Ross Mccord	12-May-16	Mitigate	30-Jun-16	2	1	2	4	2	1	1	2																		
	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments																											
	1485	In Progress	Risk 597 - action 3 to mitigate a Nuclear safety event that affects critical path.	Mitigate events when they occur: • When an event occurs, there is training, procedures and practice in handling events, thus the event is handled in a manner that mitigates the severity. • Contracts have been structured to mitigate the risk exposure to OPG. • Lines of communication to external oversight bodies, regulatory authorities and contract companies are clear and have been set in advance.	Ross Mccord	Dan Cowley	15-Sep-16	As part of risk mitigation strategy for item 597 AR28164125-03 and 04 has been raised to produce and event catagorization matrix and event recovery decision and action chart. Actions 5 of this AR will be todevelop a training package for shift management on types of reactor safety events, catagorization and event recovery strategies. Development of the training package cannot start until the matix and action chart has been approved. The traget for approval has been moved to Jan 30 2016. suggest the target for the training package (slide presentation for authorized staff feb 15 2016. In discussion with the NR DOM it was decided to move this issuance of this document (if required). The document will be reviewed in early Sept along with other plans produced by construction management to see if it should be required																											
	Service Air Project Available for Service at RISK	A Number of Technical Procedure Action Requests TPARs have been submitted to the O&M Procedures group but additional TPARs are still required. The Vendor ES Fox can not provide as they are still waiting on Vendor documentation to answer questions needed to proceed with procedure	4	Active	Boris Vulcanovic	Mike Dance	12-May-16	Monitor	31-May-16	4	1	1	4	1	1	1	1																		
There are no Not Started, In Progress Actions associated with the risk.																																			

806		<p>process.1. Instructions on the start up and shut down of the new compressors including exactly how to operate the HMI to do so.2. The HMI has many features and capabilities. Probably more than what operations typically utilizes. For example which features/screens are to be locked out and what can operators or maintenance staff do with HMI? We need explicit instructions. 3. We also understand NK38-MMM-75110-10007 is not entirely accurate as OPG has customized the HMI different from the normal manual. This means the instructions that will be created should be created referring to the updated manual, and the MMM will have to be updated if this is true. 4. At what point does Atlas Copco take over troubleshooting? What routine and breakdown maintenance is done by OPG and what is done by service agreement? This needs to be specified both in operating and maintenance procedures.5. More detail on how compressors are set up wrt loading and unloading pressures. For example how is lead/lag compressor selected and determined? Do operations rotate duty as a predefine, or is it done automatically? 6. Section 5 alarms will need instructions on how to operate HMI such that history is not erased and troubleshooting instructions are clearly laid out when an alarm is received. There is some detail provided already but they need to be elaborated with HMI operating detail. 7. Exactly how do the two Service Air systems interface. If the new CPs become unavailable can CP1-4 be run flat out to service Refurb? Has reactor safety looked at the requirement to only allow one of 7 CPs to be out for maintenance? This seems overly restrictive. These are the Major questions needed to be answered but the Vendor is waiting for information still from their Vendor in able to produce the additional TPARs required for this scope of work. Vendor material coming in April with the AFS scheduled in July. Available for Service AFS is at RISK due to lack of information needed to produce procedure changes and short time frame in which to implement the changes to the required procedures.</p>															
759	Defuelling Cost Could Increase	<p>Event: The latest RQE operations budget holds OBU defuelling cost for the defuel campaing on all four units. During 4D planning the strategy and associated cost to complete the defuel was not fully developed so the estimate was less optimal.</p> <p>Cause: In order to reduce the potential cost of the defuel for RQE planning, an analysis was completed and a strategy selected that relies on the current 5 crew schedule for the first unit and a 4 crew shift schedule for the F/H department for subsequent units in order to optimize the business plan.</p> <p>Impact: Since an approved 4 crew schedule has yet to be approved for use there is a risk that defuel cost may increase if the approval is not obtained.</p>	2	Active	Ross Mccord	Michael Mcfarlane	12-May-16	Mitigate	30-Jun-16	3	1	1	3	3	1	1	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5560	In Progress	F/H department to pursue the implementation of a 4 crew schedule - RISK 759	F/H department to pursue the implementation of a 4 crew schedule Mitigate the risk by aggressively seeking approval for a 4 crew schedule. Work closely with HR and the unions to secure an approved 4 crew schedule.	Ross Mccord	Dan Cowley	31-Oct-16	A 4 crew schedule that meets the defined requirements has been developed. A meeting in the near future (1 mo time frame) is being set up to present it to the union with the proposal to defuel using said schedule. This action is on track.							
767	O&M Procedure Update Program may not have sufficient Funding	<p>Event: Budget estimate for procedure work was estimated to cost around 42 million. this was based on opex from Bruce Power and Point Lepreau.</p> <p>Cause: Estimate was challenged and reduced down to 32 million.</p> <p>Impact: Could cost an additional 10 million dollars to complete the program.</p>	2	Active	Boris Vulcanovic	Mike Dance	12-May-16	Accept	03-Oct-16	3	1	1	3	3	1	1	3
			There are no Not Started, In Progress Actions associated with the risk.														
775	Potential Shortfall for Commissioning Support	<p>Event: There is a risk that resource requirements for the return to service and commissioning phase of the project could exceed the NR O&amp;M support capabilities</p> <p>Cause: The O&amp;M program has established support organizations based on estimated resources for the various bundles including RTS and commissioning.</p> <p>Impact:This would require the station DN O&amp;M to mobilize to assist in preserving the RTS schedule.</p>		Active	Boris Vulcanovic	Mike Stewart	10-May-16	Mitigate	26-Nov-15	3	1	1	3	3	1	1	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			1308	In Progress	Commissioning Engineer resource profile	Review commissioning engineer resource profile and mitigate through contract staff hires if required. AR#28148291-01 Review commissioning engineer resource profile TCD:2017/01/15	Mike Stewart		15-Jan-17	swim lane diagramm developed to identify activities required by functional engineering, resourcing for RTS activities as per the swim lane diagramm will be compared to projected resource profiles. Given the likelihood of resource issue the probability score has increased thus increasing the risk score to 9. Owner changed from D. Somerville to G. Leach by A. Kalafatis 2015/04/30 to align with AR assignment Initiator changed to M. Stewart, review in progress and staffing plans being developed.							

ONTARIO

POWER

GENERATION

Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
Report Owner: L. Greenland  
Process Owner: R. Smith  
Data Refreshed: 12-May-16 10:30 PM

854	Management of document revisions during execution	Event: Timeliness & control of the amount of changes that will occur is unlikely to be handled with the current process.	There are no Not Started, In Progress Actions associated with the risk.														
				Active	Boris Vulcanovic	Mike Dance	11-May-16	Accept	11-May-16	2	1	1	2	2	1	1	2
802	Reburbishment Maintenance - Milestone OP2070 Work Package Assessment Complete - At Risk	Based on data from the Assessment Status metric for week ending February 26, 2016, there is a risk that Refurbishment Maintenance will not meet the April 15 Work Package Assessing Complete Milestone, OP 2070. Maintenance is assessing at an average rate of 450 tasks per week. There are 5300 tasks requiring assessment. Approximately 2500 tasks have been added since December 2015. There are 20,000 Maintenance tasks in D1621 and DNRU2.	4	Active	Val Bevacqua	Brad Schofield	12-May-16	Monitor	15-Mar-16	1	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
813	Refurbishment Chemistry & Environment - "Milestone OP2070 Work Package Assessment Complete" at risk	Based on data from March 29th there is a risk that refurbishment Chemistry & Environment will not meet hte April 15 work package assessing complete milestone OP 2070. As of March 10th there was less than 20 hours of assessing time by a trained assessor from the chemistry laboratory. There are more than 150 tasks to be assessed by 15Apr2016. Laboratory assessing resources have not been available to be released to refurbishment per the OBU agreement. Scope additions are expected since there currently roughly the same number of tasks for this 3 year outage as there are for a normal 60 day outage. THM scope identification not well understood by individuals writing the CWPs and expecting to get support. There is a risk that there will be a lot of surprise work for laboratory employees if the number of tasks does not increase. Have been notified by R&FR that CWP preparation will not be complete until the end of May. The assessing milestone to have tasks assessed before all the work is identified is measuring to a metric not measuring actual readiness status. It is expected that there will be additional tasks identified after the assessing milestone. New Milestone date extended to June 17.	4	Active	Roger Daly	Emily Cornthwaite	10-May-16	Monitor	15-Apr-16	1	1	1	1	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Program: Operations and Maintenance - 10000																	
867	Additional cost for remote RP training capanility in the classroom and Mock-up facility	Two vendors have been identified who supply remote training technology which would be instrumental for RPC Training in both the classroom and the Mock-up facility. The Mock-up facility technology can replicate beam hazards which would be very beneficial to series testing and practical mock-up 'exposure"	3	Active	Johnathon Hash	Joe Zic	13-May-16	Mitigate	06-Jan-17	3	1	2	6	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Program: Operations and Maintenance - 73444																	
868	Non RQE identified cost for wireless integration of RP survey, shipment and Inventory data	The ability for field update to shipping paperwork, site inventory control of radioactive storage areas and up to the minute survey results can be greatly enhanced through using a vendor to network RP functions through our Project wireless network. Corollary benefits would include data not transferred on the network to be uploaded at docking stations once downloaded in the field. This data would interface with key RP databases and programs to support communication of survey results quickly and efficiently for hazards, shipping documentation and Inventory control.  We have a bounding vendor quote and we are working through that at present. The RFP process as well as CCF are in progress.		Active	Johnathon Hash	Jeff Johansson	13-May-16	Mitigate	06-Jan-17	5	1	1	5	1	1	1	1
			There are no Not Started, In Progress Actions associated with the risk.														
Program: Planning and Control -																	
667	P&M Executed F&IP and SIO Projects Exceed Forecasted Life Cycle Costs	The risk is that the forecasted life cycle costs for the F&IP (Campus Plan) and SIO projects,including contingency,areunderstated due to an incorrect assessment of estimate class resulting in increased costs tofinalizethese projects.	3	Active	Gary Rose	Ali Pasha Mohsenin	13-May-16	Mitigate	31-Aug-16	5	3	3	15	3	2	2	6
			There are no Not Started, In Progress Actions associated with the risk.														
	Ineffective use of project management control processes in NR pre-	The risk is that projects and modifications will not effectively apply scoping, scheduling, risk and cost management tools to successfully manage NR pre-requisite projects to meet program requirements.	4	Active	Gary Rose	Ali Pasha Mohsenin	13-May-16	Mitigate	31-Aug-16	3	3	3	9	1	2	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							



719	requisite projects		5858	In Progress	Establish project control process and reports in projects and modifications organization	Establish nuclear project control process and reports Establish project control process and reports in Projects and Modifications organization including scope control, detailed schedule, estimates, cost control, forecast and quad chart report for individual projects.	Ali Pasha Mohsenin		30-Sep-16	<ul style="list-style-type: none"><li>PMODs management team have started preparing Quad Charts but there are still rooms for improvement (Review of KPI needs to be performed with more attention, variance explanation text are required to explain all issue, etc.)</li><li>Forecasts are provided on Work Package level but still not completely accurate. Vendors need to contribute more on forecasting.</li><li>Schedules are improved significantly but still not completely following NR standards and governances.</li><li>Estimating and providing basis of estimate is still a challenge.</li></ul> Feb 2016: Action got extended untill end of third quarter of 2016 to ensure proper implementation has been achieved.									
751	Foreign Exchange Rate Changes Impact NR Cost Envelope	The risk is that fluctuations in foreign exchange rates adversely impact planned costs established at RQE, resulting in cost increases to the program.		Active	Gary Rose	Steve Wiacek	13-May-16	Monitor	29-Jan-16	3	3	1	9	3	3	1	9		
	There are no Not Started, In Progress Actions associated with the risk.																		
661	Inaccurate performance data causing inappropriate or untimely control of critical program deliverables	The risk is that ineffective and/or inappropriate management decisions are made due to deficient processes, flawed metrics or uncontrolled/unverified source data.	2	Active	Gary Rose	Lindsay Greenland	13-May-16	Mitigate	29-Dec-16	3	2	2	6	1	1	1	1		
	There are no Not Started, In Progress Actions associated with the risk.																		
768	Program Interest Rate Uncertainty	The RQE Program Basis (Assumption) for Interest Rates are documented in Assumption #536. This risk is to address uncertainty to this Basis for the entire NR Program.	1	Active	Gary Rose	Steve Wiacek	13-May-16	Accept	30-Jun-16	2	3	1	6	2	3	1	6		
	There are no Not Started, In Progress Actions associated with the risk.																		
640	Insufficient funds/financing available	The risk is that Refurbishment is technically ready to proceed but delayed due to insufficient funding as a result of financing issues, such as lack of establishment of a letter of credit.	1	Active	Gary Rose	John Lee	13-May-16	Monitor	15-Jun-15	1	3	3	3	1	3	3	3		
	There are no Not Started, In Progress Actions associated with the risk.																		
711	IT Infrastructure not in place for program life cycle prior to U2 check estimate	IT Infrastructure not in place for the program life cycle due to continuing of changes of IT scope and/or unclear identification of IT requirements results in increasing costs of IT projects. Test using tablet.	2	Active	Gary Rose	Chris Woodcock	13-May-16	Avoid	15-Feb-17	3	1	1	3	1	1	1	1		
	There are no Not Started, In Progress Actions associated with the risk.																		
760	Report Building resources will be insufficient to meet the extensive report & metric development needs.	A large quantity of reports and metrics have been requested by the Nuclear Refurbishment Organization. There is a risk that the current resources identified will be insufficient to generate all the reports requested. This is especially true if the organization continues to request changes/modifications to existing reports. There is the risk that the reports generated will need to be revised/modified to account as a result of the nature of the work changing, and line of business needs changing.	3	Active	Gary Rose	Lindsay Greenland	13-May-16	Monitor	31-Mar-20	3	1	1	3	3	1	1	3		
	There are no Not Started, In Progress Actions associated with the risk.																		
671	Loss of public and community support for Refurbishment	The risk is that a loss of public and community support for refurbishment (due to a variety of reasons) will result in delays, scope change or postponement. The reasons support may diminish include:There is a perception that nuclear base load is not needed in Ontario or alternatives are identified (e.g. Hydro Power from Quebec);The benefits of refurbishment are not seen/realized by the hosting communities (i.e. risks outweigh benefits);Poor project performance or cost overruns;Nuclear waste stores at site increase, resulting in local opposition;New environmental issues surface at site;Performance of other OPG plants impacts ability to licence; A major adverse nuclear event (at any nuclear power plant) results in negative public perception; orKI pill distribution in 2015 causes undue stress and anxiety.	3	Active	Gary Rose	Donna M Pawlowski	13-May-16	Mitigate	15-Oct-15	2	1	1	2	1	1	1	1		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments									
			1626	In Progress	Implement annual communications	Implement annual communication and community relations outreach plan, report annually on actions as per Refurbishment Communications Program Management Plan	Donna M Pawlowski		31-Oct-16	2014 Annual Reportcompleted December 31, 2014. Implementation of 2015 communications and community outreach plan in progress, all elements on track.									



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Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
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683	performance has required additional oversight during all phases, resulting in an increase in staff costs in OPG	significantly involved in all phases (Definition through Execution) due to the vendor's inability to meet contractual commitments on cost, schedule and quality. This has required the Owner to build an oversight organization capable of supporting/directing the planning, execution and technical supervision of the work. Current RQE forecast of OPGoversight manpower/cost assumes the EPC contractors for DNR will have the required capabilities to meet the contractual commitments on safety, quality, cost and schedule. Should the OPEX repeat itself on DNR then significant schedule impact could occur and considerable qualified oversight resources would be required.																		
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			1457	In Progress	Risk Action	Scale the Construction Oversight Group with the required quantity of specialists (Engineering/Procurement, Facilitators/coordinators, welding, NDE, Quality and safety) outside of the project teams to ensure both objectivity of oversight and provide the needed support/guidance to the vendors. These refurbishment experienced specialists and support staff may not reside within OPG. This strategy will be more cost effective and scalable than building up the individual project teams.	Ken Hobbs	Robin Granger	15-Oct-16	Construction Oversight Group has been established with resource level and organizational make up approved. Required specialists, FME, Hoisting and Rigging, Pressure Boundary, Electrical, etc. Specific Construction Oversight qualification is developmented and implemented. External Construction Oversight is now in place through Keiwiit. Current organization will be tested through the 5 RTE Projects schedule for 2016 prior to breaker open. Lessons Learned will be incorporated prior to U2 breaker open.										
762	Key skilled craft resources not available when required for Units 3, 1, 4 Execution	Refurbishment Project Contractors will be unable to secure the number of required key skilled craft resources for Units 3, 1 and 4 Execution like boilermakers, pipefitters, welders, millwrights and electricians as a result of attrition in the trades and other mega-project opportunities which may lead to schedule delays and cost overruns.	1	Active	Michael Allen	Ken Hobbs	07-Mar-16	Mitigate	16-Oct-26	4	3	4	16	3	3	3	9			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										
			6286	In Progress	Resouce Planning for Units 3, 1, 4.	Evaluation of tactics and aligned with owners strategy to minimize the risk of skilled craft shortages. The tactics evaluated will include both short term approaches (i.e. temporary foreign workers) and longer term solutions (i.e. outreach to schools, apprentices, targeting underrepresented groups). Process is similar to Action 1449 but for Units 3,1,4.	Ken Hobbs	Robin Granger	30-Jun-23	• Ongoing assessments of resources planned right up to breaker open on last unit, Unit 4. •Overall action plan NK38-PLAN-09701-10231 issued in Asset Suite on Nov 20th,2014										
	EHS and other Vault Projects - Radiography Cannot be Completed on	The risk is that non-destructive examination (NDE), in the form of radiography, cannot be completed on schedule to verify nuclear class piping welds due to potential critical path impacts. Radiography is a high rad hazard and requires evacuation of the vault which may not be feasible due to critical path	2	Active	Michael Allen	John Stopar	22-Apr-16	Mitigate	31-May-17	5	1	3	15	3	1	2	6			
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments										



Risk Report by Project with Associated Actions

Report ID: 0707A [Tech Tips](#)  
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814	Schedule Due to Critical Path Work (windows 104)	work completed by the JV. This will lead to schedule impacts for the Emergency Heat Sink (EHS) project, valve rehabilitation, valve PM's, and other projects to find time to complete radiography NDE. Per SCR N-2016-02304 it was raised that radiography may not be allowed to be performed in the vault, to prevent impacts to critical path work being performed by the JV.																
			3436	In Progress	Alternate NDE Required: Radiography Cannot be Performed inside the Vault	VW: Emergency HTS Make-Up Installation How much radiography will be required during this Vault projects installation work window?	Scott Guthrie	Jessica Perryman	03-Apr-17	all work groups/ projects to id their vault radiography requirements to Dennis. Boyd - requested to determine other if other "non-radiography" technologies avail. Jan 15th, 2015: Did discuss this with vendors (ES Fox and AMEC) and we have a path forward to determine radiography amounts (still unknown as piping modelling is underway), I'll get you detailed drawings when the modelling is done. 4Feb2015 note: all in vault projects to strive to not have to radiograph. As JV is working 6x10h: Sunday will be "radiography day". 28Apr2015 note: unkown currently how much radiography is required...this will be known better as design progresses. Due date pushed to EHS 40% design complete date for follow up. Vendor looking into other forms of NDE for pipe welds. 4-Sept-2015 Update: Will confirm amount of NDE through assessing/work planning phase. 3-Feb-2016: it was recently raised in the vault window meeting that radiography may not be allowed. This will affect multiple projects in the vault project window that require radiography. Other means of NDE is being investigated. 5-Apr-2016: This action is going to be canceled once a new action is generated and linked to a Program Risk, instead of Project Risk. The new action will be noted before this action is closed. Updates: Contacted IMS to investigate Phased Array option as an alternative. IMS to deliver proposal to BOP. New action will include all IMS support activities and TCDs.								
	U2 Containment Isolation schedule extension due to Fuel Handling operations on operating units. [window 23]	[execution phase] Event: The critical path isolation of the NR unit from containment (bulkhead installation), and subsequent removal post fuel channel and feeder replacement, may extend beyond scheduled windows. Cause: Critical path containment isolation activities can only be completed during no-fueling windows. The frequency/availability and duration of no-fueling windows is determined by operating unit zone levels, trolley reliability and required trolley maintenance. Impact: If no fueling windows are shortened or do not occur per plan, critical path schedule delays will result as well as cost overruns due to crew standby time. Reasons for no fueling windows not occurring as planned could include unit zone conditions and trolley reliability.	2	Active	Michael Allen	Marc Paiment	06-May-16	Mitigate	31-Oct-16	3	1	4	12	3	1	3	9	
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments								
			1685	In Progress	Risk Action	Reviewing/modifying fuelling strategies to provide longer no-fueling windows. This will increase efficiency during Bulkhead installation and removal as there will be a fewer number of inturptions.	Michael Mcfarlane	Michael Mcfarlane	31-Oct-16	Banking strategy has been developed that would allow longer windows of no fuelling of up to 10 days (D-OA-37000-10015-R00). As well, the bulkhead Installation co-Incides with the D1711 outage which eleiminates the need to fuel unit 1. With potential changes to AWPP 007, this would maximize bulkhead installation time and minimize interuptions								

## Risk Report by Project with Associated Actions

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784			5772	Not Started	Develop contingency plan	Develop contingency plan with several option to mitigate this risk. 1. Review over lapping strategy between U2 and U3 2. Schedule trades into U2/U3 trough 3. Resources sharing with vendor capability 4. Resources sharing with OPG/ Bruce refurbishment programs 5. Training development opportunities 6. New projects that could mitigate risk i.e. marginal mega-watt project	Bill Owens		15-Oct-16	The next step for this action is to meet with the associated unions and discuss the need to retain critical trades through the trough period and to look ahead at the project portfolio for Darlington and Pickering to identify opportunities for trade relocation. A person will be brought into the execution organisation to assist with developing the contingency plan.							
783	Estimated Cost of General Services contract may be underestimated	The risk is that Estimated Cost of General Services contract may be underestimated, the current estimate is based on third party estimate but vendor bids could be higher.	4	Active	Michael Allen	Ken Hobbs	07-Mar-16	Monitor	29-Jul-16	3	3	1	9	3	3	1	9
			There are no Not Started, In Progress Actions associated with the risk.														
755	Vendor Purchased or Owner Supplied Materials not arriving in time to support the NR Execution Schedule	The risk is that vendor purchased or owner supplied materials not arriving in time to support the NR execution due to lack or vendor capability or due to invisibility on the status and progress of procurements materials for each or of the bundles may lead to NR projects suffering schedule delay and increased cost.	3	Active	Michael Allen	Sean Toohey	25-Jan-16	Mitigate	15-Sep-16	2	1	4	8	1	1	3	3
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5214	In Progress	Ongoing effort to mitigate Risk 00755 - Provide material list for each project , monitor delivery schedule to support Refurbishment execution	This action started as "Provide list of materials required for each project ". While developing the Procurement and Materials Management Strategy for DNR, it became apparent that we need to document our ongoing effort to control risk 00755 - "Vendor purchased or owner supplied materials not arriving on time to support execution". Going forward, this action will be used to track progress of mitiagtion against that risk	Michael Allen	Sean Toohey	14-Oct-16	• Procurement and Materials Management Strategy N-GUID-09701-10124 issued and rolled out to projects and vendors. • Procurement Forecast Model established and routinely run to monitor EPC Vendor Procurement Performance. • Procurement Tracking Tool (PPT) in place and producing metrics used to provide oversight from project directors to EPC vendors and forecast potential need for intervention and problem resolution. • Compliance to the plan and exceptions are reviewed weekly. • Materials lists for each project are collated in the PTT which is a subset of the IDB. • Per Milestone OP2040 material information shall be uploaded into the Material Tracking System not later than 30 days after WO/CWP assessing is complete. • Going forward the PTT is being linked to OEM MITPs and RMO "Issue Tab" to provide deeper project manager oversight capabilities.							
781	TG-Turbine Generator issues during dynamic testing	There is a chance that during the dynamic commissioning of the Turbine Generator we might encounter various issues. This issues might include but are not limited to various equipment performance issues such as equipment failure and maintenance related failures & software related issues such as software logic malfunctions, dynamic logic and parameter tune up issues. For this event only risks that have the most probability of occurring are considered and does not take under consideration any catastrophic scenarios.	1	Active	Michael Allen	Todd Josifovski	12-Apr-16	Accept	01-Feb-19	2	2	4	8	1	1	3	3
			There are no Not Started, In Progress Actions associated with the risk.														
	Significant contractor event occurs	The risk is that project related High Maximum Reasonable Potential for Harm (High-MRPH) events caused by poor execution of work practices would have a negative effect on the project schedule and result in financial loss..	1	Active	Michael Allen	Ken Hobbs	13-May-16	Mitigate	15-Oct-16	2	1	3	6	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

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651	At Risk and Long Lead Material identification is incomplete for some projects due to detailed scope not defined completely at this time.	The risk is that the detailed Scope and Preliminary Engineering (which is also tied to H0S4 (Healthy of Scope)) is not completely defined for some projects and therefore, any "At risk or Long Lead Material" may not be defined at this time.	3	Active	Michael Allen	Sean Toohey	25-Jan-16	Monitor	15-Aug-16	2	2	2	4	2	2	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
717	Estimated Cost of RPPE Laundry may be underestimated	The risk is that more Radiation Personal Protective Equipment (RPPE) may required due to increases in time to execute the work and/or additional resources required versus what is currently estimated based on lesson learned and best practices.	3	Active	Michael Allen	Ken Hobbs	07-Mar-16	Accept	15-Oct-26	4	1	1	4	4	1	1	4
			There are no Not Started, In Progress Actions associated with the risk.														
782	Vendor Default	The risk is that a major NR vendor becomes unwilling or unable to execute the work they have been contracted to perform, resulting in a need to secure a new qualified vendor to perform the scope of work.		Active	Michael Allen	Roy Martin	07-Mar-16	Avoid	15-Oct-16	1	4	1	4	1	4	1	4
			There are no Not Started, In Progress Actions associated with the risk.														
2	Key skilled craft resources not available when required for Unit 2 Execution	Refurbishment Project Contractors will be unable to secure the number of required key skilled craft resources for unit 2 Execution like boilermakers, pipefitters, welders, millwrights and electricians as a result of attrition in the trades and other mega-project opportunities which may lead to schedule delays and cost overruns.	1	Active	Michael Allen	Ken Hobbs	19-Apr-16	Monitor	14-Oct-16	1	1	2	2	1	1	2	2
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			1449	In Progress	Risk Action (Re Risk 0002 & 762)	Part One: Evaluation of tactics and development of an Action Plan aligned with owners strategy to minimize the risk of skilled craft shortages. The tactics evaluated will include both short term approaches (i.e. temporary foreign workers) and longer term solutions (i.e. outreach to schools, apprentices, targeting underrepresented groups). Part Two: Work with BuildForce Canada and other owners on strategies to address construction and maintenance workforce challenges.	Ken Hobbs	Robin Granger	14-Oct-16	<ul style="list-style-type: none"><li>• Ongoing assessments, of resources, planned right up to breaker open on first unit.</li><li>• Overall action plan NK38-PLAN-09701-10231 issued in Asset Suite on Nov 20th,2014</li><li>• Communication to IBEW completed on April 10th, 2015.</li><li>• Presentation to CBTU Legislative Convention completed on May 5th, 2015.</li><li>• Millwrights Apprentice presentation completed on June 3rd, 2015.</li><li>• Union Halls Communication have been completed.</li><li>• UA conference completed on August 2015.</li><li>• Boilermakers Conference August 2015 Complete</li><li>• Boilermakers now have Benefit reciprocal agreements with UA, Millwrights and Ironworkers will be implemented as required.</li><li>• All major unions signed Nuclear Project Agreement (NPA)</li><li>• All Major Unions have agreed to a new Collective Bargaining Agreement</li><li>• NQW alignment across OPG Nuclear</li><li>• Build force refresh in 2016</li><li>• Increase apprentice number of Aug staff by min. 20%</li></ul>							
	Primary Side Clean Adverse Impact to SG Tube Integrity	The risk is that Primary Side Clean (magnetite removal process) could potentially remove tube wall material causing SG tube thinning. Impact (from highest to lowest probability): 1. SG tube thinning could result in the need for additional tube plugging which would extend the PSC execution	2	Active	Michael Allen	Jamie Lawrie	04-Mar-16	Mitigate	15-Oct-16	1	2	1	2	1	1	1	1
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							



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684		window. 2. Depending on the amount of tube plugging needed, the station may need to de-rate the unit. 3. In the unlikely event that the tube damage is so severe that de-rating the unit is not ecomincally viable, complete SG replacement may be required.	1731	Not Started	Review PSC OPEX regarding Primary Side Clean Adverse Impact to SG Tube Integrity prior to execution window (T-6month)	Review PSC OPEX regarding Primary Side Clean Adverse Impact to SG Tube Integrity prior to execution window (T-6month)	Pejman Asgaripour	Mike Lutz	23-Aug-17	As pre req to this action, optimization will include extended duration tests to ensure visible wear is produced. Visible wear will clearly identify how process parameter adjustments affect tube wear, allowing verification of future decisions that may occur(ie increase execution blast duration). future operating pressures will be within the bounds of qualification completed in 2009.										Review OPEX with EPC vendor following PSC campaign in Cernavoda in Q2 2016.			
679	Zebra Mussel Fouling Impacting Operations and Refurbishment	Ongoing Unit Operation: Darlington’s historical intermittent chemical injection strategy for low pressure service water (LPSW) and powerhouse upper level service water (PULSW) was not fully effective in preventing zebra mussel accumulation in some areas that supply cooling to safety related components. This resulted in unavailability of a shutdown cooling pump and instrument air compressors because of Zebra mussel in cooling systems. In addition, loads have seen reduced cooling effectiveness (HT Pump motor cooler, Vault Coolers, etc). Refurbishment (drained and dried service water systems as a contingency): Zebra/quaga mussels, silt and foreign material (FM) concentration can affect successful startup of service water systems following a period of long term drain and dry. The concern is foreign material becoming solidified in the pipe. The flow in the pipe would then be permanently reduced not meeting operational requirements. This could occur following the drain and air dry of contaminated LPSW pipework.	1	Active	Jeff Lehman	Andy Ireland	01-Mar-16	Monitor	31-Dec-15	1	1	1	1	1	1	1	1	1	1				
	There are no Not Started, In Progress Actions associated with the risk.																						
Program: Refurbishment Execution - RF																							
772	Qualification of Existing Bellows	The existing bellows are not currently qualified for the full post refurbishment life. There is a risk (low probability) that qualification testing will fail which would require that all bellows be replaced (960 bellows per unit), resulting in increased cost and critical path duration. In addition, the lead time for the large quantities of bellows is substantial with ~6-12 months of float to the need date in the field. Test program is underway and results are expected within the time required to initiate procurement. The current bellows replacement tooling that is currently in the JV toolset is not efficient for a complete bellows replacement program which could be required if bellows qualification testing failed. The incremental tooling development would be required and a high level estimate of tooling development, manufacturing and testing timeframe is 24 months.	3	Active	Michael Allen	Marc Paiment	18-Feb-16	Mitigate	29-Feb-16	1	2	5	5	1	2	5	5	5	5				
	There are no Not Started, In Progress Actions associated with the risk.																						
Program: Refurbishment Execution - 73440																							
825	Fresh Fuel Start up Anomalies	The risk is that anomalies associated with fresh fuel are encountered on Unit 2 startup due to discovery issues around low power testing and power monitoring component resulting in cost increase/schedule delay or safety risk during start up evolution.	1	Active	Michael Allen	Gerry Martin	29-Apr-16	Monitor	14-Jan-19	2	2	2	4	1	1	2	2	2	2				
	There are no Not Started, In Progress Actions associated with the risk.																						
Program: Supply Chain -																							
	Incorrect OPG lead time information	The risk is that late delivery or non-compliant material due to incorrect lead time information in OPG Asset Suite may impact schedule and cost to the project.	3	Active	Phil Reinert	Julian Read	13-May-16	Mitigate	30-Jun-16	2	1	2	4	2	2	3	6	6	6				
	Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments															



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790	not integrated with DINGS schedule and Resource Balance Toolkit	their IFC and Outage plans. This also includes the resource demand loaded into the Resource Balance Toolkit (RBT). Potential Impact of this are: - critical conflicts of work on the refurbishment unit with operating units may not be properly identified and resolved. - non-integrated schedules may overdemand shared OBU staff that reside with the site. Current site overdemand is preventing the release of staff to the project.	There are no Not Started, In Progress Actions associated with the risk.														
698	Unexpected Operating Unit Impacts	Activities in Operating Units (either adjacent units or units being prepared for refurb or readied for return to service) may cause unpredictable access issues and work hindrances resulting in refurb workers stopping work and, hence,productivity losses - negative impacts on costs and schedule. This level of integration of a unit under refurbishment with the midst of multiple operating units has never been undertaken before. This risk is transferred from RFR JV (Risk #44) to OPG.	1	Active	Karen Fritz	Daniel Sawyer	01-Oct-15	Accept	01-Jan-27	3	2	3	9	2	2	3	6
			There are no Not Started, In Progress Actions associated with the risk.														
689	Failure to eliminate current constraints on vault loading	The risk is that failure to eliminate current constraints (vault egress limits and breathing air capacity) on vault loading as assumed for DNRU2 Level 1 Rev A outage plan will extend critical path by up to 30 days.	3	Active	Karen Fritz	Daniel Sawyer	01-Oct-15	Mitigate	15-Nov-15	2	1	4	8	1	1	2	2
			There are no Not Started, In Progress Actions associated with the risk.														
	Failure to obtain approval for early HTS Fill	At an Operational Decision Meeting (ODM) on June 1st, approval in principle was obtained to allow filling the HTS prior to the restoration of the normal containment boundar. However the approval was conditional on a number of actions. Actions have been established in the Passport Action tracking database to address the conditions given in the ODM approval which includes some follow-up nuclear safety analysis and CNSC approval for a minor revision to an OP&P. The risk is that one or more of the follow-up conditions can not be met, and the logic reverts to having an HTS fill following the removal of the bulkhead. This logic change would add approximately 43 days to the lead-out logic for each unit.	2	Active	Karen Fritz	Daniel Sawyer	01-Oct-15	Mitigate	15-Jul-16	2	2	4	8	1	2	4	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							
			5389	In Progress	martingInitiate Moderator RD failure scoping analysis.	Initiate preliminary analysis to establish, for the case of an in core LOCA with bursting of calandria (moderator) rupture discs, the consequences of D2O releases from Moderator and PHT systems, taking into account tritium concentrations in both the moderator and PHT, as well as the release of entrained fission products or other radiological contaminants in the released D2O.	Gerry Martin		30-Aug-16	AMEC contacted to start scoping out analysis, high level analysis plan and cost and time estimate received. Review of documents generated some comments that need to be resolved before work can progress. TCD changed to Jan 15, 2016 to allow for work scope finalization and analysis to be completed.  Restart HIT team formed, meetings being held to narrow down the correct questions to ask contractors to complete the analysis. Contract for the analysis is not yet in-place as scope of required analysis and initial conditions are still being developed. action extended till March 30th - Gerry Martin Jan 8th, 2016. Contract being finalized as scope was recently clarified, no firm TCD from signed contract available, action extended till Aug 30, 2016 - Gerry Martin March 24, 2016							

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<a href="#">5390</a>	In Progress	Impact of non-tritium HTS radionuclides	Ensure that spill analysis for the HTS fill scenario includes an assessment of the effect of entrained contaminants or provides a limiting value.	Gerry Martin		30-Aug-16	<p>Analysis for the D2O contingency storage project is being reviewed to determine if that analysis can be used to respond to this action. Quantification of what possible contaminants could be present in the PHT coolant may prove difficult and would need some bounding assumptions. The present analysis assumed dose came from tritium gas escaping the reactor vault, and did not assume any liquids escape. Solid contaminants would not likely escape from the vault as they are heavy, non-soluble and would stay with the liquid, and not exit the RV with the tritium gas. C-14 may be presents, but typically, the dose from tritium is 7 times that from C-14 for scenarios such as this one. TCD extended to Jan 15, 2016 to allow for D2O storage tank work to be completed and finalized - to determine applicability to this situation.</p> <p>Restart HIT team formed, meetings being held to narrow down the correct questions to ask contractors to complete the analysis. Contract for the analysis is not yet in-place as scope of required analysis and initial conditions are still being developed. action extended till March 30th - Gerry Martin Jan 8th, 2016 Contract being finalized as scope was recently clarified, no firm TCD from signed contract available, action extended till Aug 30, 2016 - Gerry Martin March 24, 2016</p>
<a href="#">5391</a>	In Progress	Assessment of spill volume and rate	The analysis is to include an assessment of maximum volume of tritiated D2O that may be released in the event of an accident, the maximum rate of release that may be experienced and the impact of that volume/rate on the proposed release mitigation strategy.	Gerry Martin		30-Aug-16	<p>Assessment of total spill volume is underway and argument to be supported is that there is enough spill capacity containment in the vault that water will not be exiting the RV. TCD extended to Jan 15 2016 due to completing priorities of Aug 15 design milestone and now DNGD VBO support.</p> <p>Restart HIT team formed, meetings being held to narrow down the correct questions to ask contractors to complete the analysis. Contract for the analysis is not yet in-place as scope of required analysis and initial conditions are still being developed. action extended till March 30th - Gerry Martin Jan 8th, 2016 Contract being finalized as scope was recently clarified, no firm TCD from signed contract available, action extended till Aug 30, 2016 - Gerry Martin March 24, 2016</p>

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			<a href="#">5392</a>	In Progress	Submit OP&P revision request with supporting analysis to CNSC	Submit safety assessment information as required to support the revision of OP&P to allow HTS to be pressurized while the refurbishment unit is disconnected from Containment.	Gerry Martin		16-Oct-17								
			<a href="#">5393</a>	In Progress	Prepare the D2O spill mitigation plan	Prepare a decision making matrix which provides the appropriate response strategy in the event of a significant HTS leak while still disconnected from Containment. This strategy will incorporate lessons learned from a review of Pickering OPEX. It will address procedures to be completed with respect to open airlock doors configurations and the impact of those configurations on releases and will assess feasibility of airlock door closure prior to initiation of key evolutions such as PHT D2O fill and PHT hydrostatic testing.	Ross Mccord	Dan Cowley	31-Oct-16	A spill mitigation strategy has been prepared and sent out for review. The TCD for feedback is Oct 15 2015.This action is being extended until after the reactor safety action 5391 is complete. After which we will have a bounded accident leak rate.  Initiator changed from dennis Curley to Dan Sawyer Nov 27 2015 by RDC							
			<a href="#">5394</a>	In Progress	Confirm spill strategy alignment with Spills analysis	Confirm that the mitigation strategy and the timing for airlock door closure in event of accidents is consistent with the potential release volumes and rates.	Ross Mccord	Dan Cowley	31-Oct-16	Emergency closure of the airlock doors has no been developed at the present time. When it is developed ops will complete this verification and include it in or spill mitigation strategy. This action is being extende until after the RX safety action 5391 is completed to bound the accident scenario. **2015-11-24 Changed Initiator from Dennis Curley as LAN ID was no longer recognized**							
	Critical path Impact of HTS Pump Motor Changeout	In the current outage in Unit 1 they cleared the vault when they lifted a HTS pump motor, presumably for concern that a dropped motor would actually penetrate the containment structure and kill people below it. We're swapping 4 pump motors in DNRIU2, which means 8 lifts (out and	3	Active	Karen Fritz	Daniel Sawyer	02-Oct-15	Avoid	15-Feb-16	4	1	2	8	2	1	2	4
			Action#	Status	Action Title	Action Description	Owner	Delegate	Due Date	Comments							

776		back in). Barring a change to the critical lift plan, that will drive 8 vault evacuations and depending on how pessimistic you are that could be anywhere from a half shift to a shift of critical path time lost for each such evolution. We currently don't have any critical path time allocated for this activity.	5703	In Progress	Analysis of HTS pump motor critical lift plan requirements	In the current outage in Unit 1 they cleared the vault when they lifted a HTS pump motor, presumably for concern that a dropped motor would actually penetrate the containment structure and kill people below it. We're swapping 4 pump motors in DNRU2, which means 8 lifts (out and back in). Barring a change to the critical lift plan, that will drive 8 vault evacuations and depending on how pessimistic you are that could be anywhere from a half shift to a shift of critical path time lost for each such evolution. We currently don't have any critical path time allocated for this activity.	Ryan Finnie		14-Jul-16	DNGS Civil Design Engineering indicated that the original recommendation to clear the vault for lifting HTS pump motors was based on a hand calculation that incorporated conservative assumptions. A more detailed analysis using a software simulation is being performed by DNGS Civil Design to determine the amount of damage that would likely occur if a HTS pump motor were to be dropped during a lift over the vault. The results of this analysis will determine whether the original recommendation can be revised. Additionally, a request has been made to Civil Design to incorporate the Adjustor Rod flask lift into this analysis. The expected completion date for this analysis is January 8, 2016. Due to competing priorities with outage extensions and forced outages at the station, DNGS Civil Design Engineering has not completed the analysis for the PHT Pump Motor Lift. Additional time will be required to complete the analysis and interpret the results. [11JAN2016] (Feb. 09/16)-Request for Support Refurb/Station Design Engineering is in place. Due to competing priorities (Design Eng.) new TCD has not yet been provided to perform calculations. (Mar22/16) NR Design Engineering has indicated that the analysis can be performed and independently verified by 30JUN16.							
798	Higher Than Expected CSA Demand for U134	The RQE Plan only reflected 8.5 FTE CSAs budgeted for 2018 and beyond (due to a planning assumption that anticipated a drop in demand for CSAs post January 15, 2016 milestone: OP2360 – All Level 3 Schedules Quality Acceptance Complete). However, the "CSA Transition Plan" developed late in 2015, has clearly identified a need for 11 CSAs 2016-2023 in order to adequately support Pre-Req work and Unit Execution based on the OPEX and Lessons Learned based on the last 12 months. CCF 812 was generated to remedy this situation for U2.. There is a risk that U134 will experience the same higher demand and will require additional funds to remedy this demand. Among other details, some drivers for this increased need include: 1. Increased demand for dedicated CSA support for reviews, scheduling, and actions based on Pre-Reqs to Breaker Open for each of U134. 2. Increasing requests from Vendors to provide dedicated CSA support at vendor location, which take OPG CSAs away from crucial oversight and planning activities 3. Increased demand for OPG-performed activities to be scheduled within the Integrated Level 3 (U13)	1	Active	Karen Fritz	Vijay Santhanam	14-Jan-16	Monitor	31-Jul-16	4	2	1	8	4	2	1	8
			There are no Not Started, In Progress Actions associated with the risk.														
785	Inadequate schedule detail and work instructions to support the schedule development milestones	The risk is that less than adequate schedule detail and work instructions developed to support the schedule development milestones (REV C and REV 0) from all schedule owners leads to less than adequately planned Execution Schedule.		Active	Karen Fritz	Daniel Sawyer	11-Nov-15	Mitigate	15-Jan-16	3	2	2	6	2	2	2	4
			There are no Not Started, In Progress Actions associated with the risk.														
791	Refurbishment project not properly accomodated in the Generation Plan	Refurbishment project reflected on the long range generation plan only as a high level place keeper. Outage schedule and planned generation does not currently take into account the shared O&M and vendor support for the outages at PNGS and DNGS. Potential impact is an unavailability of critical resoruces or vendors during peak demands due to scheduled overlaps. This needs to be reflect in the genration plan as submitted to the OEB to ensure credible generation assumptions.	4	Active	Karen Fritz	Daniel Sawyer	11-Nov-15	Monitor	29-Jul-16	2	2	1	4	2	2	1	4
			There are no Not Started, In Progress Actions associated with the risk.														
	Requirement for 24/7 PCC coverage	To maintain lower staff numbers, a days based rotation for PCC coverage is described. The underlying assumption in this model is that little work is conducted on the back shifts that will not be	1	Active	Karen Fritz	Daniel Sawyer	02-Oct-15	Accept	15-Oct-19	2	1	1	2	2	1	1	2

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773	coverage	underlying assumption in this model is that little work is conducted on the back shifts that will not be managed by the RFR project. However there may be periods during execution phase where other groups are required to work extended schedules. The risk is that additional coordination efforts are required over and above those provided for in this plan.	There are no Not Started, In Progress Actions associated with the risk.													
	WCTL Staffing Estimate Uncertainty	- The number of Work Control Team Leaders (WCTL's) is reduced from 12 to 8 in outages following the execution of the first unit. This reduction credits a increase in ease of implementation of the following units. This may be overly optimistic.	1	Active	Karen Fritz	Daniel Sawyer	02-Oct-15	Accept	15-Oct-22	2	1	1	2	2	1	1
774			There are no Not Started, In Progress Actions associated with the risk.													

Program: Work Management - RF

800	HTS RTS Schedule Risk – Hot Conditioning with Fuel in Core	<p>EVENT: The current base case is sequenced such that fuel is manually loaded in core and later Hot Conditioning is performed, which may not be an acceptable sequence if this results in deposits on the fuel bundle.</p> <p>CAUSE: During Restart of Bruce Units 1 &amp; 2, Hot Conditioning was performed with fuel in core using EDTA process. Deposits were seen on fuel bundles from both units, with hot conditioning being the probable cause of the deposits. Unit operation with fuel bundles that have deposits is not an analyzed configuration for the fuel. As such, the CNSC directed Bruce Power (see NK21-CORR-00531-10509) not to perform any Hot Conditioning on subsequent units with the fuel in core unless there is agreement with the CNSC. It cannot be precluded that a similar phenomenon could happen at Darlington. Darlington is using the conventional hot conditioning rocess not EDTA which was used at the Bruce.</p> <p>Chemistry concerns with hot conditioning following ATC still need to be resolved. There is no current approved documentation supporting HC after the reactor is critical. Increased activated crud may result from performing HC while critical resulting in increased dose rates that affect worker safety and plant equipment lifecycle.</p> <p>IMPACT: The current RTS sequence (hot conditioning with fuel in core) may not be acceptable if it is found that Hot Conditioning with fuel in core results in deposits on the fuel. This would be an unanalyzed configuration in the safety report and would result in diminished regulator confidence in the project and S-99 reportable events. Allowing deposits on the fuel must be precluded or dispositioned. A change in RTS sequencing may be required resulting in a 30-45 day extention to the current schedule.</p>	2	Active	Karen Fritz	Daniel Sawyer	11-Mar-16	Mitigate	18-Mar-16	5	4	4	20	1	1	2	2
	There are no Not Started, In Progress Actions associated with the risk.																

Program: Work Management - WM

800	HTS RTS Schedule Risk – Hot Conditioning with Fuel in Core	<p>EVENT: The current base case is sequenced such that fuel is manually loaded in core and later Hot Conditioning is performed, which may not be an acceptable sequence if this results in deposits on the fuel bundle.</p> <p>CAUSE: During Restart of Bruce Units 1 &amp; 2, Hot Conditioning was performed with fuel in core using EDTA process. Deposits were seen on fuel bundles from both units, with hot conditioning being the probable cause of the deposits. Unit operation with fuel bundles that have deposits is not an analyzed configuration for the fuel. As such, the CNSC directed Bruce Power (see NK21-CORR-00531-10509) not to perform any Hot Conditioning on subsequent units with the fuel in core unless there is agreement with the CNSC. It cannot be precluded that a similar phenomenon could happen at Darlington. Darlington is using the conventional hot conditioning rocess not EDTA which was used at the Bruce.</p> <p>Chemistry concerns with hot conditioning following ATC still need to be resolved. There is no current approved documentation supporting HC after the reactor is critical. Increased activated crud may result from performing HC while critical resulting in increased dose rates that affect worker safety and plant equipment lifecycle.</p> <p>IMPACT: The current RTS sequence (hot conditioning with fuel in core) may not be acceptable if it is found that Hot Conditioning with fuel in core results in deposits on the fuel. This would be an unanalyzed configuration in the safety report and would result in diminished regulator confidence in the project and S-99 reportable events. Allowing deposits on the fuel must be precluded or dispositioned. A change in RTS sequencing may be required resulting in a 30-45 day extention to the current schedule.</p>	2	Active	Karen Fritz	Daniel Sawyer	11-Mar-16	Mitigate	18-Mar-16	5	4	4	20	1	1	2	2
	There are no Not Started, In Progress Actions associated with the risk.																

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## NUCLEAR PROJECTS RISK MANAGEMENT

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**Revision Summary**

Revision Number	Date	Comments
R002	2015-03-30	Major Revision to the document to address the integration of the draft P&M Risk Guide RISK-G-01 and to incorporate direction of the new Risk Management and Oversight (RMO) tool. Integration of all NR manuals (RISK-04, RISK-05, RISK-06, RISK-07, RISK-08) regarding OPEX, lessons learned, assumptions and decisions management into a single document.
	2014-06-28	Updated the Risk Management Process to include Key Risk Areas and the related sponsors' responsibilities
	2014-03-24	Integrate N-MAN-00120-10001-Risk 05 (contingency development) to create a consolidated single document. Removed the cost control/change control/reporting sections for contingency. Non-intent updates to provide clarification or context as requested by manual users.
R001	2013-07-07	Minor updates
R000	2012-07-25	First Issue

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## NUCLEAR PROJECTS RISK MANAGEMENT

### 1.0 DIRECTION

Risk management is a systematic approach to identifying, analyzing, and responding to project risks. The goal of risk management is to proactively identify and manage risks in order to deliver projects safely, with quality, on time and on budget. This document provides direction to projects for both day-to-day risk management activity as well as the risk management preparations for authorization packages presented at funding gates/committees.

### 2.0 SCOPE

A graphic depicting the “inputs to” and “outputs of” risk management activity that fall under the scope of this document is outlined below. The sections of this manual are structured in alignment with this diagram.

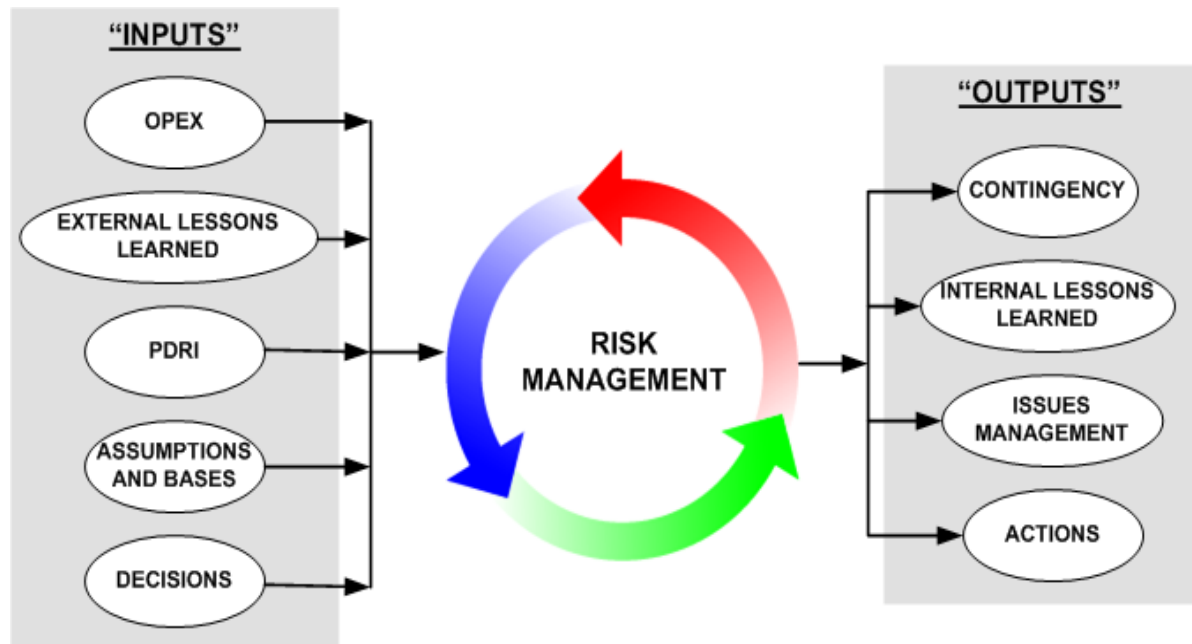


Figure 1: The Risk Management Process

#### 2.1 Risk Management and Oversight Tool (RMO)

The Risk Management and Oversight (RMO) tool is an application project managers will use to perform risk management activity for projects. The Project Management Office (PMO) is the owner and administrator for this tool and provides training, support, and guidance to the organization. This manual does not include detailed direction for using the RMO tool. For details on how to use the RMO tool, refer to *N-GUID-09701-10123, Risk Management and Oversight Tool*.

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### 2.2 PMO Role

The PMO Risk Department will provide guidance to the project managers in the application and interpretation of the requirements outlined in this manual. The support provided exists both in the day-to-day application as well during preparation of funding approval packages (e.g. Gate Review Board). The PMO risk department will perform oversight of the RMO contents on behalf of the Nuclear Projects organization and will prepare reports, metrics, self-assessments, and other such analyses from time to time to monitor the effectiveness and use of the processes outlined in this manual. Annually a consolidated report will be prepared incorporating a strategic review and identification of any corrective actions.

Additional project controls support and deliverables, where applicable, are outlined in the appropriate section of this manual.

### 3.0 RISK MANAGEMENT INPUTS

Risks to project objectives can be identified from a number of sources. If these sources of risk are not considered both in the development of the initial risk profile as well as during ongoing risk management activity the ability for the project manager and senior leadership to make informed decisions about the project may be adversely impacted.

#### 3.1 Operating Experience (OPEX) and External Lessons Learned

OPEX is information ***gained through experience*** that should be retained for future use. Depending on the observation made, OPEX could be a valuable technique, a best practice or a successful outcome you wish to repeat or an undesirable result you wish to avoid. When applicable OPEX is recognized, the project manager is then equipped with the knowledge to incorporate it into their baseline cost and schedule or manage it as a risk.

The Nuclear Projects process complies with *OPG N-PROC-RA-0035, Operating Experience Process*. This base standard has an operational focus. For project risk management, the goal is to look beyond operational events and seek out events that have happened both in nuclear and non-nuclear projects that may present risks to the project that is being undertaken.

OPEX obtained through RA-0035 process is added to the RMO database by the PMO and dispositional by the designated department or project. Anyone with access to the RMO tool can add an OPEX event under the OPEX tab. The PMO can assist the project manager in searching for specific event types and populating the RMO OPEX library with new information that will be helpful to others.

Lessons Learned (LL) are similar to OPEX items, in that they have a foundation in past events. A lesson learned however ***goes beyond an individual event to provide key insights and clearly identify the causal factors that contributed to a positive or negative outcome***. The RMO tool contains a searchable lessons learned library, with major lessons learned categorized as Programmatic Lesson Learned (PLL). Each PLL

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is assigned an owner within Nuclear Projects whose accountability is to ensure that proper actions are developed, assigned, and are monitored to completion.

### 3.1.1 Project Manager Direction

Project managers should be up to date on the content of the OPEX and LL libraries as they conduct their day-to-day risk management activities. Good practice would be to establish periodic reviews of OPEX and LL within their project teams during regular risk reviews.

Prior to any funding gate a detailed review of the RMO OPEX and LL library must be performed and any items that were considered in the preparation of the baseline cost and schedule or resulted in a project risks shall be identified. A summary of the review performed shall accompany the gate or funding approval package in the form of a narrative in *N-FORM-11652, Nuclear Projects Risk Management Input Assessment*.

#### PMO Role

The PMO Risk Department receives external OPEX from the central nuclear OPEX coordinator. The OPEX received has been pre-screened as per *N-GUID-04947.02-10000 External Events Screening Guide* and is determined to be relevant to Nuclear Projects. These items are populated in the RMO tool by the PMO risk department. The PMO risk department will also proactively seek out external and internal project related OPEX events through a variety of sources identified in Appendix A. The PMO risk department provides oversight support and disseminates significant information in real time through email communications. The PMO risk department creates programmatic lessons learned (PLL) based on significant OPEX and presents them to CARB.

### 3.2 Project Definition Rating Index (PDRI)

The Project Definition Rating Index (PDRI) is an industry best practice front end planning tool that helps assess the level of project scope definition and stakeholder alignment during the critical formative stages of the project. The objective of a PDRI is to identify gaps in scope definition early on, prior to committing significant funding to the project. The gaps in understanding or definition identified in the PDRI workshop shall be closed by the project manager prior to proceeding further (i.e. prior to submitting the funding package for approval). At minimum if the gaps cannot be resolved the project manager can use the insights gained in the PDRI session to inform the project risk register.

The requirement for a project to undertake a PDRI workshop is defined by the gating process. The PMO Risk Department can assist the project manager in executing a PDRI workshop by providing resources and facilitation.

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### 3.3 Assumptions and Project Bases

Assumptions are factors in the planning process that are considered to be true, real, or certain, without proof or demonstration. Assumptions are ***not completely defined in project documents*** but are required in order to develop the cost and schedule estimates for projects.

Project bases are ***documented descriptions of how an estimate, schedule, or other plan component was developed*** and defines the information used in support of development.

To the extent possible when preparing funding approval packages, the use of assumptions shall be minimized. It is important when preparing the cost and schedule estimates to disposition assumptions so that the project plan being presented has been validated and is supported by project bases. Any residual assumptions that cannot be dispositioned or built into the cost and schedule as a project basis shall be entered into the RMO assumption log and reviewed during preparation of the project risk register. Assumptions are to be populated in the RMO tool, and can be initiated by any Nuclear Projects personnel with access. Project bases that are not documented in other project documents (such as the basis of estimate) shall also be documented in the assumptions log in the RMO tool.

#### 3.3.1 Assumption Revision or Closure

Assumptions can be closed when they are no longer relevant or when they are known to be incorrect or invalid. New or modified assumptions that impact other projects directly, or those that are widely applicable (i.e. "program" level assumptions) shall be broadly communicated by the initiating project manager in order to bring awareness to those affected departments or projects. For example, an assumption pertaining to contracting or resourcing strategies may have a wide ranging impact on projects already in flight therefore strategic, effective communication is imperative.

#### 3.3.2 Project Manager Direction

Prior to submission of funding approval packages, the project managers shall populate the assumptions log in RMO. These assumptions shall be assessed to determine if they introduce risk to the project and require entry to the project's risk register. A summary of the assumptions made shall accompany the gate or funding approval package in the form of a narrative in *N-FORM-11652, Nuclear Projects Risk Management Input Assessment*.

The project managers shall keep up to date on the content of the assumptions log as they conduct their day-to-day risk management activities, and assess risks against assumptions made. Good practice would be to establish periodic reviews of the RMO assumptions log for any new programmatic assumptions made or any assumptions made for projects that may impact the subject project. The project manager shall re-validate their assumptions on a regular basis and at minimum at funding approval gates or when initiating the change control process.

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### 3.4 Decisions

***Documented decisions form a part of the project basis.*** Decision records are critical for maintaining an auditable trail for Nuclear Projects and assist in “telling the story” of the projects. In most cases, decisions exist in the form of approved documentation generated by following existing approved processes (the modifications and the engineering change control processes, Engineering or Operational Decision Making, for example). Decisions made under the execution of these processes do not need to be duplicated in the RMO tool.

Project decisions that should be entered into the RMO are those that are not covered by existing processes. These decisions tend to be strategic in nature and arise when there is not a clear path forward but rather a number of possible options to achieve the project’s objectives. Too often, these decisions are made informally without the appropriate authority and are not communicated effectively, resulting in adverse impacts on the projects. These decisions shall be documented in a DRAS (*Decision Record and Analysis Summary*) N-FORM-11390 and entered into the RMO tool once approved. A control document number shall be obtained for the DRAS and the DRAS shall be submitted to records in parallel with being added to the RMO decision log.

This decisions process and associated N-FORM is flexible and may be applied to provide structure to a number of different project departments for a number of different types of decisions. While all decisions documented in a DRAS shall be recorded in the RMO tool, this manual will not provide direction for all the various possible applications.

#### 3.4.1 Project Manager Direction

There is no strict prescription or threshold for entering decisions in the RMO tool. If there is confusion regarding the appropriateness of preparing a DRAS, contact the PMO risk department for support and guidance. As a general rule, the project manager should use judgment and input decisions in the RMO tool if:

- The decision forms a fundamental aspect of the project basis and is not documented elsewhere as part of approved project processes, and/or
- The decision would assist external and internal personnel in understanding the rationale and the considerations made in establishing the project plan, and are not documented elsewhere as part of approved project process.

In all cases, decisions must be validated with sufficient authority to ensure prudence and facilitate alignment among multiple organizations. Where a decision has a financial impact, the DRAS approver must have the authorization to approve the decision based on OPG-STD-0017, Organizational Authority Register. At minimum, for decisions that impact (or have the potential to impact) other OPG organizations, the Stratum IV manager of that department, or their delegate, shall review and comment. It is the project manager’s accountability to ensure this happens. Any DRAS that results in a change of scope to the project must be submitted to the appropriate project review board/committee for authorization prior to approval. Any employee can initiate a decision in the RMO tool provided it is supported by an approved DRAS.

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To the extent possible when preparing funding approval packages, the practice of documenting decisions is encouraged. The objective when preparing the cost and schedule estimates is to formally document decisions to support the project basis. A summary of the decisions made and recorded in RMO in the development of the project plan shall accompany the gate or funding approval package in the form of a narrative in *N-FORM-11652, Nuclear Projects Risk Management Input Assessment*. Good practice would be to establish periodic reviews of the RMO decisions log for any new decisions made that may impact the subject project and following up on any impacts if required.

Owners of the decisions recorded in the RMO tool shall review these decisions quarterly and update the project risk register as appropriate. Decisions that impact multiple organizations shall be broadly communicated by the decision owner in order to bring awareness to those affected departments or projects.

## 4.0 RISK MANAGEMENT

Project managers are accountable to apply the risk management (RM) practices identified in this section to their projects. The PMO Risk Department will provide tools, guidance, training, and support to the project managers.

The RM process includes the following fundamental steps:

- Planning** – defining how to conduct risk management activities for the project or program.
- Identification** – determining events that may affect the project objectives and documenting their characteristics.
- Assessment** – analyzing and prioritizing identified risks based on probability and impact (qualitative), and estimating the potential cost and schedule implications of the risks to the approved objectives if they were to occur (quantitative).
- Treatment** – determination of the most appropriate risk response to reduce threats to project objectives, or exploit opportunities to improve project performance.
- Monitoring and Control** – implementing risk response plans, monitoring identified risks, identifying new risks, and evaluating risk process effectiveness throughout the project life cycle.

### 4.1.1 Risk Management Planning

A Risk Management Plan (RMP) describes how risk management responsibilities structured and performed. Each project should prepare a standalone RMP or have a section dedicated to risk management within its Project Management Plan (PMP). Where the project is a subset of a larger program, referencing the program RMP or PMP and documenting any specific project deviations or details to the parent plan is acceptable.



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Included in RMPs are the following sections:

- **Risk Management Methodology** - defines the approach, tools, and data sources that may be used to perform risk management on the project.
- **Roles and Responsibilities** - defines the risk management leads, support personnel, and other team members including their responsibilities and accountabilities to ensure compliance with the risk management process.
- **Monitoring and Control** – definition of when and how often the risk management process will be performed, including the establishment of major risk management activities to be included in the project schedule. Monitoring and update frequencies will reflect the phase of the project life cycle (i.e. the execution phase will require a focused effort to stay on top of risks with more frequent updates).

### 4.1.2 Risk Identification

Risk identification is an iterative process because new risks may evolve or become known as the project progresses. The risk profile presented to support contingency development in a funding approval package is a “point-in-time” snapshot. Failure to perform ongoing risk management activity is negligent from a project management perspective and will result in adverse impacts to the individual project and the overall portfolio.

A number of techniques or forums may be used to identify risks. The project team and functional and external stakeholders should be involved in the process so they can develop and maintain a sense of ownership and responsibility for the risks and associated actions.

Tools and techniques to identify risks include, but are not limited to:

- Facilitated workshops
- Structured Interviews with experienced project team members, stakeholders and SMEs.
- Project Definition Rating Index (PDRI) Workshops
- OPEX and Lessons Learned Review
- Basis of Estimate (BOE) Review; review of assumptions and constraints in the BOE can be used as a source for risk identification.
- Project Schedule Review; review of near critical, critical path and schedule float in schedule assumptions can be used as a source for risk identification.
- Review of a standard risk breakdown structure for potential risks (Refer to Appendix C)

#### 4.1.2.1 Common Pitfalls in Risk Identification

There are five common pitfalls in risk identification that leads to inefficiencies in managing risks:

- Identifying Risk Without Clear Project Objectives

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Effective risk identification requires a high quality project plan with clearly defined cost, schedule, quality, and safety objectives. Without this, one cannot effectively identify risk to these objectives and items raised will be based in speculation and not facts. This can lead to initiating actions too early, team confusion, and create a perception that risk management is not an effective use of time or resources.

#### (b) The Presumption of Failure

Too often project and functional managers submit project plans (scope, cost, schedule, resources) for approval that they do not believe are reasonable and achievable. Further, a large risk register may be viewed as a means to indicate to the approval board that the project "is not easy" or has been unsuccessful in the past. This presumption of failure creates too many risks to effectively manage and a lack of clear prioritization for the team. A project risk register is not a repository to capture known shortcomings of an underdeveloped project plan.

#### (c) Identifying Issues as Risks

Issues are events that have 100% probability of occurring, or have occurred already and require resolution. As such, these are not preventable risk events but rather issues that should be addressed. Identifying issues as risks may distract the project managers and prevent them from focusing on the adverse impacts that are truly preventable.

#### (d) Business-as-Usual Risks

Events that will be addressed in the normal course of conducting work are termed Business-as-Usual items. These are items that have a process, plan or organization in place to address them, but the concern is that the execution may be "less than adequate". Examples of poor use of Business-as-Usual risks include:

- "Project Managers may not meet milestones".
- "Oversight plan may not provide complete details to provide guidance for oversight."

In general, in order to be a risk there has to be impact to the objectives of the project plan. Business as usual items may truly present a risk to the project but the cause and the impact must be clearly identified in the risk description in order to be effectively managed.

#### (e) Vague or Misleading Risk Titles and Risk Descriptions

Risk titles that are vague or misleading may result in response plans that do not address the real risk that the project is facing.

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#### 4.1.2.2 Risk Titles

Risk titles describe the event and the context of the event.

**“There is a risk of insufficient welders available <event> to support Execution <context>”**

#### 4.1.2.3 Risk Descriptions

Risk descriptions should be comprised of the risk **event**, the **cause** of the event, and the **impact** of the event on project objectives. The absence of any one of these critical items would preclude the item from being added to the risk register due to the inability to define a proper risk treatment.

**“There is a risk of insufficient welders available <event> to support Execution due to competition with other large industrial projects in the province <cause>, resulting in a delay that will impact the critical path by 30 days <impact>”.**

#### 4.1.2.4 Opportunities

An opportunity is an event that, if it is implemented or occurs, increases the likelihood of achieving project objectives. An opportunity must demonstrate a clear benefit to achieving a project objective *in sufficient magnitude to offset the risk presented by changing course*. Opportunities identified in the SharePoint log “Opportunities Inbox” will be reviewed periodically by the PMO risk department and reported in the Risk Oversight Committee meetings for further consideration. In all instances where opportunities are identified as valid, they are to be pursued with focus (i.e. exploited to the extent possible).

### 4.1.3 Risk Assessment

#### 4.1.3.1 Risk Register

A project risk register is a living repository of risks and is the project manager’s tool for identifying, assessing, monitoring, and updating project and program risks. The RMO tool contains the risk registers for all nuclear Projects – it is the working tool and also provides storage and backup of all risks and the associated logs. Risks included in the risk register should include **all project life cycle risks** that can be properly defined, without speculation, bias, or other such features identified in section 4.2.1.

#### 4.1.3.2 Qualitative Scoring of Risks

Qualitative risk scores assist those inside and outside project team in quickly determining the biggest risks to the project. A “heat map” scoring approach is taken based on the probability of occurrence, schedule impact and financial impact of a risk (refer to Figure 2). After the probability, financial impact and schedule impact scores are determined the risk score is calculated by multiplying the probability score with the financial or schedule score, whichever is highest. The heat map scoring is standard for probability and schedule impact, but scaled to four categories for cost assessment criteria based on magnitude of the project and financial impact of the risk. This scaled

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approach allows all project managers to qualitatively assess and prioritize risks to their project, with the understanding that a high risk to a \$500K project is not as impactful as high risk to a \$100M refurbishment project that has the same score.

Impact Score	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
RED = Major Risks YELLOW=Significant Risks GREEN = Minor Risks		1	2	3	4	5
		Probability Score				

**Figure 2: Generic Heat Map identifying the potential qualitative risk scores for Nuclear Projects**

Refer to Appendix D for the risk assessment criteria/scale and guidelines for how to use the heat map.

#### 4.1.3.3 Urgency

Urgency is another qualitative risk measure that assists project managers in prioritization. In the RMO, an urgency score shall be applied for each risk. The measure of urgency for risks in Nuclear Projects is as defined below:

Urgency Score	Approximate Timeline for risk response	Urgency Assessment Criteria
1	> 1yr	Risk treatment activities complete or risk not required to be addressed for the foreseeable future
2	6 months – 1 yr	Risk can be addressed in the long term and risk treatment will still be effective
3	1-6 months	Risk should be addressed in the midterm for risk treatment to be effective
4	Within 1 month	Risk must be addressed immediately for the risk treatment to be effective

#### 4.1.3.4 Quantitative Risk Analysis

Quantitative risk analysis is the process of assigning a dollar value to the effect of identified risks on overall project objectives. Quantitative risk analysis is performed on risks that have a significant qualitative residual risk score and require contingency funding. Not all risks qualitatively scored and managed per this process will require contingency (refer to Section 5.1 for guidelines). Wherever possible, the estimating

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group should be engaged in supporting the determination of the cost impact of a risk to the project plan. If the quantification of risk exceeds the cost benefit argument for the project, the viability of the project should be revalidated.

### 4.1.4 Risk Treatment

Risk treatment requires effort to develop a plan to minimize the risk and implement response actions where appropriate. All risks in the risk register should have one of the following risk responses:

- **Avoid** – Obtain information to better define the risk source, eliminating the risk entirely. In this case the residual risk score should be reduced compared to the current risk score to reflect the level of confidence in the ability to avoid this risk.
- **Transfer** – Shifting some or all negative impacts of a threat to a third party (e.g. to a contractor via contract terms and conditions). If this response is chosen, the risk owner is still accountable to manage this risk on an ongoing basis. In this case the residual risk score should be less than the current risk score due to the consequence of the risk being transferred to a third party.
- **Mitigate** – Take actions to reduce the probability and/or impact of an adverse risk event to be within acceptable limits. In this case the residual risk score should be less than the current risk score due to mitigation actions being taken.
- **Accept** – Take no action and accept the possibility that the risk could occur. In this case the residual risk should reflect the current risk score, because nothing is being done to reduce the risk. Accepting risk may result in significant cost impacts, as such the risk owner is required to gain the endorsement of the responsible project director prior to selecting this response.
- **Monitor** – Periodically assess the risk through the normal course of project execution until, a) clear mitigating actions are identified, or b) a more appropriate risk response is identified. In this case the residual risk should reflect the current risk score, because nothing is actively being done to reduce the risk.

An informal cost-benefit analysis may be performed to evaluate the appropriate of the risk response. For example, if the cost to mitigate the risk is greater than accepting the probability and the impact of the risk “as-is”, then the risk response should be “Accept” and not “Mitigate”.

#### 4.1.4.1 Evaluating the Effectiveness of Risk Responses

All risks in the risk register should have three risk scores:

- Pre-Response Risk Score** – the score assuming that the risk will be accepted. This is a one-time assessment at the “point of discovery” of the risk.
- Post-Response Risk Score** – the score of the residual risk assuming the risk response is completed successfully. This score is subjective and based on the confidence level of the risk owner in the effectiveness of their risk response. This post response score is a gauge of how manageable the risk owner believes the risk is.

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- (c) **Current Risk Score** – the score reflecting the current status of the risk. This is the primary measure of risk exposure for the purpose of planning and risk metrics/response analysis.

## 4.2 Risk Monitoring and Control

### 4.2.1 Risk Reviews

The risk owner identified in the RMO tool has complete accountability for the content of their risks in the tool and for the implementation regular reviews of these risks. This is true even if they have delegated their authority to update or manage the risk to others. Each risk owner shall perform, at minimum, monthly risk reviews to:

- Ensure risk responses are optimal based on the latest information;
- Ensure mitigation actions are on track and status the actions in the actions log in the RMO tool and initiate new actions were warranted;
- Determine if the assumptions related to the risks are still valid and update in the Assumptions log in the RMO tool, if applicable;
- Determine if the risk characteristics have changed;
- Determine if new risks should be identified;
- Determine if risk has been realized or has expired and can be closed in the RMO Tool (with justification).
- Assess, modify and validate the risk score and any other applicable fields (such as owner, comments, etc.) in the risk register as required.

### 4.2.2 Risk Reporting

Risk reporting is performed in line with monthly or quarterly reporting cycles. The content of risk reports can be taken directly from the RMO Tool using the Business Intelligence (BI) report engine. For senior management and external stakeholder reporting, the PMO risk department may make the the risk wording in the RMO tool more concise to align with the level of detail required in the specific reporting vehicle.

Examples of reporting vehicles for risk include:

- Risk Dashboard
- Key Risk Area Summary Report
- Program Reports
- Quad Charts
- NOC ( Nuclear Oversight Committee) Reports
- Quarterly ERM (Enterprise Risk Management) Reports
- User Reports (“boxed” reports) from BI

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### 4.2.3 Risk Metrics

In order to assess the effectiveness RM in Nuclear Projects, the PMO risk department will prepare metrics. The Risk Dashboard will contain the primary metrics that will identify trends and allow comparisons of risk across the projects, functions, and Nuclear Projects as a whole. As risk management is a qualitative measure, with no focus on achieving a quantitative “target”, metrics prepared shall be geared towards process compliance only. As the risk management practice in Nuclear Projects evolves and matures, additional metrics may be introduced.

### 4.2.4 Key Risk Areas

Key Risk Areas are used to group risks from different projects which may impact major, overarching Nuclear Projects objectives. Each Key Risk Area is assigned a senior management sponsor who is responsible for providing oversight of the Key Risk Area to ensure that it is effectively being managed as a whole. Key Risk Areas are intended to provide a cross-cutting look at high level risk areas which need increased visibility and attention within Nuclear Projects. It is important to note that not all risks in the RMO Tool need to be categorized under a Key Risk Area.

The Sponsor of a Key Risk Area is required to champion the risk management process to ensure that, as an aggregate, the Key Risk Area is being addressed **efficiently** and **effectively** in order to minimize impact on NR objectives. It is expected that the Key Risk Area Sponsor is:

- **Knowledgeable of** and **able to communicate** the general “health” and status of the Key Risk Area at the R-ROC and in other major communication vehicles, as required.
- **Proactive in initiating change in their Key Risk Area** to improve the efficiency and effectiveness of the NR response.
- **Available to provide the strategy/rationale** for the requested change to the individual risk owners, when required.
- **Rigorous in follow up** to ensure sponsor directives have been implemented.

## 5.0 RISK MANAGEMENT OUPUTS

Effectively managing the outcomes of realized risks is critical to recovering project objectives. Ineffectively managing realized risks can create a snowball effect where distractions result in loss of focus on the remaining risks leading to their eventual impact on the project.

### 5.1 Contingency

Contingency is a tool to manage uncertainty and risk throughout the life of a project. The contingency reserve should be proportional to the project size, duration, complexity, risk exposure and tolerance, prior experience with the work, and

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confidence levels set by management. ***Contingency is not a tool to compensate for an underdeveloped project plan.***

Contingency covers the *known unknowns* in a project. Specifically, these are the uncertainties associated with a schedule and cost estimate, as well as the discrete risk events that impact the objectives defined by these fundamental products. Any contingency development exercise requires a high quality, vetted estimate and schedule. Without a high quality project plan, one cannot effectively identify risks or the level of uncertainty. Without a high quality risk register and well understood uncertainty profile, one cannot effectively calculate an appropriate contingency estimate. It is the expectation that the project plan presented for contingency analysis is reasonable and achievable and endorsed by necessary stakeholders during its development.

The PMO risk department will work with the project managers to develop an appropriate project contingency estimate. Contingency should be calculated in advance of submitting the funding approval package to the approving board/committee but after the development of the cost and schedule estimate. Once approved, ongoing contingency adequacy reviews should be performed through the PMO risk department in line with Section 5.1.5.

Management Reserve (MR) is an amount of the project's calculated contingency withheld for management control purposes.

### 5.1.1 Discrete Risks

Risk events have cost, schedule, quality, or safety impacts, all of which can be characterized into potential financial consequences.

The cost score should indicate the direct cost impacts resulting from the realization of the risk exclusive of time dependent costs. Using three point estimates to establish ranges of possible outcomes for risks, the impact of the discrete risks can be modelled in a Monte Carlo simulation to estimate the amount of contingency required to address these specific events.

The schedule score identified on the risk register indicates the impact to a project's critical path, usually expressed in "days" and easily translated to dollars based on burn rates. This approach to schedule contingency (i.e. burn rate x days delay) is high level approach and is less precise than range analysis on a CPM schedule, which is the preferred method. This approach uses a Monte Carlo methodology and assigns three point estimates to critical path project activities considering the risks identified.

### 5.1.2 Cost Estimate Uncertainty

Cost estimate uncertainty is a function of estimate class and is an implicit risk to project objectives. For example, a point estimate built upon conceptual design information is only assumed accurate within a very broad range and may have many potential outcomes. Uncertainty in estimates is expected to decrease over time as the project definition improves and the project matures. Appendix E Table 1 identifies the ranges of uncertainty associated with estimate class definition as defined by AACE.



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The determination of the size of the contingency fund must take into the account the estimate accuracy and project phase.

Cost growth areas typically covered by estimating uncertainty contingency are more general than those covered by discrete risks, and include items such as:

- Minor errors in omissions in the estimating process (e.g. precise quantity is only known during execution)
- Variability of productivity (e.g. estimating based on execution in the summer, but actually executed in the winter)
- Variability in wages (e.g. labour agreements expiring during execution)
- Variability in prices (e.g. material prices assumed)

Effort must be made to ensure the factors covered by cost estimating uncertainty are not duplicated in the project risk register. Using three point estimates, the impact of the cost estimate uncertainty can be modelled in a Monte Carlo simulation to estimate the amount of contingency required to address these events.

Estimate uncertainty does not capture variability in scope.

#### 5.1.3 Risk Tolerance and Confidence Levels

Risk tolerance is the degree, amount, or volume of risk that an organization is willing to accept. Nuclear Projects risk tolerance is informed by a number of contributors including the experience and instinct of the project management team, past performance of similar projects, and stochastic methods.

In stochastic risk analysis, it is often expressed in a percentage value called a confidence level. For example, a P50 value on a Monte Carlo contingency estimate means that a project manager can be 50% confident that the contingency allocated is sufficient to address the risks and uncertainties defined for the project.

In managing a portfolio or program of projects, the concept of confidence levels can be useful in managing contingency funds. For example, for a given project's contingency analysis, the following structure could be employed to support the approval authority of contingency funding. This is for illustrative purposes and may be applied differently for different funding streams and risk tolerances within the Nuclear Projects organization.

Contingency \$ at Confidence Level	Up to P50 (Current Phase Risks and Uncertainties)	Up to P50 (Future Phase Risks and Uncertainties)	P50 → P70 (All Risks and Uncertainties)	P70 → P90 (All Risks and Uncertainties)
Treatment Upon Project Approval to Proceed	Released to Project	Allocated to Project but not Released	Allocated to Project but not Released to	Allocated to Management Reserves

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		to Project	Project	
Authorization for Release to Project	N/A	VP Nuclear Projects	VP Nuclear Projects	SVP Nuclear Projects

Table 1: Example of how contingency developed for a specific project feeds into portfolio or program management

### 5.1.4 Probabilistic Analysis of Uncertainties

Monte Carlo simulation is a form of probabilistic analysis. It is a method to predict the impact of defined risks and uncertainties using project simulations. Gathering the three point estimates required for the Monte Carlo method can be quick and simple or rigorous, and should be commensurate to the overall magnitude or cost of the project. For example, small projects can use the projects manager's judgment for inputs but large projects should be done with rigor and inputs from knowledgeable personnel. Poor quality inputs to the Monte Carlo (including choosing a misrepresentative probability distribution, or omissions of key risks) will produce misleading results – "garbage in, garbage out".

The PMO risk department will perform the Monte Carlo analysis for risk and uncertainty inputs defined by the project manager. All contingency requests in support of funding approval packages are required to have a supporting Monte Carlo analysis, unless an exception is approved by the Director of the executing Nuclear Projects organization.

The general steps to executing the Monte Carlo contingency analysis are as follows. The PMO risk department can help provide direction and guidance to project teams where required:

- Confirm the basis of analysis. The project scope, schedule, and estimate should be well defined/finalized with minimal anticipated changes.
- Conduct risk screening to determine which risks are warranted to have contingency allocated against them. Not all risks are suitable for contingency allocation. Appendix E Table 2 provides a guideline on how risk screening should be conducted.
- Gather inputs for probabilistic analysis. This involves obtaining three point estimates (Most Likely, Optimistic, and Pessimistic) for residual risk impacts, cost uncertainty, and the logic tied critical path schedule activities.
- Run Monte Carlo simulations using software and analyze the results. Results will be presented as S-Curves or in other tabular forms/reports generated from the Monte Carlo tool.
- Determine the size of contingency required for the determined level of confidence.
- Reassess the inputs if required based on the outcome of the analysis and iterate steps (a) through (e).

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### 5.1.5 Monte Carlo Analysis - Limitations

Monte Carlo project predicts the impact of the identified risks and uncertainties by running simulations to identify the possible outcomes of the project. This technique helps in forecasting the likely outcome of a project, thereby helping decision makers and project managers in make informed decisions.

***Monte Carlo contingency analysis is not intelligent. It will not compensate for omissions or errors in the risk registers or estimates that are submitted for analysis. The output of a Monte Carlo considers only those risks and uncertainties the project manager has identified as an input to the process.***

### 5.1.6 Contingency Adequacy Review

The owner of contingent funds should re-evaluate the amount of contingent funds required as the project progresses. Contingency funds defined in funding approval packages are “point-in-time” estimates that reflect the project risk profile in that instance. As the project progresses, risks will be retired and new risks will emerge. It is critical that the contingency estimate is updated to reflect this and maximize the organization’s flexibility in managing these funds.

Contingency reviews should be conducted at the following checkpoints:

- (a) Gate submission, including gate refreshes; BCS submission or superseding BCS submission
- (b) Upon initiation of the project change control process;
- (c) Release planning;
- (d) Risk realization, especially a risk with high demands for funds;
- (e) Unexpected event requiring high demands for funds;
- (f) Significant change in the risk register;
- (g) Significant deviation from the planned usage of contingency
- (h) Alongside regular cost forecasting as defined by the PMO cost control department.

Note that the contingency adequacy review (or contingency assessment during normal forecasting activity) may reveal that there is too much contingency or not enough contingency allocated to the project. The project manager should return contingent funds that are no longer required via change control. If additional funds beyond what has been approved at the gate or release are required, then the function manager or project manager should request additional funds via change control process.

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### 5.1.7 Refurbishment Contingency Development

All projects being executed within the Nuclear Projects organization, including refurbishment projects, are required to comply with this manual. However, for Nuclear Refurbishment, a white paper will prepared for each release period detailing how the contingency estimate is assembled. This white paper will be governed by this manual but will contain sufficient detail and additional considerations commensurate to the magnitude of the project.

### 5.2 Internal Lessons Learned

Internal lessons learned (ILL) are valuable because they ***provide real time, directly applicable experiences that other project managers can use when establishing their project plans***. ILL usually take the form of detailed reports prepared upon project completion as defined in the modifications process. While this is valuable the objective of the ILL process is to share lessons both large and small in an effective way with minimal administration. Management and documentation of ILL is conducted electronically in the RMO Lessons Learned library.

ILL entries can be generated by Nuclear Projects staff for the purposes of sharing non-confidential OPEX and Lessons Learned from their department, project, a specific task, pre-post job debriefings, oversight activity, benchmarking trips, meetings, human performance observations or any other source.

#### 5.2.1 Project Manager Direction

All project managers shall proactively document important lessons learned throughout the project life cycle to support improved project performance within the Nuclear Projects organization. Project managers will notify the PMO risk department to ensure lessons are documented and disseminated properly to increase awareness among the Nuclear Projects organization and improve management decision making.

#### PMO Role

The PMO Risk Department actively solicits real-time feedback on ILL throughout the organization, ensures accessibility to all members of the project and ensures standards, quality and completeness is accomplished. PMO Risk Department will provide simple templates for the project management team and prepare communication products (reports, emails, articles) for dissemination to the Nuclear Projects organization and its vendors.

### 5.3 Issues Resulting from Realized Risks

An issue is defined as ***a point or matter in question or in dispute***. For projects, issues that arise usually surface gaps that must be addressed in order to achieve project safety, quality cost, and schedule objectives. Project issues can occur when risks are realized, assumptions made during the development of the project plan are

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proven to be invalid, or as the result of project authorization to proceed at risk with an underdeveloped plan.

Issues ***are not the normal challenges encountered in the progression of project planning and execution.*** Similar to risks, issues generated from realized risks – as defined in this manual - must demonstrate the potential to impact approved project objectives.

#### 5.3.1 Project Manager Direction

Management of issues resulting from realized risks have one of two outcomes:

- A recovery plan is prepared and implemented with the target of achieving the approved plan, or
- The issue cannot be recovered and impacts the ability to execute the approved plan, resulting in a need to modify the plan (i.e. move milestones, increase costs beyond contingency).

When an issue of this type arises a Station Condition Record (SCR) shall be raised to document the issue as an adverse condition. In most cases this SCR will be trended D4 and closed out to recovery actions input to the RMO action log or to the change control process, as appropriate, wherein the issue will be managed to closure. Any actions generated in the RMO action log associated with an issue of this type shall reference the SCR. As defined by the requirements of the SCR process, and depending on the severity of the issue, actions inside the SCR process may be required. In this scenario, the actions do not need to be duplicated in the RMO actions log.

The project manager, depending on the severity and possibility of repeat occurrence, shall work with the PMO risk department to generate an internal lesson learned for distribution by the PMO.

#### 5.4 Actions

Project actions not included in an existing managed system (project schedule, business plan, action tracking, etc.) will be documented and managed in the RMO action log. This action log can take the place of Microsoft excel or word files that project managers may be using to track actions.

Nuclear Projects action sources should be diverse and comprehensive and may include, but are not limited to, meeting actions, audit response actions, actions to mitigate risks, actions to validate assumptions, actions arising from assumptions, decisions, issues, oversight, OPEX and lessons learned implementation actions. Actions that are part of the normal course of executing project work such as day to day individual accountabilities and “business as usual” actions should not be included in the log.

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### 5.4.1 Reporting

User reports can be generated by anyone at any point in time. These online business intelligence (BI) reports may be communicated from time to time in meetings or other forums. PMO risk department will administer these reports and facilitate project team access to them, in real time. Change to reports will occur from time to time as required.

## 6.0 ROLES AND ACCOUNTABILITIES

### 6.1.1 Senior Vice President and Vice Presidents in Nuclear Projects

Champion the risk management process in Nuclear Projects.

### 6.1.2 Project Managers and Directors

Apply this manual to all projects being executed by the Nuclear Projects organization.

### 6.1.3 Project Team

Support project managers and directors through application of this manual.

### 6.1.4 PMO Risk Department

Support project team members in the application of this manual and the RMO tool. Maintain this manual and provide guidance, training, and support to project teams. Support Nuclear Projects executives by providing oversight and reporting of the risk management program in Nuclear Projects.

## 7.0 ACRONYMS

<b>AACE</b>	Association for the Advancement of Cost Engineering
<b>BOE</b>	Basis of Estimate
<b>CARB</b>	Corrective Action Review Board
<b>CCF</b>	Change Control Form
<b>CII</b>	Construction Industry Institute
<b>COG</b>	CANDU Owners Groups
<b>DRAS</b>	Decision Record and Analysis Summary
<b>ERM</b>	Enterprise Risk Management Team
<b>LL</b>	Lessons Learned
<b>MR</b>	Management Reserve
<b>NOC</b>	Nuclear Oversight Committee
<b>NR</b>	Nuclear Refurbishment
<b>OAR</b>	Organizational Authority Register

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<b>OPEX</b>	Operating Experience
<b>OPGN</b>	Ontario Power Generation Nuclear
<b>PDRI</b>	Project Definition Rating Index
<b>PMO</b>	Project Management Office
<b>RBS</b>	Risk Breakdown Structure
<b>RM</b>	Risk Management
<b>RMO</b>	Risk Management and Oversight Tool
<b>RMP</b>	Risk Management Plan
<b>SCR</b>	Station Condition Record
<b>SME</b>	Subject Matter Expert
<b>SRB</b>	Scope Review Board
<b>WBS</b>	Work Breakdown Structure

## 8.0 RECORDS AND REFERENCES

### 8.1 Governing Documents

Any controlled documents which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0003, Controlled Document Management.

Any records which may be produced as a result of this document should be managed in accordance with N-PROC-AS-0042, Quality Assurance Records.

The following records may be generated by use of this document and shall be registered in appropriate document management system in accordance with the following table.

Record Created	Associated Form Number	QA Record? Y/N	Filing Information/Retention (Asset Suite Type/ Sub-Type)
Risk Input Assessment Form	N-FORM-11652	N	Not required to file. Template for RMO Tool, submit with package to Risk Management group. Form to be destroyed after update or RMO database.
Decision Record and Analysis Summary Form	N-FORM-11390	N	File in Asset Suite, Records Management Module, completed form will be linked and confidential as auto generator number as NK38-LIST-09701-XXXXX RRC NO2-0049 Retention: 10 years after completion of the overall Refurbishment program.

A final report, detailing projects Nuclear Refurbishment Risks, Actions, Issues, Decisions, Assumptions, OPEX and Lessons Learned located today in the Risk Management and Oversight (RMO) tool will be sent to Records, retention as above, during project close phase.

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## 8.2 References

### 8.2.1 Performance References

N-GUID-09701-10123 Risk Management and Oversight Tool

N-FORM-11390 Decision Record and Analysis Summary Form

N-FORM-11652 Project Risk Input Assessment

### 8.2.2 Developmental References

- WANO-GL 2003-01, Guidelines for Operating Experience at Nuclear Power Plants
- NK38-REF-09701-0535862 Nuclear Refurbishment Opex\lesson Learned Program Strategic Plan
- N-STD-AS-0028, Project Management Standard
- N-PROC-RA-0035, Operating Experience Process
- N-PROC-RA-0022, the Station Condition Record (SCR)
- N-PROC-AS-0003, Controlled Document Management
- N-GUID-04947.02-10000, External Events Screening Guide
- OPG-STD-0017 , Organizational Authority Register
- OPG-PROC-0094 , Enterprise Risk Management Process
- Construction Industry Institute. Applying Probabilistic Risk Management in Design and Construction Projects. Implementation Resource 280-2. June 2012.
- Project Management Institute. Project Management Body of Knowledge (PMBOK Guide), Fourth Edition. 2008



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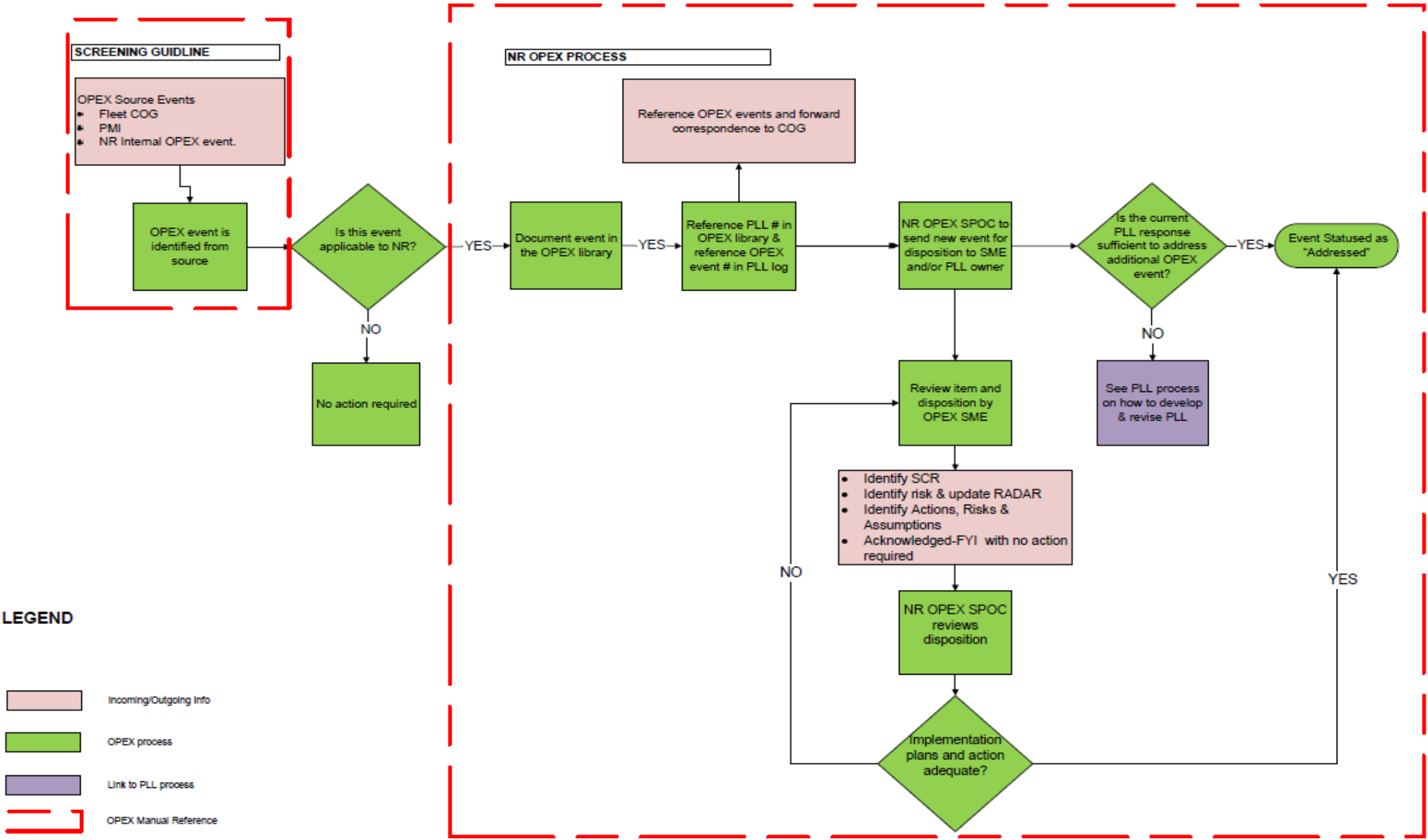
### Appendix A: OPEX and Lessons Learned Resources

The following are OPEX and Lessons Learned resources available for use by all NR employees. Please contact your SME or the NR OPEX SPOC for assistance to setup newsfeeds or alerts.

- **CANDU Owners Group Weekly Screening Meeting (COG WSM)**
  - COG OPEX Database, COG Newsgroups and COG Publications
  - Station Condition Records (SCRs) database
  - World Association of Nuclear Operators (WANO)
  - Institute of Nuclear Power Operators (INPO)
  - International Atomic Energy Agency (IAEA)
  - Electric Power Research Institute (EPRI)
  - Safety Flash Report
- **NR Internal OPEX events**
  - Risk Assessment Database and Register (RADAR)
  - OPG Self Assessment Database
- **Other Sources**
  - Project Management Institute (PMI)
  - INPO Project Management
  - Professional Journals / Newspapers
  - Lessons Learned Reports from other projects (Asset Suite)
  - Benchmarking visits to other stations and employees' experience with similar projects

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Appendix B: OPEX Flowchart



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Appendix C: Sample Risk Breakdown Structure

COMMERCIAL	BUSINESS PLAN	BUSINESS CASE
		FEASIBILITY
		ECONOMIC INCENTIVES / BARRIERS
		MARKET / PRODUCT
		STANDARDS / PRACTICES
		OPERATIONS
		COMPETITION
		INTEREST RATES
		TAXES / TARIFFS
	FINANCING / FUNDING	SOURCES AND FORM OF FUNDING
		FOREIGN CURRENCY FLUCTUATIONS
CONTRACTUAL	COMMERCIAL	ESTIMATE UNCERTAINTY
		PAYMENT TERMS
		INSURANCES
		LIABILITIES
		INTELLECTUAL PROPERTY
		PERFORMANCE GUARANTEES
		FOREIGN CURRENCY FLUCTUATIONS
		CHANGE MANAGEMENT
		NOTICE REQUIREMENTS
	PROJECT SCOPE	SCOPE DEFINITION
		TECHNOLOGY
		HAZARDOUS MATERIALS
		HEALTH & SAFETY
		UTILITIES / OFFSITES
		SITE SELECTION & CLEAR TITLE
		APPROVALS / PERMITTING
CLIENT	CLIENT	RELATIONSHIP
		CLIENT SPECIFIC REQUIREMENTS
		APPROVAL OR RE-APPROVAL PROCESS
		PAST EXPERIENCE
		INTERFACE REQUIREMENTS INCL. PMC OR OWNERS ENGINEER
TECHNICAL	ENGINEERING & DESIGN & EXECUTION	ENGINEERING / DESIGN PROCESS
		ORGANIZATIONAL STRUCTURE
		PLANNING & PROCEDURES
		EXECUTION PLANNING
		TECHNOLOGY SELECTION
		PARTNERS
		HIGH VALUE ENGINEERING/DESIGN SERVICES (HVEC)
		HOME OFFICE SCHEDULE
		RESOURCES
		PROJECT MANAGEMENT
		CONSTRUCTABILITY

EXTERNAL	TAX / TARIFF	TARIFFS / DUTIES
		VALUE ADDED TAX
		LEGAL ENTITY ESTABLISHMENT
		APPLICATION OF TAX LAWS AND ENFORCEMENT OF CHANGES
		TECHNOLOGY TAX
		PERSONAL INCOME TAX
		CORPORATE INCOME TAX
		TAX EQUALIZATION
		CHANGE IN FISCAL / MONETARY POLICY
		MISCELLANEOUS TAX
	GEOGRAPHICAL	COUNTRY / AREA
		NATURAL DISASTER
		FORCE MAJEURE
		WAR / INSURRECTION
		SOCIAL UNREST / VIOLENCE
		GOVERNMENT PARTICIPATION & CONTROL
		RELATIONSHIP WITH GOVERNMENT & OWNER
	CULTURE	TRADITIONS & PRACTICES
		PUBLIC OPINION
		RELIGIOUS DIFFERENCES
	LEGAL	LEGAL BASIS
		LEGAL STANDING
		GOVERNING LAW / FORMALITIES / LANGUAGE
		CONTRACT TYPE & PROCEDURES
		ENVIRONMENTAL PERMITTINGS
		CORRUPT BUSINESS PRACTICES
	POLITICAL	NATIONALISM & EXPROPRIATION
		GOVERNMENT OR POLITICAL INSTABILITY
PROCUREMENT	SOURCING & SUPPLY	LOCATION / LOGISTICS / DELIVERY
		LONG LEAD EQUIPMENT (LLE) DELIVERY
		ENGINEERED EQUIPMENT PRICING
		PACKAGED EQUIPMENT SYSTEMS
		BULK MATERIALS / COMMODITY PRICING
		SUBCONTRACTORS
		IMPORTING & CUSTOMS

CONSTRUCTION	CONSTRUCTION	SAFETY DURING CONSTRUCTION
		CLIMATE
		WORKFORCE AVAILABILITY
		CONSTRUCTION PERMITTING
		CONSTRUCTION DELIVERY METHOD - SUB / DIRECT HIRE
		GENERAL CONTRACTOR AVAILABILITY
		CONTRACTOR PAYMENTS
		CONSTRUCTION SCHEDULE
		WORKFORCE LOGISTICS & SUPPORT
		COMMUNICATIONS / DATA TRANSFER
	STARTUP	QUALITY
		TRAINED WORKFORCE
		FACILITY TURNOVER
		FEEDSTOCK & UTILITIES
PRODUCTION/ OPERATIONS	PEOPLE	OPERATIONAL SAFETY
		SECURITY
		LANGUAGE
		HIRING / RETAINAGE
	LEGAL	GOVERNING LAW / OPERATIONAL LIABILITY
		PERMITTING
		INSURANCE
		EXPORTS
		ENVIRONMENTAL COMPLIANCE
	TECHNICAL	LOGISTICS & WAREHOUSING
		SUPPLY CHAIN
		DATA SECURITY
		RELIABILITY
		FACILITY MANAGEMENT
	MAINTENANCE	INFRASTRUCTURE SUPPORT
		TECHNICAL SUPPORT
		QA/QC
		OPERATIONAL SHUTDOWNS

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**NUCLEAR PROJECTS RISK MANAGEMENT**

**Appendix D: Program and Functional Risk Assessment Criteria/Scale**

Nuclear Projects Risk Assessments Scale							
Risk Attribute	Definition	1 (Minimal)	2 (Minor)	3 (Notable)	4 (Substantial)	5 (Major)	
Probability	The probability that a risk will occur	<20%	20%-40%	40%-60%	60%-80%	>80%	
Schedule Impact	The impact that a risk would have on the project critical path	No Delay	< 1 Week	1-2 Weeks	2-6 Weeks	>6 weeks	
Financial Impact							
Refurbishment	Program (Functions)	Financial consequences of a risk should it occur	<\$50M	\$50M-\$100M	\$100M-\$200M	\$200M-\$400M	>\$400M
	Projects (Bundles)		<\$1M	\$1M-\$10M	\$10M-\$50M	\$50M-\$200M	>\$200M
AISC Projects	<\$1M	Financial consequences of a risk should it occur	<\$50K	\$50K-\$100K	\$100K-\$300K	\$300K-\$500K	>\$500K
	\$1M - \$5M		<\$200K	\$200K-\$500K	\$500K-\$1M	\$1M-\$2M	>\$2M
	\$5M - \$10M		<\$400K	\$400K-\$1M	\$1M-\$2M	\$2M-\$4M	>\$4M
	\$10M - \$20M		<\$700K	\$700K-\$2M	\$2M-\$4M	\$4M-\$8M	>\$8M
	>\$20M		<\$2M	\$2M-\$5M	\$5M-\$10M	\$10M-\$20M	>\$20M

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**NUCLEAR PROJECTS RISK MANAGEMENT**

**Appendix E: AACE Estimate Class and Expected Accuracy Ranges**

Table 1 - AACE Estimate Class and Expected Accuracy Ranges

ESTIMATE CLASS	Primary Characteristic	Secondary Characteristic		
	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges <sup>[a]</sup>
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Notes: [a] The state of process technology, availability of applicable reference cost data, and many other risks affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

Figure E-1: AACE Estimate Class and Expected Accuracy Ranges

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**NUCLEAR PROJECTS RISK MANAGEMENT**

**Table E-2 - Optimal Response based on Risk Probability and Impact**

Quadrant	Description	Optimal Response	Contingent Funds Assignment?
Low Impact, Low Probability	<ul style="list-style-type: none"> <li>Essentially negligible</li> <li>In the unlikely condition that it does arise it should be possible to deal with it simply and with minimal impact</li> </ul>	<ul style="list-style-type: none"> <li>Monitored to determine that the impact or likelihood does not increase</li> </ul>	No
High Impact, High Probability	<ul style="list-style-type: none"> <li>Management should determine if project should proceed or if the benefits of taking the risks is justified</li> </ul>	<ul style="list-style-type: none"> <li>Budget for mitigating actions in the project scope to lower the probability and impact of the risk</li> </ul>	Yes – for the residual risk post-mitigation
Low Impact, High Probability	<ul style="list-style-type: none"> <li>Uncertainties from common sources in a project (e.g. cost of labour, materials, actual duration of activities, productivity, etc.)</li> <li>Each of these uncertainties alone would have little impact, but the cumulative effects may have impact</li> </ul>	<ul style="list-style-type: none"> <li>Reduce uncertainties in estimates by obtaining additional information or improving work processes</li> <li>Budget for mitigating actions in the project scope to lower the probability and impact of the risk, if reasonable to do so</li> </ul>	Yes – for the residual risk post-mitigation
High Impact, Low Probability	<ul style="list-style-type: none"> <li>Rare occurrences</li> <li>Difficult to assign probabilities based on past events</li> <li>Cannot be effectively funded by contingency, especially if maximum impact is realized</li> </ul>	<ul style="list-style-type: none"> <li>Budget for mitigating actions in the project scope to lower the probability and impact of the risk, if reasonable to do so</li> </ul>	Case-by-case basis. If yes, should be covered by Management Reserve

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## NUCLEAR PROJECTS RISK MANAGEMENT

### Appendix F: Outputs of the Monte Carlo Method

Several standard outputs are available to provide project managers with insights to cost, and even schedule predictability in their projects. These graphical representations of results allows for robust means of communicating risk, and provides additional data to support decision making and identify the possible outcome of decisions.

Figures F-1 and F-2 are graphs depicting the results of a Monte Carlo simulation defining the probability distribution of cost and schedule outcomes based on input assumptions. This type of information is useful for understanding the expected cost/duration and the range/dispersion of the projected cost and durations.

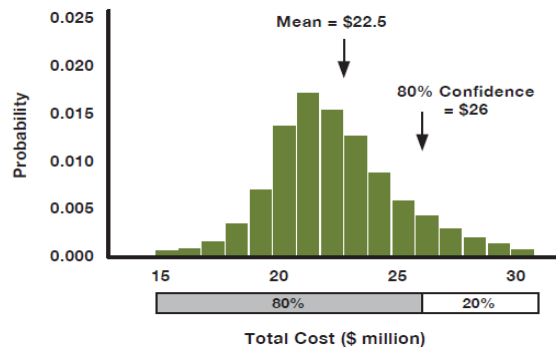


Figure F-1: Sample Probability Mass Function on Project Costs

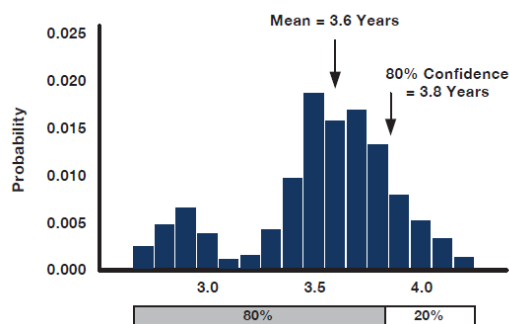


Figure F-2: Sample Probability Mass Function on Schedule Duration

### Confidence in Cost or Schedule

The cumulative probability functions shown in Figure F-3 provide the same information shown in Figure F-1, but in a cumulative manner. The cumulative functions provide a quick reference for the mean (P50) and a confidence level in the estimate or schedule.

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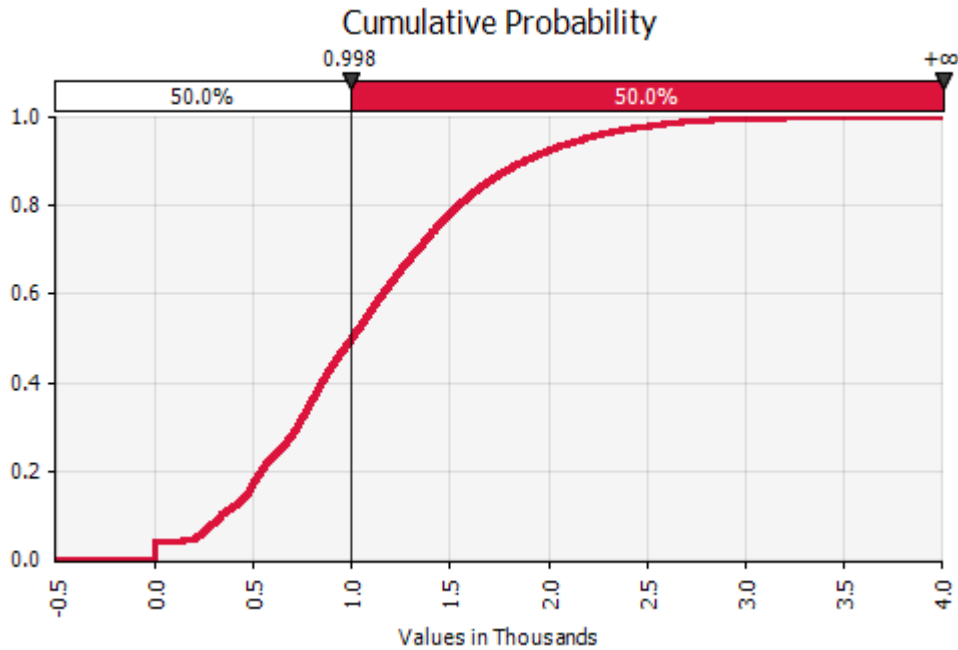


Figure F-3: Sample Cumulative Probability Function on Project Costs

**Identification of Risks with the Greatest Impact**

Sensitivity analysis is a primary modelling output that can be used in the valuation of the impacts of individual risks. Figure F-4 Sample Sensitivity Analysis on Project Risks provides a sensitivity analysis in the form of a “tornado diagram”. Tornado diagrams depict the influence of individual risks and highlight the greater contributors to the overall risk. Using this information, project managers or function managers can spend more effort on mitigating the risks that has the higher impact on the success of the project/function.

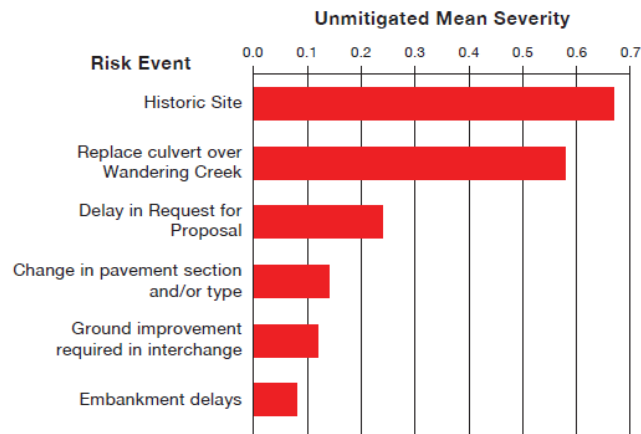


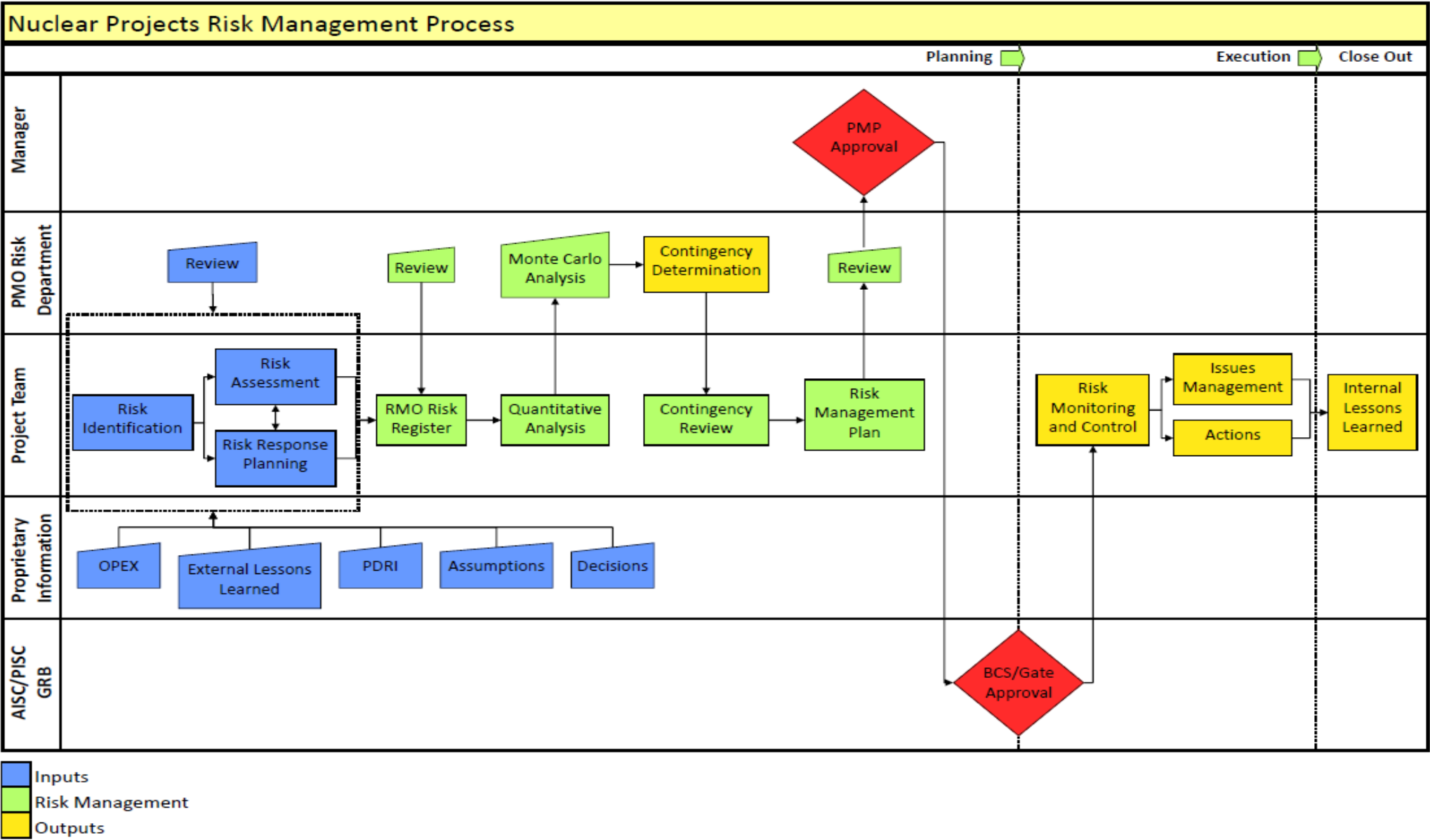
Figure F-4: Sample Sensitivity Analysis on Project Risks



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Appendix G: Risk Management Process



# Refurbishment Readiness for Execution

Roy Martin  
April 26, 2016

## BEHAVIOURS

- Say It, Do It
- Simplify It
- Think Top and Bottom Line
- 
- 



VALUES ▪ SAFETY ▪ INTEGRITY ▪ EXCELLENCE ▪ PEOPLE & CITIZENSHIP ▪

## Refurbishment Ready for Execution



- Completion of the Definition Phase
  - RQE delivery
  - Execution Organization implementation
  
- Readiness to Execute Plan
  - Preparing of Processes for testing
  - Implementation of the RTE Test period work
  - Table-Top exercises for the balance of Processes
  - Lessons Learned implementation and Process Adjustment
  - Change Management throughout



## Readiness to Execute Plan Periods



### ■ Plan Periods

- Lead-up Period (Complete)
  - Develop the test plans for the Test Period, and define 'table top' exercises to test those plans, processes and activities that can't be directly tested during the implementation of the Test modifications
- Pre-test Period (Complete)
  - Refine work programs and 'proxies' for the test period, conduct challenge meetings and indoctrinate the Execution team on the RTE purpose
  - Preparation for the for the RTE field work
- Test Period (February 2016 – mid-June 2016)
  - Execute the planned field work activities and 'table-top' exercises
  - Develop the basis of information for conducting extensive lessons learned reviews focused improvements and corrections to training, work processes, team dynamics and worker and team behaviours
- Implementation of Lessons Learned (June 2016 – October 2016)
  - Make the identified changes based on vetted results from the Test Period
  - Conduct change management to ensure that all part of the integrated execution are practicing the changes in their work

## Readiness to Execute Plan Periods



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  - Conduct change management to ensure that all part of the integrated execution are practicing the changes in their work

## RTE Example Review

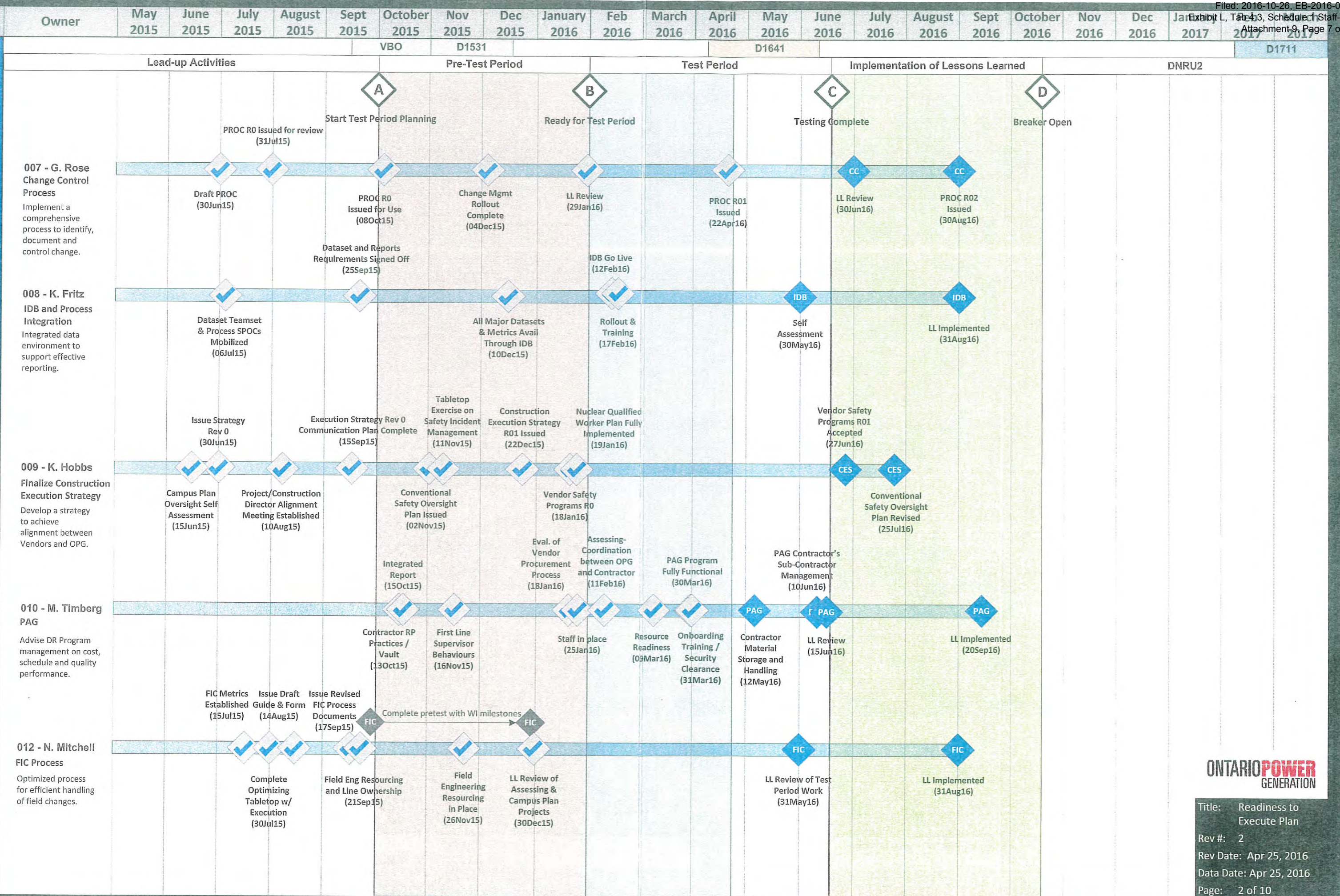


- Distribute RTE Package and Review examples



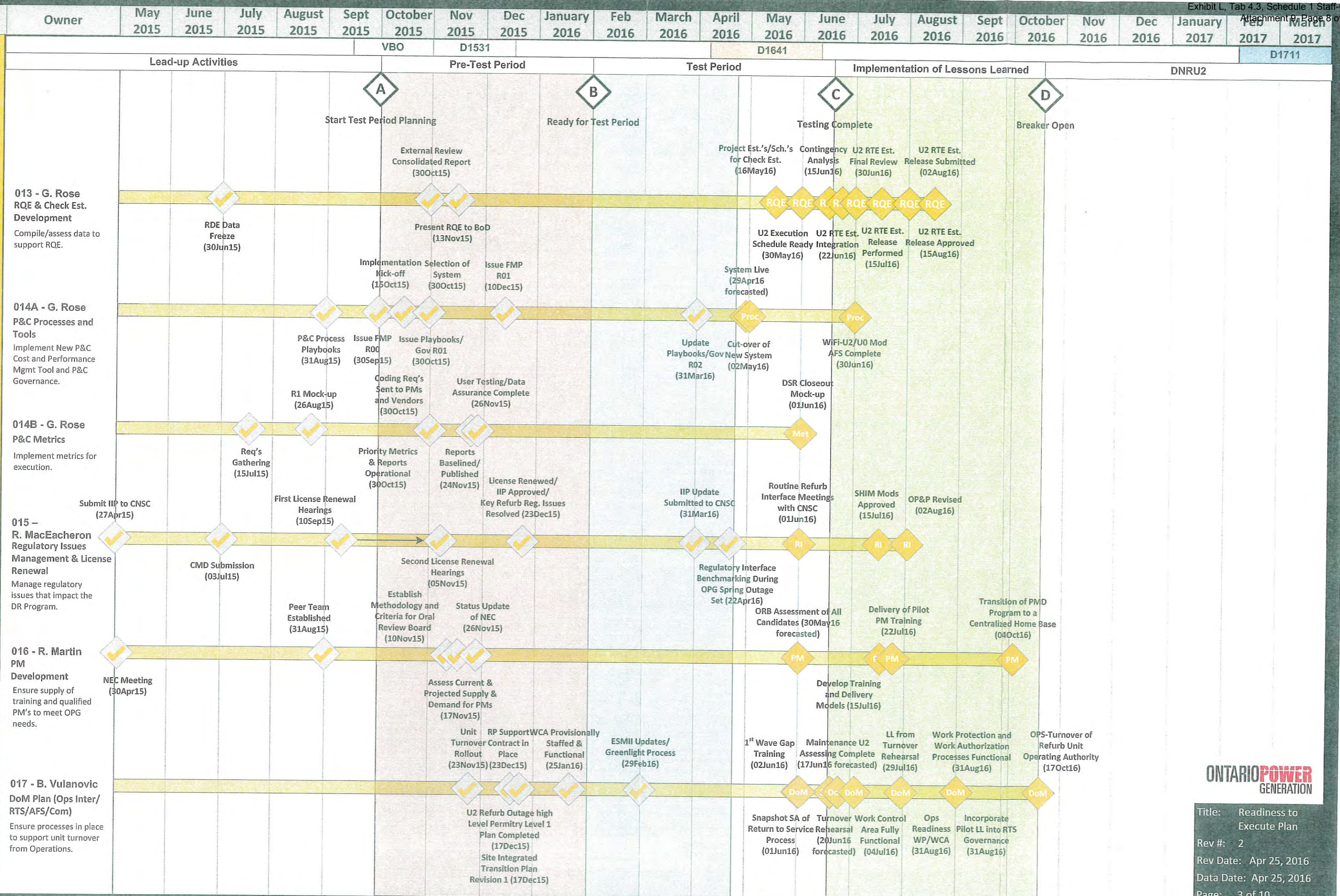






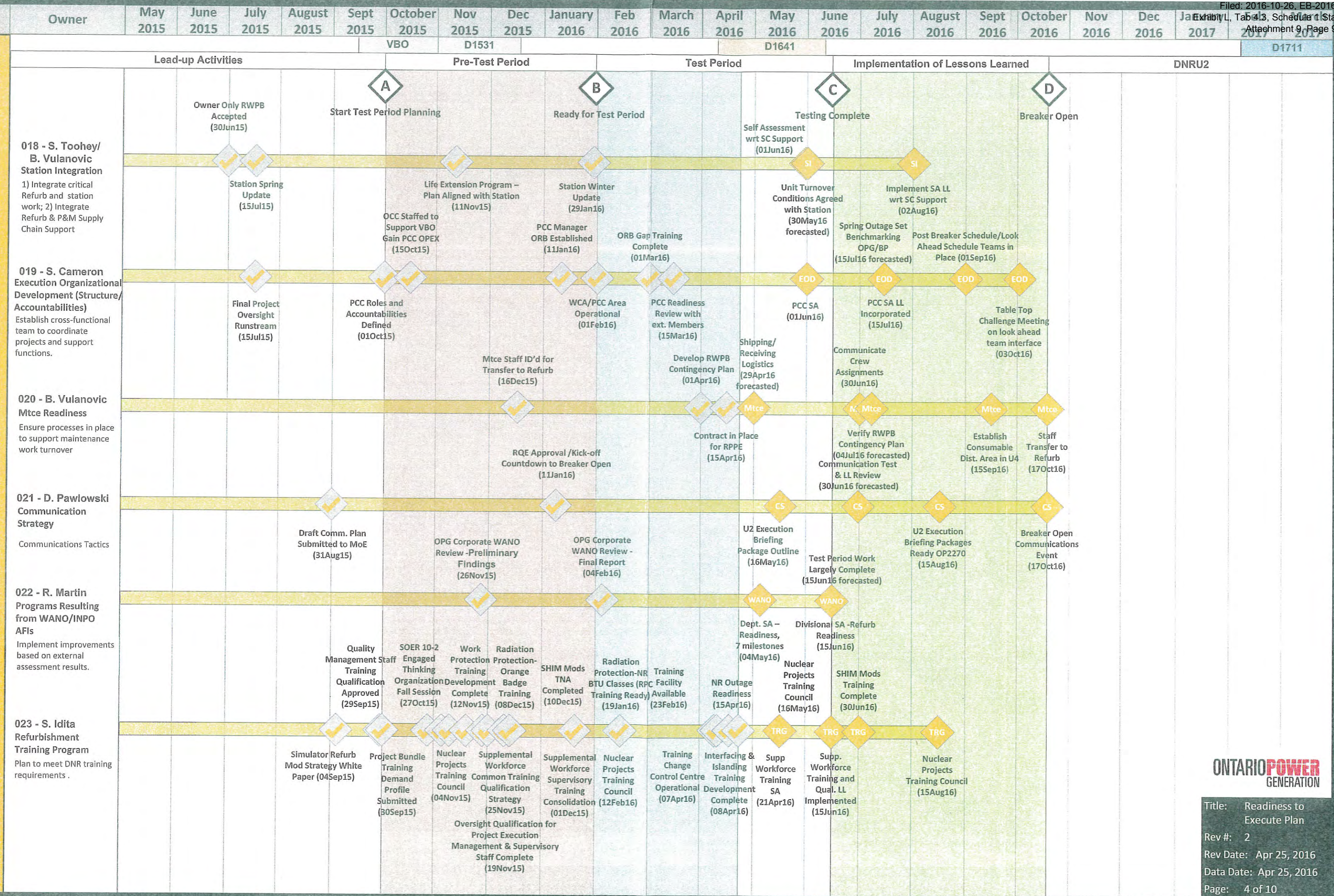


Cross-Functional





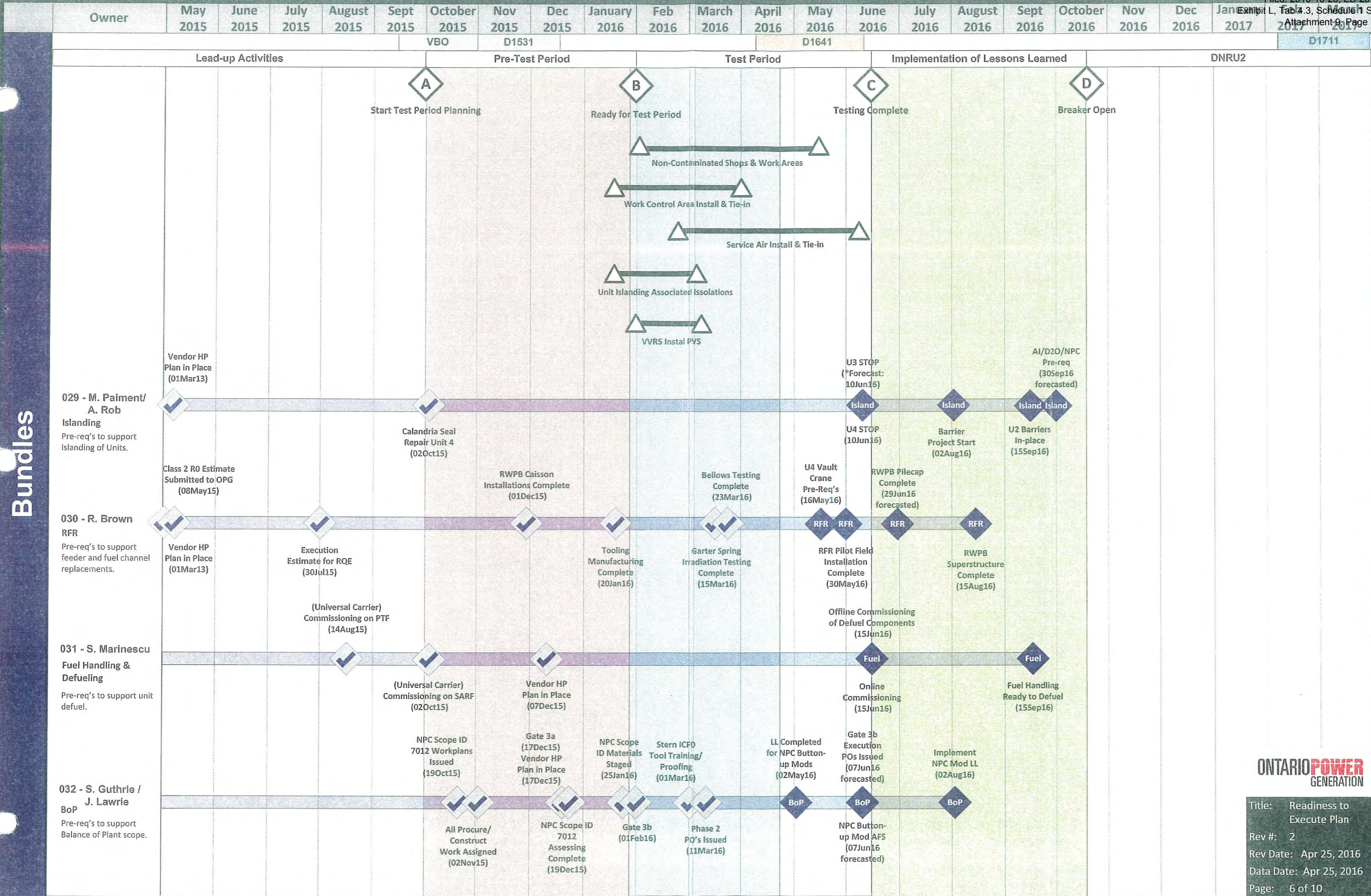
Cross-Functional





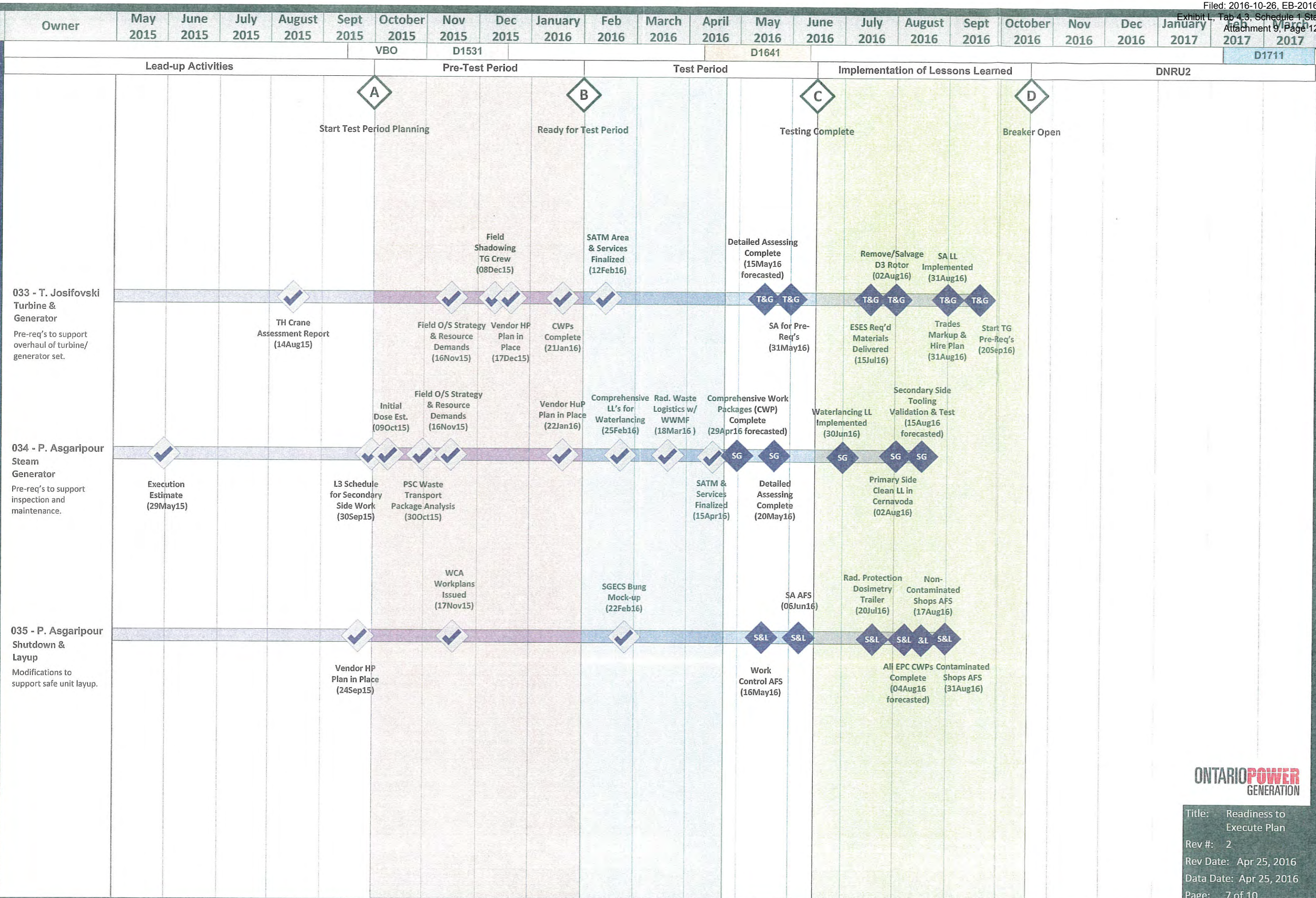






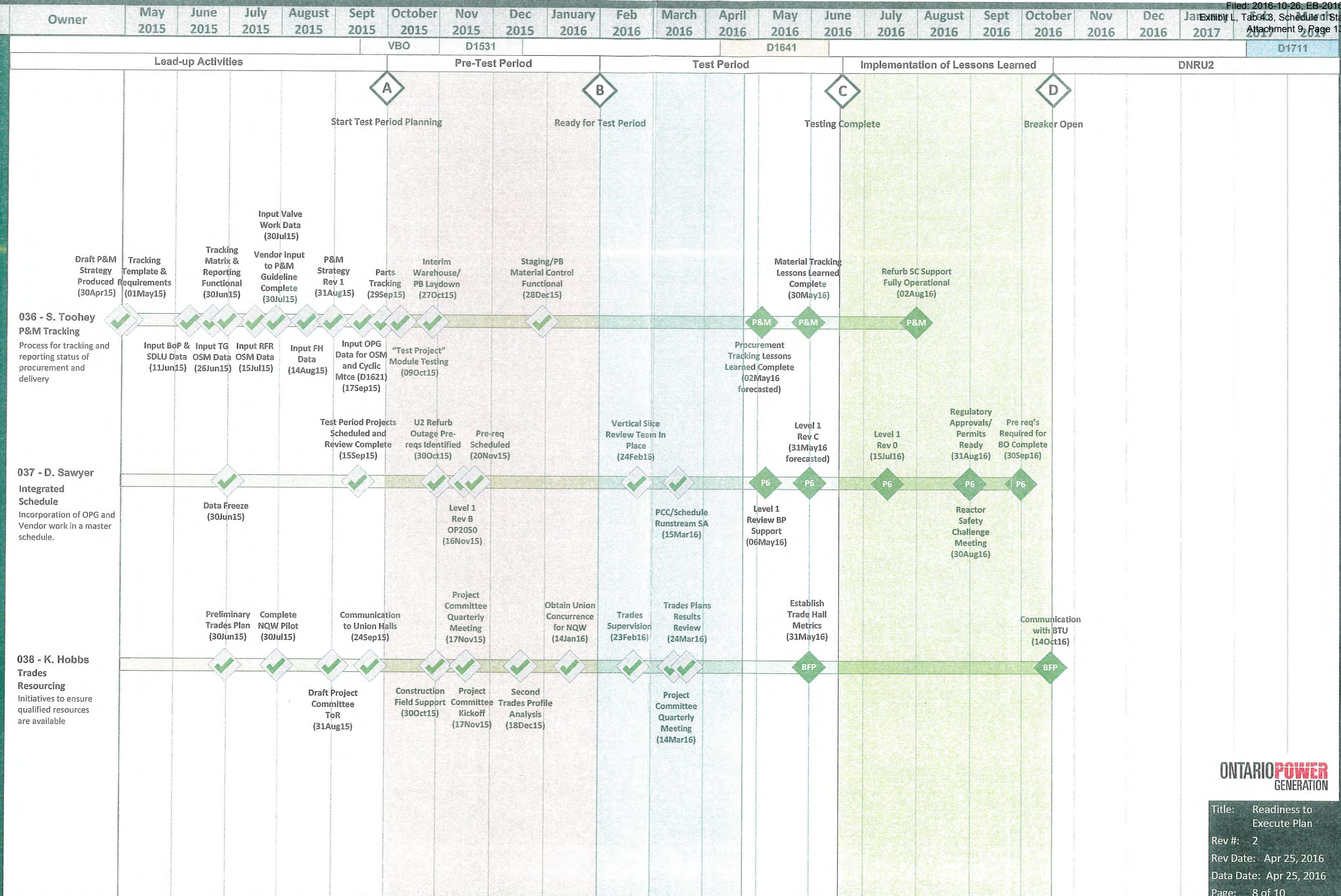


Bundles





Execution









Owner	May 2015	June 2015	July 2015	August 2015	Sept 2015	October 2015	Nov 2015	Dec 2015	January 2016	Feb 2016	March 2016	April 2016	May 2016	June 2016	July 2016	August 2016	Sept 2016	October 2016	Nov 2016	Dec 2016	January 2017	February 2017	March 2017
						VBO	D1531						D1641										D1711
	Lead-up Activities					Pre-Test Period					Test Period					Implementation of Lessons Learned					DNRU2		
						A					B					C					D		
						Start Test Period Planning					Ready for Test Period					Testing Complete					Breaker Open		
024 - L. Saagi Business Focus SI Increase business focus amongst DR staff.						Business Acumen Training Available (29Jun15)																	
						Contractor Time & Payment Controls Framework (30Jun15)					Project Cost Baseline White Paper Approved (24Aug15)												
						Define Focus of SI (17Jul15)					Full RTE Plan & Metrics Available (15Oct15)												
028 - R. Martin Alignment Strategic Initiative Initiatives to support organizational alignment within the DNR Program.						RTE R0 Issued (24Aug15)					Plan in Place for Execution (03Nov15)												
						Bi-Monthly Meeting with Bruce (15Jun15)																	
041 - R. Martin Bruce Collaboration Ensure ongoing OPEX and lessons learned are shared between BP and OPG.						Engineering Integration Meeting (22Jul15)					Bi-Monthly Meeting with Bruce (30Sep15)					Confirm BP Participation in Test Period Activities (16Nov15)							
						PO Issued (15Jul15)					Core Team Mobilized (29Sep15)					30-Day Assessment Plan issued (26Nov15)					Implement Recommendations & Plan (19Jan16)		
042 - K. Hobbs Acquire Construction Partner Engage external expertise to augment the Refurbishment Construction Director.																							

ONTARIOPOWER  
GENERATION

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**Board Staff Interrogatory #74**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-11, Attachment 3, page 10

In her report, Dr. Galloway states that "[t]he Facilities and Infrastructure Projects (F&IP) and Safety Improvement Opportunities (SIO) were not necessarily completed per the initial planned schedule and estimate, however I did not find any fundamental issues that would impact the Program execution."

Please explain why OPG has such a high level of confidence in the forecasted schedule and budget for the remaining work in DRP when OPG was unable to complete the required preliminary work on budget and on schedule?

**Response**

Please refer to the answer to Ex. L-4.5-1 Staff-78, where OPG details the application of lessons learned from the Heavy Water Facility project to the other Darlington Refurbishment Program projects. Exhibit L-4.5-1 Staff-78 also explains that there are significant differences between the Darlington Refurbishment Program projects during the Execution Phase (which will primarily be completed on in-station components and equipment) and the Facility and Infrastructure Projects (F&IP) and Safety Improvement Opportunities (SIO), many of which were new construction, first-of-a-kind for OPG and the Darlington site, and involved excavations.

OPG also notes that, while some of the F&IP and SIO did go over budget and schedule, others were completed on schedule and budget.

**Board Staff Interrogatory #75**

**Issue Number: 4.3**

**Issue:** Are the proposed nuclear capital expenditures and/or financial commitments for the Darlington Refurbishment Program reasonable?

**Interrogatory**

**Reference:**

Ref: Exh D2-2-11, Attachment 3, page 53 Ref: Exh D2-1-3, Attachment 25, page 23 Ref: Exh D2-2-8, Attachment 1, page 7

Dr. Galloway in the first reference above, states that she found the Release Quality Estimate to be a Class 3, which according to the second reference above means that there is an expected accuracy range of -20% to +30%. The third reference states that OPG has determined the amount of contingency required to deliver the project, and produced a high confidence (P90) schedule.

Please reconcile a Class 3 estimate with P90, a 90% confidence that the contingency is appropriate and the schedule will be met.

**Response**

Please note that the range for a Class 3 Estimate referenced in Ex. D2-1-3, Attachment 25, p. 23 are the larger ends of the low and high Class 3 Estimate ranges. As shown in Ex. D2-2-8, Chart 1, p.3, the AACE expected accuracy ranges for a Class 3 Estimate are: Low -10% to -20%; High: +10% to +30%.

The Class of Estimate and the confidence level determined through detailed risk assessments and contingency development are not the same.

The Class of Estimate refers to the expected uncertainty range of the base cost estimate excluding contingency, and is determined by assessing the amount of work, particularly the level of project definition, which was completed in order to develop the estimate. It means that, over a large sample of projects which achieved a Class 3 estimate before execution, one would expect the actual costs of those projects to fall within a range of -10% to -20% to +10% to +30%. In OPG's case, the Release Quality Estimate (RQE) development process included completion of the detailed engineering, evaluations of actual durations to perform tasks on the reactor mock-up, detailed resource estimates, and many other factors which would support a conclusion that the RQE was at least to a Class 3 estimate quality.

OPG's contingency development process is explained in detail in Ex. D2-2-7. It includes the assessment of (1) cost estimate uncertainty, (2) schedule estimate uncertainty, and (3) discrete risks. It utilizes range estimates for projects within the major work bundles and

1 functional support costs, as well as range estimates for durations of critical path activities on  
2 the schedule. It also involves assessing the probabilities and consequences of discrete risks.  
3 These inputs are then processed through a Monte Carlo simulation which simulates the  
4 outcome of the project thousands of times and produces an output which informs  
5 management as to the level of contingency (both cost and schedule) which would be  
6 required to give a particular confidence level that the actual cost of the project would be  
7 expected to be below a certain value. This is the basis for OPG's determination that, with  
8 \$1.7B (2015\$) of contingency added to the base cost estimate, there is a 90% probability  
9 that the Darlington Refurbishment Program's actual costs would be below \$12.8B.

10  
11 Please note also that the \$1.7B (2015\$) in contingency represents approximately 20% of the  
12 going forward costs for the Darlington Refurbishment Program, and approximately 31% of  
13 the costs of the project bundles. Therefore, the contingency amount as a percentage of the  
14 Darlington Refurbishment Program costs is in the expected range for a program with a Class  
15 3 estimate.